UNIVERSITY OF SOUTHAMPTON

MESOPOTAMIAN CERAMICS OF THE THIRD MILLENNIUM BC WITH ANALYSIS OF POTTERY FROM ABU SALABIKH, KISH AND UR

H. S. Mynors

Volume 2
Part ii

8.3 PETROGRAPHIC ANALYSIS

8.3.1 Introduction

Petrographic analyses of Mesopotamian ceramics have been confined hitherto to the study of distribution patterns for a few specific ware types (Blackman 1981; Courtois and Velde 1983b; Kamilli and Steinberg 1979; Oates et al. 1977; Riley 1981). With the exception of al 'Ubaid wares from Tell Oueili (Courtois and Velde 1983a), few research programmes have examined collectively the pottery assemblages from individual sites in the context of local production. The emphasis of the present research, however, is based on pottery production in the Early Dynastic period and the chronological distinctions apparent from technological changes in local ceramic assemblages.

Samples selected for thin sectioning have been classified according to a visual examination of the fabrics coupled with a petrological analysis (Sections 8.2.2 and 8.3.4). Details of the technique together with a description of the methodology are discussed in Section 2.3.

Most of the samples included in the pottery corpus are derived from sites on the southern Mesopotamian plain. Petrographic analysis is therefore based principally on a study of the sedimentary petrology of ceramics produced from alluvial deposits. The mineral assemblages of pottery fabrics from this region are distinctive by virtue of the high proportion of derived igneous inclusions present in the clays used in their manufacture. Thus, subsequent identification of local wares specific to individual sites on the basis of their mineral inclusions (Table 8.5) has provided the means by which evidence for exchange and distribution of pottery may be examined.

Specific sources of raw materials used in local production at individual sites have not been identified. Recent alluvial deposits may have concealed ancient clay sources and the mineralogical diversity within ceramic assemblages from individual sites suggests that it would be impractical to select modern clay sources for analysis and comparison with third millennium Mesopotamian sites. Furthermore, the pottery manufacturing process frequently produces fabrics which may not be compared directly with specific raw materials.

The classification of late fourth and third millennium pottery fabrics (Section 8.3.4), however, has provided data by which local wares from different assemblages may be identified. This forms the basis for archaeological interpretation of regional and chronological variations in Mesopotamian pottery production.

8.3.2 Explanation of the petrographic table (Table 8.5)

A rapid visual comparison of microscope slides provides a convenient method of checking fabric identifications, but more detailed analyses (Table 8.5) have been undertaken to illustrate important differences in thin section. Some 630 vessels have been analysed from all twenty-three sites included in the pottery catalogue (Table 8.4). Extensive sampling has been carried out on the pottery assemblages from Ur, Kish and Abu Salabikh. Sampling has been undertaken to illustrate important regional differences between pottery fabrics and to identify chronological distinctions from the late Uruk/ED I period through to the ED III period.

The petrographic table has been divided into twenty-four columns identified by a numerical system of coding. Column 1 contains the thin section number with the accompanying fabric classification in column 2. The reference number by which individual samples may be identified from the pottery catalogue (Table 8.4, column 1) has been cited in column 3 of the petrographic table. Entries have been arranged in numerical order of thin section number and these are grouped according to the museum or private collection where the original vessels have been retained.

Information concerning the clay mineralogy of each sample is recorded in columns 4 to 24. A fuller discussion of the methodology is included in Section 2.3. To summarise, however, columns 4-7 provide a simple indication of fabric textures using quartz grain sizes based on the Udden-Wentworth grade-scale (Blatt et al. 1980, 56-58) to identify and compare pottery fabrics. Four scales are used ranging from very coarse sand (>1mm) and coarse sand (>0.5mm) to medium sand (>0.25mm) and fine sand (>0.125mm). In order to classify each group a coding for the proportion of quartz grains present in each fabric has been devised. The letters A, M, and S indicate 'abundant' 'medium' and 'sparse' respectively. A schematic representation of quartz grain sizes and frequencies is illustrated in Fig. 8.92.

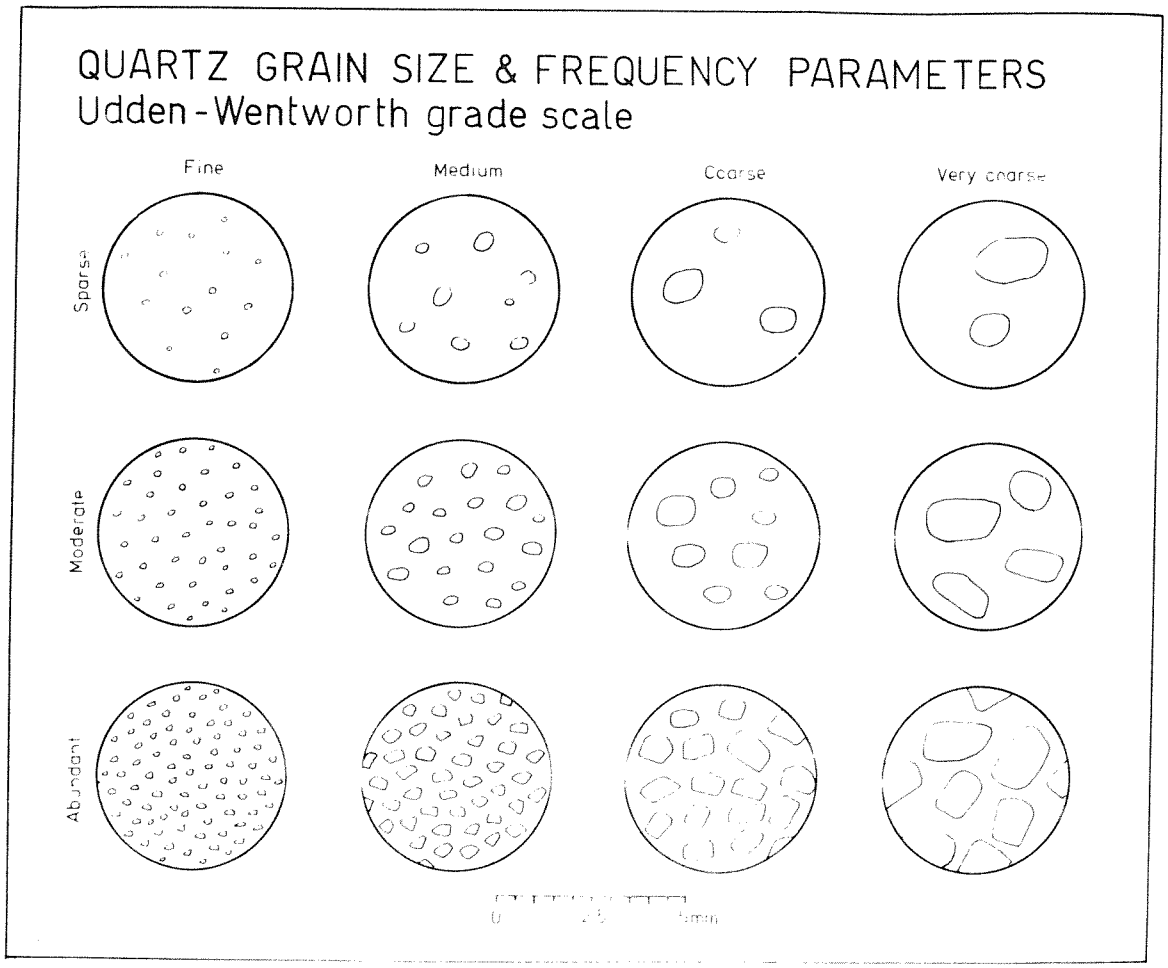


Fig. 8.92 Pottery fabric classification: quartz grain sizes and frequencies

The identification of feldspars in thin section is recorded, and a broad distinction has been made between the two principal types by noting 'p' for plagioclase and 'o' for orthoclase in column 8 of the table.

Distinctions between the mineralogical assemblages of fabrics from different sites frequently rely on the presence (*) or absence of accessory minerals. These minerals are recorded as follows:

Column 9: muscovite
Column 10: biotite
Column 11: pyroxene
Column 12: epidote
Column 13: amphibole
Column 14: serpentine
Column 15: olivine

The majority of these mineral inclusions are extremely small, of the order of <0.125mm, and identification within the mineral groups is rarely possible. Where distinctions have been made (e.g. augite or glauconite), these have been noted in column 24 under 'additional information'.

Ferruginous material is indicated in column 16, and this includes both haematite and magnetite. The presence of magnetite is also identified from visual examination of the fabric and its relative abundance (recorded in column 24) has been used, in conjunction with other attributes, to identify different fabric groups.

The section of the petrographic table concerned with sedimentary rocks includes three principal types: siltstone (column 17), limestone (column 18) and sandstone (column 20). A record of the size and abundance of large inclusions of sedimentary rock fragments is also noted in column 24 of the table. This information is useful in categorising local fabric groups where sedimentary rock fragments have been added as tempering material.

Much of the pottery which has been thin-sectioned contains fine igneous rock fragments, either in the form of inclusions of volcanic glass or as coarse sand-sized fragments with a vitrophyric texture (see Fig. 8.94, Sample no. 2803: Fabric Eii). These are described in column 20.

Columns 21 to 23 contain a record of the organic inclusions observed in thin section, usually shell fragments or vegetable material. Fragments of shell may occur naturally or as tempering material and the presence of either or both categories is indicated in columns 21 and 22. Foraminifera are occasionally detected in thin section (Fig. 8.94, Sample no. 2826: Fabric Aii) and are cited in column 23.

Inclusions of fine vegetable material frequently form part of the fabric and as such do not constitute a tempering agent. Coarse and medium vegetable material, however, is used as a temper particularly in pottery from the late Uruk/ED I period. The fabric group (column 2) indicates whether vegetable material or shell have been used as a from of tempering, but, where a sample contains abundant shell fragments or vegetable material, the size and frequency of these inclusions is noted in column 23.

Additional information is recorded in column 24. The presence of mineral inclusions identified within principal mineral groups, such as augite (pyroxene) and glauconite (mica), is included together with notes on the relative abundance of magnetite, calcite and/or ooliths (or voids left by the dissolution of ooliths). Further information is also available in column 24 concerning less common inclusions such as grog, argillaceous fragments or the rare occurrence of dolomite or olivine with serpentine veining. Tempering material derived from sedimentary rock fragments (e.g. chert and sandstone) is also registered in column 24.

The petrographic table forms the basis for testing the validity of fabric groups identified in the hand specimen. The use of petrology also permits the identification of the range of clays used in local pottery production. Chronological distinctions apparent from variations in the use and type of tempering material are best examined using petrographic analysis coupled with a visual examination of the fabric groups.

8.3.3 Late fourth and third millennium Mesopotamian ceramics: petrographic analysis

Table 8.5 is arranged in numerical order of thin section number. The fabric groups in column 2 are discussed in Section 8.3.4.

Table 8.5 Late fourth and third millennium Mesopotamian ceramics: petrographic analysis

LATE FOURTH AND THIRD MILLENNIUM MESOPOTAMIAN CERAMICS: PETROGRAPHIC ANALYSIS

1. Sample number
2. Fabric group
3. Reference no
4. Very fine
5. Fine
6. Medium
7. Coarse

Quartz

8. Feldspar
Mica
9. Muscovite
10. Biotite

Accessory minerals
11. Pyroxene
12. Epidote
13. Amphibole
14. Serpentine
15. Olivine

16. Ferruginous material
Sedimentary rocks
17. Siltstone
18. Limestone
19. Sandstone
20. Igneous rocks

Shell
21. Natural
22. Temper
23. Other organic

24. Additional information

See text for abbreviations

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
KISH AND JAMDAT NASR																							
(Ashmolean Museum Collection)																							
001	Aii	2817	S	S			o&p	*	*	*					*	*	*		Sparse fine-grained fragments (vitrophyric)	*		Void: shell	Sparse sparry calcite
002	Ai	2684	M				o&p	*	*	*					*	*	*		Sparse fine-grained fragments (vitrophyric)				Sparse argillaceous fragments Sparse sparry calcite
003	Ei	2660	A	S	S		o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments			Moderate medium/fine vegetable material	Large inclusions of muscovite
004	Ei	2653	A	S	S		o&p	*	*	*					*		*		Sparse fine-grained fragments	*			Sparse sparry calcite Coarse sand-size calcite inclusion
005	Ai	2679	S				o&p	*	*	*	*				*		*		Sparse fine-grained fragments				Aggregate of calcite, sparry calcite and very fine quartz. Angular void
006	Aii	2649	M				o&p	*	*	*					*	*	*		Moderate fine-grained fragments	*		Abundant medium/fine vegetable material Voids: shell	Moderate sparry calcite sparse argillaceous fragments
007	Aii	2644	M				o&p	*	*	*					*	*	*		Sparse fine-grained fragments	*			Glauconite
008	Avii	2802	M	S			p	*	*	*					*	*	*		Moderate fine-grained fragments Volcanic glass	*		Sparse medium vegetable material Sparse fine shell	Abundant sparry calcite
009	Ai	2734	M				o&p	*	*	*	?				*	*	*		Sparse fine-grained fragments				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
010	Ei	2780	A	S	S		o&p		*	*	*				*	*	*	*	Moderate fine-grained fragments Volcanic glass	*		Sparse medium vegetable material	
011	Avii	2783	A				o&p	*	*	*	*				*	*	*		Moderate fine-grained fragments	*		Sparse medium/fine vegetable material	Abundant sparry calcite
012	Ai	2755	S				o&p	*	*	*	*				*		*		Sparse fine-grained fragments (vitrophyric)	*			
013	Ai	2704	M				o&p	*	*	*					*	*	*		Sparse fine-grained fragments			Sparse fine vegetable material	Sparse sparry calcite
014	Aii	2683	M				o&p	*	*	*					*	*	*		Moderate fine-grained fragments (vitrophyric) Volcanic glass				Abundant calcite Moderate medium/coarse magnetite. Voids (calcite?)
015	Aii	2661	M				o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments			Sparse fine vegetable material	Moderate voids (calcite?) Argillaceous fragment
016	Avi	2711	A	S			o&p	*	*	*					*	*	*		Moderate fine-grained fragments Volcanic glass			Moderate fine vegetable material	Abundant magnetite
017	Avi	2591	M	S			o&p	*	*	*					*	*	*		Sparse fine-grained fragments Volcanic glass			Moderate fine vegetable material	Moderate magnetite
018	Aii	2709	S				o&p	*	*	*					*		*		Sparse fine-grained fragments			Sparse fine vegetable material	Moderate magnetite Sparse voids (calcite?)
019	Aviii	2769	M				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)			Abundant medium/fine vegetable material	Argillaceous fragments Moderate magnetite
020	Aii	2699	S	S			o&p	*	*						*	*	*		Moderate fine-grained fragments				Abundant magnetite Voids possibly formed by dissolution of ooliths
021	Aiv	2613	S	S	S		o&p		*	*					*		*		Sparse fine-grained fragments	*			Voids (calcite?) Sparse sparry calcite
022	Aiii	2705	S	S			o&p		*	*					*	?	*		Sparse fine-grained fragments				Abundant magnetite Voids (calcite?)
023	Avii	2659	M	S			o&p	*	*	*	*				*	*	*		Moderate fine-grained fragments	*		Sparse fine vegetable material	Abundant calcite Abundant magnetite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
024	Aiii	2795	S				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments Volcanic glass	*			Voids possibly formed by dissolution of ooliths Abundant fine magnetite
025	Ai	2742	S				p	*	*		*				*		*	?	Sparse fine-grained fragments			Sparse medium/fine vegetable material	Voids (calcite?) Argillaceous fragment
026	Avi	2645	S				p	*	*	*	*				*	*	*		Sparse fine-grained fragments Volcanic glass	*		Abundant fine vegetable material	Moderate medium sand-sized calcite Moderate magnetite Argillaceous fragments
027	Aiv	2706	S				o&p	*	*	*	?				*	*	*		Sparse fine-grained fragments	*		Sparse fine vegetable material	Moderate medium sand-sized calcite Voids (calcite?)
028	Ei	2813	A	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments	*			Calcite/ooliths Voids possibly formed by dissolution of ooliths Moderate magnetite
029	Avi	2770	S				o&p	*	*	*					*	*	*		Sparse fine-grained fragments			Abundant fine vegetable material	
030	Ciii	2777	S	S											*	*	*	*	Sparse fine-grained fragments				Fine 'clay matrix Voids possibly formed by dissolution of ooliths
031	Avii	2794	M				o&p	*	*						*	*	*	*	Sparse fine-grained fragments	*		Sparse medium/fine vegetable material	Moderate calcite
032	Ai	2701	M				o&p	*	*						*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Sparse sparry calcite 'Granular' matrix
033	Ei	2682	A	S			o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments Volcanic glass			Sparse fine vegetable material	Voids possibly formed by dissolution of ooliths Sparse calcite
034	Ai	2751	M				o&p	*	*	*	?				*	*	*	*	Sparse fine-grained fragments (vitrophyric) Volcanic glass			Sparse fine vegetable material	
035	Aiv	2650	M	S	S		o&p	*	*	*	*				*	*	*		Moderate fine-grained fragments				Abundant calcite Argillaceous fragments
036	Avi	2655	M				o&p		*	*	*				*	*	*		Sparse fine-grained fragments Volcanic glass			Sparse fine vegetable material	Voids possibly formed by dissolution of ooliths Moderate magnetite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
037	Aviii	2807	M	S			o&p	*	*	*	*	*			*	*	*	*	Sparse fine-grained fragments			Abundant fine vegetable material	Abundant magnetite
038	Avi	2712	M				o&p		*	*		*			*	*	*		Sparse fine-grained fragments Volcanic glass			Moderate medium/fine vegetable material	Abundant calcite Abundant magnetite
039	Eii	2698	A				o&p	?		*		*			*	*	*	*	Sparse fine-grained fragments (vitrophyric)			Sparse fine vegetable material	Voids (calcite) Abundant magnetite Abundant calcite
040	Ei	2700	A	S			o&p	*	*	*					*	*	*		Moderate fine-grained fragments (vitrophyric) Volcanic glass				Moderate calcite
041	Aiv	2719	A	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)			Sparse fine vegetable material	Voids: quartz Abundant calcite (voids)
042	Aii	2774	S				o&p		*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)				Glauconite
043	Ei	2652	A	S			o&p	*	*	*	?				*	*	*	*	Sparse fine-grained fragments Volcanic glass			Sparse fine vegetable material	Abundant magnetite Abundant clinopyroxene (augite)
044	Eii	2808	A	S			o&p			*	*				*	*	*	*	Sparse fine-grained fragments Volcanic glass	*			Sparry calcite Argillaceous fragment Abundant calcite
045	Ai	2745	S		S		o&p	*	*	*	?				*	*	*	*	Sparse fine-grained fragments (vitrophyric) Volcanic glass	*			
046	Eiii	2804	M	M			o&p	*		*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric) Volcanic glass	*		Abundant fine shell	Abundant magnetite Abundant calcite
047	Ai	2776	S				o&p		*						*	*	*	*	Sparse fine-grained fragments				Abundant calcite
048	Av	2696	A		S		o&p	?	*	*					*	*	*		Sparse fine-grained fragments	*	?	Sparse medium vegetable material	Abundant magnetite Abundant calcite Argillaceous fragment
049	Av	2713	A				o&p		*	*					*	*	*	*	Sparse fine-grained fragments (vitrophyric)	*	?	Sparse medium vegetable material	Voids (quartz) Voids(calcite) Abundant magnetite
050	Avi	2656	M				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments			Moderate medium/fine vegetable material	Abundant magnetite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
051	Ai?	2779	S				o&p	*	*	*	*				*		*		Sparse fine-grained fragments				Abundant sparry calcite
052	Aiv	2703	A		S		o&p	*	*	*					*		*		Sparse fine-grained fragments				Argillaceous fragments
053	Av	2702	A				o&p	*	*	*					*		*					Sparse fine vegetable material	Inclusions fragmented Argillaceous fragments Abundant magnetite
054	Av	2669	M				o&p	*	*	*					*	*	*		Sparse fine-grained fragments Volcanic glass	*	*	Sparse medium/fine vegetable material	Abundant crushed shell Sparry calcite Abundant magnetite
055	Av	2651	A				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric) Volcanic glass	*	*		Inclusions fragmented Sparry calcite Grog Abundant magnetite
056	Aiii?	2681	S						*						*	*	*	*	Sparse fine-grained fragments			Sparse medium to fine vegetable material	Carbonised fabric Abundant magnetite Ooliths?
057	Hii	2605	S					*	*	*					*		*		Fine-grained fragment				Abundant magnetite
058	Eii	2803	M	M	S		o&p								*	*	*	*	Medium sand-sized fine-grained fragments			Abundant fine vegetable material	Abundant medium sand-size limestone, siltstone, sandstone and chert
059	Eiii	2722	M	M	S		o&p	*	*	*					*		*	*	Sparse fine-grained fragments Volcanic glass	*	?	Abundant fine shell	Argillaceous fragments Moderate calcite
060	Ci	2744	S						?						*					*			Abundant magnetite
061	Ci	2716	S				o&p	*	*	*					*	*	*			*			Sparse sparry calcite Granular matrix
062	Cii	2606						*		*					*		*			*		Sparse medium to fine vegetable material	Sparse sparry calcite Granular matrix
063	Ci	2585					o&p	*	*	*					*	*	*			*			Argillaceous fragments Voids (calcite?)
064	Ci	2792						*	*	*					*		*			*		Sparse fine vegetable material	Abundant magnetite Sparse sparry calcite Granular matrix

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
065	Ci	2592					o&p	*	*	*					*				Fine-grained fragment			Sparse medium vegetable material	
066	Ciii	2662	S				o&p	*	*	*	*				*		*		Sparse fine-grained fragments (vitrophyric)	*			
067	Ci	2768					o&p	*	*	*	*				*		*		Volcanic glass	*			Argillaceous fragments
068	Ci	2667					p	*		*					*		*		Volcanic glass			Sparse fine vegetable material	Sparse sparry clacite Argillaceous fragment
069	Aiii	2735	S				o&p	*	*	*					*	?	*		Sparse fine-grained fragments Volcanic glass	*			Abundant fine magnetite Abundant calcite and sparry calcite
070	Hiv	2590	S				o&p								*		*					Sparse fine vegetable material	Sparse sparry clacite Grog
071	Hiii	2604	S				o&p	*	*	*					*	*	*		Volcanic glass				Voids possibly formed by dissolution of ooliths Moderate sparry calcite Abundant magnetite
072	Avi?	2708	M	S			o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments	*		Sparse fine vegetable material	Abundant magnetite Aggregate of siltstone and calcite
073	Ii	2607	S				o?		*						*					*			Fine 'clay' matrix very few inclusions
074	Ii	2674																		*			Void (calcite?) by dissolution of an oolith
075	Biv	2647	S					?	*	*					*					*		Abundant medium/fine vegetable material Abundant fine shell	Argillaceous fragments containing fine shell
076	Bii	2707	S												*	*	*		Sparse fine-grained fragments			Sparse fine vegetable material	Abundant magnetite Moderate voids possibly formed by dissolution of of ooliths
077	Bii	2800	M				o&p	?	*	*	*				*	*	*		Sparse fine-grained fragments				Abundant magnetite Argillaceous fragment
078	Biii	2620	M	S			o&p	*	*	*					*	*	*		Sparse fine-grained fragments	*		Moderate medium/fine vegetable material	Abundant magnetite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
079	Avi	2637	S				p	*	*						*				Fine-grained fragment	*		Moderate medium/fine vegetable material	Abundant magnetite
080	Bi	2676	M				o&p			*					*	*	*		Sparse fine-grained fragments				Abundant magnetite Aggregates of quartz, igneous rock fragments and ooliths in limestone cement
081	Biii	2757	M				o&p	*?	*	*					*	*	*		Moderate fine-grained fragments	*		Sparse medium vegetable material	Abundant large magnetite inclusions Abundant clinopyroxene (augite)
082	Biii	2809	M				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments	*		Sparse medium/fine vegetable material	Voids possibly formed by dissolution of ooliths Abundant large magnetite inclusions
083	Biii	2788	M	S			o&p		*	*	*				*		*		Sparse fine-grained fragments	*			Voids possibly formed by dissolution of ooliths Abundant magnetite
084	Bi	2793	S				o&p								*	*	*		Sparse fine-grained fragments	*			Abundant magnetite
085	Biv	2811	M	S	S		o&p			*					*	*	*	*	Sparse fine-grained fragments			Moderate fine vegetable material	Argillaceous fragments Abundant magnetite
086	Bv	2695	A				o&p		*	*	?				*	*	*		Sparse fine-grained fragments	*		Moderate medium/fine vegetable material	Argillaceous fragments Abundant magnetite
087	Bi	2710	S	S			o&p	*	*	*					*	*	*		Sparse fine-grained fragments			Sparse fine vegetable material	Abundant magnetite
088	Bii	2718	A	S			o&p			*					*							Sparse medium/fine vegetable material	Abundant large magnetite inclusions
089	Bii	2692	M				o&p			*				*?	*		*		Sparse fine-grained fragments	*		Sparse fine vegetable material	Voids possibly formed by dissolution of ooliths Abundant magnetite
090	Bii	2658	A	S			o&p		*	*					*	*	*		Sparse fine-grained fragments Volcanic glass			Sparse very fine vegetable material	Voids probably formed by dissolution of ooliths Abundant magnetite
091	Iii	2729													*	*	*		Sparse fine-grained fragments	*		Moderate medium fine vegetable material	Fine 'clay' matrix Very few inclusions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
092	Di	2640	S							*					*		*		Sparse fine-grained fragments		*	Abundant crushed shell	Abundant magnetite
093	Bvi	2697	M	M			o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments	*		Abundant fine vegetable material	Abundant magnetite Argillaceous fragments
094	Bvi	2775	M				o&p		*	*					*	*	*		Sparse fine-grained fragments	*			Abundant calcite Voids (calcite?)
095	Other: 1	2778	S				p			*			*	*	*		*		Fine-grained fragments: Ophiolites (GABBRO)			Pale yellow organic material	Weathered olivine with serpentine veining Abundant large magnetite inclusions
096	Gii	2782					p	*		?					*		*		Fine-grained fragment	*	?	Abundant medium vegetable material Abundant fine shell	Fine 'clay' matrix
097	Gi	2654	S				o&p		*	*					*	*	*		Sparse fine-grained fragments	*		Sparse medium/fine vegetable material	Very fine sandy matrix Glauconite
098	Diii	2715	M				o&p	*	*	*	*			*	*	*	*	*	Sparse fine-grained fragments (vitrophyric)		*	Abundant medium/coarse vegetable material	Abundant crushed shell Abundant magnetite
099	Hi	2717	A	M	S	S	o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)			Abundant fine vegetable material	Glauconite (serpentine) Abundant calcite and magnetite Medium sand-size sandstone and siltstone Argillaceous fragment
100	Ei	2657	A	M			o&p		*	*	*		*	*	*	*	*	*	Sparse fine-grained fragments (vitrophyric) Volcanic glass	*			Weathered olivine with serpentine veining Abundant calcite Sandstone
101	Biv	2714	M				o&p		*	*						*	*	*	Moderate fine-grained fragments (vitrophyric)			Sparse medium/fine vegetable material	Argillaceous fragments Abundant magnetite Voids: quartz Voids (calcite) Glauconite
102	Dii	2781	A	S			o&p	*	*	*	*		?	*	*	*	*	*	Sparse fine-grained fragments Volcanic glass	*	*	Sparse medium/fine vegetable material Abundant crushed shell	Argillaceous fragment Glauconite Coarse sand-size sandstone
103	Fii	2733	M	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Large (3mm) argillaceous fragment Abundant calcite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
104	Biii? waster	2771	A				o&p	*	*	*	*				*	*	?		Fine-grained fragments				Abundant magnetite Argillaceous fragment Voids possibly formed by dissolution of ooliths
105	Other: 2	2773		S				*							*		*	*	Fine-grained fragment				Argillaceous fragment Sparse coarse sand-size calcite and sandstone Very fine sandy matrix
106	Fi	2648		M			o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments Volcanic glass	*		Sparse fine vegetable material	Grog tempered Glauconite
UR																							
(British Museum Collections)																							
107	Ai	0339	M				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)	*			Sparry calcite
108	Ai	0340	M				o&p	*	*		*				*	*	*		Sparse fine-grained fragments	*		Moderate fine vegetable material	Abundant calcite Argillaceous fragments/ grog?
109	Avi	0354	S	S			o&p	*	*	*	*				*	*	*		Fine-grained fragment (vitrophyric)			Sparse medium/fine vegetable material	Voids (calcite?)
110	Ai	0302	M				o&p		*	*	*?				*	*	*		Sparse fine-grained fragments				Voids possibly calcite or formed by dissolution of ooliths
111	Ai	0051	S				o&p	*	*	*					*	*			Sparse fine-grained fragments	*		Sparse fine vegetable material	Argillaceous fragment
112	Ai	0383	S				o&p	*	*	*					*	*	*	?	Sparse fine-grained fragments	?			Abundant calcite/voids
113	Aii	0350	S				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments	*		Sparse fine vegetable material	Abundant calcite
114	Aii	0349	S				o&p	*	*	*					*	*	*		Sparse fine-grained fragments	*			Abundant calcite Sparry calcite
115	Aii	0337	S				o&p	*?	*	*					*	*	*		Sparse fine-grained fragments	*		Sparse fine vegetable material	Abundant calcite
116	Aii	0338	M				o&p	*	*	*					*	*		*		*		Sparse fine vegetable material	Argillaceous fragment Moderate magnetite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
117	Aii	0097	M				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments	*		Sparse very fine vegetable material	Large muscovite inclusions
118	Aii	0097	M			S	o&p	*	*	*	*				*	*	*	*	Fine-grained fragment	*		Sparse fine vegetable material	Large muscovite inclusions
119	Aii	0366	S				o&p	*	*	*					*	*	*		Sparse fine-grained fragments	*		Sparse fine vegetable material	Glauconite Abundant calcite
120	Avi	0358	S				o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments	*			Abundant calcite Sparry calcite Glauconite
121	Avi	0357	S				o&p	*	*	*					*	*	*		Sparse fine-grained fragments	*		Sparse fine vegetable material	Aggregate of quartz and igneous rock fragments in calcite cement
122	Avi	0356	S				o&p	*	*	*					*	*	*		Sparse fine-grained fragments	*		Sparse medium/fine vegetable material	Abundant calcite Voids (calcite) Very coarse sand-size siltstone inclusion
123	Avi	0377	M	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments	*		Sparse fine vegetable material	Abundant sparry calcite Ooliths? Voids (quartz?)
124	Aii	0361	S				o&p	*	*	*					*		*		Sparse fine-grained fragments	*			Voids possibly formed by dissolution of ooliths Glauconite
125	Avi	0376	M				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments	*	?	Sparse medium/fine vegetable material Abundant fine shell	Voids possibly formed by dissolution of ooliths
126	Ai	0363	S				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments Volcanic glass			Sparse fine vegetable material	Abundant calcite
127	Aii	0050	S				o&p		*	*	*	*			*		*		Sparse fine-grained fragments Volcanic glass	*		Moderate medium/fine vegetable material	Aggregate of ferruginous material in calcite cement Voids (ooliths?)
128	Aii	0063	S				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric) Volcanic glass			Moderate medium/fine vegetable material	Fine granular matrix Moderate magnetite
129	Aiv	0372	M	S			o&p	*		*					*	*	*		Sparse fine-grained fragments (vitrophyric)	*		Sparse medium/fine vegetable material	Moderate magnetite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
130	Aii	0360	S				o&p	*	*	*	*				*	*	*	?	Sparse fine-grained fragments	*			Glauconite Aggregate of calcite with quartz, igneous rock fragments and ferruginous material Abundant calcite
131	Aii	0301	M				o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments			Sparse medium/fine vegetable material	Voids possibly formed by dissolution of ooliths Moderate magnetite
132	Aii	0292	M	S			o&p	*	*	*	*			*	*	*	*	*	Abundant fine-grained fragments (vitrophyric)	*			Abundant calcite/ooliths
133	Aii	0280	S				o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments Volcanic glass	?			Sparry calcite Ooliths
134	Aiii	0373	S				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments	*		Moderate medium/fine vegetable material	Glauconite Voids (calcite)
135	Aiii	0373			S		o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments	*		Moderate medium vegetable material	Aggregate of sparry calcite and ferruginous material in calcite cement Grog
136	Aiii	0158	A		S		o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)				Voids possibly formed by dissolution of ooliths
137	Aiii	0255	M				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments	*		Abundant fine vegetable material	Sparry calcite Moderate magnetite Moderate sandstone Voids possibly formed by dissolution of ooliths
138	Aiii	0258	M				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments	*		Abundant fine vegetable material	Moderate (sparry) calcite Very fine sandy matrix Voids possibly formed by dissolution of ooliths Glauconite
139	Aiii	0159	S	S			o&p	*	*		*				*		*	*	Sparse fine-grained fragments	*			Abundant magnetite
140	Bii	0367	S				o&p	*	*	*					*		*		Sparse fine-grained fragments	*		Sparse medium/fine vegetable material	Voids possibly formed by dissolution of ooliths Sparry calcite
141	Bii	0087	S				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments				Moderate magnetite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
142	Biv	0369	S	S			o&p	*	*						*				Sparse fine-grained fragments	*	?	Moderate fine vegetable material	Abundant magnetite Argillaceous fragment Abundant crushed shell
143	Bii	0011	M				o&p	*		*	*				*	*	*		Sparse fine-grained fragments	*			Abundant magnetite Glauconite
144	Bii	0024	M				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments	*		Sparse fine vegetable material	Abundant magnetite
145	Ci	0362	S				o&p	*	*						*		*			*		Sparse fine vegetable material	Sparse voids posiibly formed by dissolution of coliths
146	Ci	0364	S				o&p	*	*						*	*	*		Sparse fine-grained fragments				Glauconite Argillaceous fragment
147	Ci	0368	S				o&p	*	*						*	*	*		Sparse fine-grained fragments			Sparse medium/fine vegetable material	Abundant (sparry) calcite Argillaceous fragment
148	Ci	0253	S				o&p	*	*	?					*		*		Fine-grained fragment	*		Sparse medium/fine vegetable material	Sparse voids (clacite)
149	Cii	0027	S				o&p	*	*	*		?			*		*		Sparse fine-grained fragments	*		Moderate medium/fine vegetable material	Moderate very fine calcite
150	Cii	0065	S				o	*	*	*					*	*	*		Sparse fine-grained fragments	*		Moderate medium/fine vegetable material	Voids possibly formed by dissolution of ooliths
151	Ciii	0381													*		*			*		Abundant fine vegetable material	Fine 'clay' matrix Crushed shell in calcite cement
152	Ciii	0393						*							*		*			*		Sparse fine vegetable material Abundant fine shell	Fine 'clay' matrix
153	Ciii	0390					p								*					*		Moderate medium/fine vegetable material	Fine 'clay' matrix Aggregates of very fine quartz, shell and igneous rock fragments in calcite cement
154	Ciii	0391																		*		Sparse very fine vegetable material	Fine 'clay' matrix Aggregate of very fine igneous rock fragments in calcite cement

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
155	Ciii	0385								?					*		*		Fine-grained fragment	*		Moderate very fine vegetable material Abundant fine shell	Fine 'clay' matrix
156	Ciii	0380	S							*					*					*		Sparse very fine vegetable material Abundant fine shell	Fine 'clay' matrix
157	Eii	0382	S	S	S				*	*					*				Sparse fine-grained fragments	*		Abundant fine shell	Fine 'clay' matrix Argillaceous fragments
158	Ciii	0177							*		?				*		*		Fine-grained fragment	*			Fine 'clay' matrix Sparse very fine quartz
159	Bi	0081	S				o								*		*			*		Sparse fine vegetable material	Fine 'clay' matrix Sparse voids probably formed by dissolution of ooliths
160	Bi	0394	S						*						*					*		Sparse fine vegetable material	Fine 'silty' matrix
161	Bi	0335	S												*							Sparse very fine vegetable material	Fine 'clay' matrix Sparse voids probably formed by dissolution of ooliths
162	Bi	0107						*							*					*		Abundant fine vegetable material	Fine 'silty' matrix
163	Bi	0081	S	S			o								*		*	*	Sparse fine-grained fragments			Abundant medium vegetable material	Voids possibly formed by dissolution of ooliths
164	Div	0169		S				*							*				Fine-grained fragments	*	?	Abundant shell Carbonised bone?	Grog/argillaceous fragment
165	Di	0399									*				*		*		Fine-grained fragment	*	?	Crushed shell fragments	Fine 'silty' matrix
166	Di	0398						*		*					*		*			*	?	Moderate medium/fine vegetable material Large shell inclusion: gastropod	Fine 'clay' matrix
167	Di	0387						*	*						*				Sparse fine-grained fragments	*	?	Sparse fine shell Vegetable material	Fine 'silty' matrix

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
168	Di	0398	S					*	*	*					*		*		Sparse fine-grained fragments	*	?	Sparse medium/fine vegetable material Abundant fine shell	Fine 'silty' matrix Aggregate of very fine inclusions in clacite cement
169	Di	0164	S					*	*						*				Fine-grained fragment	*	?	Sparse fine shell Vegetable material	Fine 'silty' matrix
170	Ciii	0365	S												*							Abundant fine vegetable material	Fine 'silty' matrix
171	Di	0105							*		?				*				Fine-grained fragment	*	?	Sparse shell fragments	Fine 'clay' matrix Aggregate of very fine quartz and igneous rock fragments in calcite cement
172	Aiii	0116	S				o&p	*	*		*				*	*	*	*	Sparse fine-grained fragments	*			Voids (calcite) Abundant (sparry) calcite
173	Diii?	0379	S				p		*						*				Sparse fine-grained fragments (large)	*	?	Sparse fine vegetable material Abundant fine shell	Fine 'clay' matrix Argillaceous fragment
174	Diii	0012	S				o&p	*	*		*				*		*		Fine-grained fragments	*	?	Sparse fine vegetable material Moderate fine shell	Abundant fine calcite Very fine sandy matrix
175	Fi	0044													*	*						Sparse very fine vegetable material	Fine 'clay' matrix
176	Biii	0180	S												*	?			Sparse fine-grained fragments	*		Sparse fine vegetable material	Fine 'clay' matrix Argillaceous fragments Moderate magnetite
177	Other: 2	0037	M	S				*	*		*				*	*	*		Sparse fine-grained fragments Volcanic glass	?			Abundant magnetite Moderate calcite Abundant muscovite
178	Jii	0229			M	S									*					*			Fine 'clay' matrix
179	waster	0506	M				o&p								*	*	*	*					Voids possibly formed by dissolution of coliths
180	waster	0502	M												*	*	*	*	Fine-grained fragment				Voids (calcite?) Abundant magnetite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
181	waster	0505		A			o&p									*		?	Fine-grained fragment				
TELL SAKHERI SUGHIR																							
182	Bvii	0419	M	S			o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments				Argillaceous fragments
183	Ei	0420	A	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments Volcanic glass				Abundant (sparry) calcite Glauconite
184	Aii	0431	M	S			o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments (vitrophyric) Volcanic glass				Chert? Abundant calcite
185	Aii	0429	M				o&p	*	*	*	*	*			*	*	*	*	Sparse fine-grained fragments				Voids (quartz) Voids (calcite) Chert?
186	Biv	0430	M				o&p	*	*	*	*				*	*	*	*	Abundant fine-grained fragments				Fine 'clay' matrix Glauconite Argillaceous fragments
187	Aiv	0428	A	S			o&p	*	*	*	*				*		*	*	Sparse fine-grained fragments Volcanic glass	*			Abundant sparry calcite
188	Av	0427	S				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments	*		Moderate medium/fine vegetable material	Oolitic voids Abundant siltstone and sandstone Abundant magnetite
189	Eiii	0421	A	S			o&p	*	*	*					*	*	*	*	Moderate fine-grained fragments	*			Grog inclusions Oolitic voids
190	Bii	0432	M				o&p	*	*	*					*	*	*	*	Moderate fine-grained fragments				Abundant magnetite Fine 'clay' matrix
191	Giii	0425	M	S	S	S	o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments			Sparse fine vegetable material	Moderate sparry calcite
192	Kii	0422	M	S	M	M	o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments	*		Sparse fine vegetable material	Abundant magnetite
193	Jii	0426	M	S	A		o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments Volcanic glass				Sparry calcite Mudstone? Glauconite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
194	Jii	0423	A	S	A	S	o&p	*	*	*	*			*	*	*	*	*	Sparse fine-grained fragments Volcanic glass	*		Sparse fine vegetable material	Abundant (sparry) calcite Mudstone?
195	Jii	0424	M	S	A	S	o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments (vitrophyric) Volcanic glass				Abundant (sparry) calcite Large muscovite inclusions
196	-	0433	S				o&p	*	*	*	?				*		*	*	Sparse fine-grained fragments			Moderate medium/coarse vegetable material	Sparry calcite Voids (calcite) Argillaceous fragments
197	-	0434	S												*								Aggregate of very fine quartz and igneous rock
198	-	0435	S				o	*	*	*	*				*	?	*	*	Sparse fine-grained fragments	*		Moderate medium/coarse vegetable material	Voids probably formed by dissolution of ooliths Sparry calcite Abundant magnetite
TELL AL 'UBAID																							
199	Aiv	0462	A	M			o&p		*	*	*				*	*	*	*	Moderate fine-grained fragments (vitrophyric)			Sparse medium vegetable material	Abundant calcite Abundant magnetite Glauconite
200	Avii	0495	A				o&p		*	*					*	*	*	*	Sparse fine-grained fragments			Sparse medium vegetable material	Abundant calcite/voids
201	Aii	0450	M				o&p	*	*	*					*	*	*	*					Moderate calcite Fine 'silty' matrix
202	Aiii	0488	M	S			o&p	*	*	*					*	*	*		Sparse fine-grained fragments			Sparse fine vegetable material	Abundant magnetite
203	Bii	0498	A	S			o&p			*	?				*	*	*		Sparse fine-grained fragments				Abundant magnetite Fine 'clay' matrix
204	Bii	0448	A?					?	*						*	*	*		Sparse fine-grained fragments			Sparse medium/fine vegetable material	Abundant magnetite Fine 'clay' matrix
205	Bi	0451		S		S									*				Fine-grained fragment	*	?		Fine 'clay' matrix
206	Bi	0470	S												*		*		Fine-grained fragment	*			Fine 'clay' matrix Calcite inclusion

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
207	Bi	0471	S												*		*		Grey vitrified inclusion with voids	*	?		Fine 'clay' matrix Aggregate of fine quartz and feldspar
208	Ci	0472							*											*			Fine 'silty' matrix Single aggregate of very fine quartz, feldspar and biotite
209	Div	0469	S?	S																	*		Fine 'silty' matrix Grog/argillaceous fragment
210	Giii waster	0473	M (voids)	A	S											*							Glauconite
ERIDU																							
211	Ai	0511	M				o&p	*	*	*					*	*	*		Sparse fine-grained fragments Volcanic glass			Sparse fine vegetable material	Moderate calcite Argillaceous fragment
212	Ai	0511	M				o&p	*		*					*		*	*	Sparse fine-grained fragments Volcanic glass				Abundant calcite Sandstone
213	Bii	0509	M	S											*		*						Moderate magnetite Fine 'silty' clay matrix
214	Ei? waster	0503	M				p			*					*		*			*	?		Over-fired fabric: predominantly voids Moderate magnetite
LAGASH																							
215	Aii	0513	S				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments				Moderate calcite Voids (calcite)
216	Aiii	0514	M	S			o&p	*		*	*				*	*	*	*	Sparse fine-grained fragments				Abundant (sparry) calcite
KHEIT QASIM																							
217	Aiv	2837	M	S			p			*					*	*	*		Sparse fine-grained fragments Volcanic glass	*			Sparry calcite
218	Bii?	2835	S							*					*	*	*		Fine-grained fragment	*		Sparse fine vegetable material	Abundant voids possibly formed by dissolution of ooliths

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
219	Bi	2836	S				p		*	*					*	*	*	*	Sparse fine-grained fragments	*			Abundant calcite Glauconite
220	Ci	2838		S											*	*	*		Sparse fine-grained fragments	*	?		Fine 'silty' matrix
WARKA																							
221	Aiv	0516	M				o&p	*	*		*				*		*		Moderate fine-grained fragments	*			Voids possibly formed by dissolution of ooliths Abundant (sparry) calcite Glauconite
222	Ci	0518													*				Fine-grained fragment	*	?	Sparse fine vegetable material Abundant crushed shell	Fine 'clay'matrix
223	Ci	0518													*				Fine-grained fragment	*	?	Moderate crushed shell	Fine 'clay'matrix Voids (mudstone?)
224	Bi	0517													*	*	*			*			Voids possibly originally mudstone inclusions Voids (ooliths) Fine 'silty' matrix
FARA																							
225	Aiii	0527	M	S			o&p	*	*	*					*	*	*		Sparse fine-grained fragments	*		Sparse fine vegetable material Abundant crushed shell	Abundant magnetite
226	Aiii	0528	M	S			o&p	*	*	*	?				*	*	*		Moderate fine-grained fragments Volcanic glass	*			Sparry calcite Abundant siltstone Glauconite
227	Aii	0524	S				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments Volcanic glass	*		Sparse fine vegetable material	Voids possibly formed by dissolution of ooliths Abundant magnetite
228	Aiv	0521	S				o&p	*	*	*					*	*	*		Sparse fine-grained fragments			Sparse fine vegetable material	Abundnat calcite Voids (calcite)
229	Ai	0520	S				o&p	*	*	*					*	*	*		Fine-grained fragment			Sparse fine vegetable material	Voids (calcite)
230	Bi	0519					p			*					*	*	?		Sparse fine-grained fragments	*		Sparse fine vegetable material	Abundant magnetite Fine 'clay' matrix

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
231	Bi	0522	S				o&p			*					*	*	*		Sparse fine-grained fragments	*		Foraminifera	Glauconite Fine 'clay' matrix
232	Bi	0523	S				p	*		*					*	*	*		Sparse fine-grained fragments	*		Sparse fine vegetable material	Abundant magnetite Fine 'clay' matrix
233	Bi	0526					o	*		*					*	*	*		Sparse fine-grained fragments Volcanic glass	*			Abundant magnetite
NIPPUR																							
234	Ei	0530	A	S			o&p	*	*	*	?				*	*	*	*	Abundant fine-grained fragments	*		Moderate medium/fine vegetable material	Voids (quartz?) Fine 'clay' matrix Moderate siltstone
235	Bi	0531	M				o&p		*						*	*	*		Sparse fine-grained fragments (vitrophyric)				Voids (ooliths?) Sparry calcite Abundant magnetite
236	Aiv	0529	M				o&p	*	*	*					*	*	*		Sparse fine-grained fragments			Sparse fine vegetable material	Voids (quartz?)
JAMDAT NASR (British Museum Collection)																							
237	Ei	2789	M	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments Volcanic glass	*			Voids (calcite) Moderate calcite Glauconite
TELL AL WILAYAH																							
238	Aii	2818	M				o&p	*	*			*			*	*	*		Sparse fine-grained fragments Volcanic glass			Moderate fine vegetable material	
TELL AGRAB																							
239	Aiv	2822	S	S			o&p		*						*	*	*	*	Sparse fine-grained fragments	*		Sparse fine vegetable material	Abundant siltstone Voids (calcite) Abundant calcite
240	Aiv	2821	S	S			o&p	*	*	*					*	*	*	?	Sparse fine-grained fragments	*		Sparse fine vegetable material	Abundant calcite Abundant magnetite
241	Bi	2819	S				o&p		*	*					*	*	*	*	Sparse fine-grained fragments				Abundant voids possibly formed by dissolution of ooliths

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
242	Bi	2820	S				o&p		*	*					*	*	*		Sparse fine-grained fragments				Abundant voids possibly formed by dissolution of ooliths
243	waster	2823	S				o&p	*		*					*	*	*		Fine-grained fragment				Sparry calcite Argillaceous fragments
KHAFAJAH																							
244	Aii	2826	S	S			o&p	*		*	*				*	*	*		Sparse fine-grained fragments	*		Foraminifera	Sparry calcite Moderate siltstone Voids (calcite)
245	Aiv	2824	M				o&p	*	*	?					*	*	*		Abundant fine-grained fragments (vitrophyric) Volcanic glass			Abundant medium/coarse vegetable material	Moderate siltstone Moderate calcite
246	Av	2828	M				o&p	*	*	*	*				*	*	*	*	Abundant fine-grained fragments			Moderate medium vegetable material	Ooliths (occasionally voids only)
247	Biv	2827	S				o&p	?							*	*	*		Sparsent fine-grained fragments	*			Grog? Abundant magnetite
TELL ASMAR																							
248	Aiv	2829	A				o&p								*	*	*		Moderate fine-grained fragments				Moderate siltstone Moderate calcite
ABU QASIM																							
249	Ei?	2830	M	S			o&p			*					*	*	*		Sparse fine-grained fragments			Fine vegetable material	Abundant voids (calcite) Abundant medium sand-size siltstone
250	Eii	2832	M	S			o&p			*					*	*	*		Sparse fine-grained fragments (vitrophyric)			Sparse fine vegetable material	Coarse sand-size siltstone and calcite
KHEIT QASIM																							
251	Bvi	2834	S				o&p	*		*					*	*	*	*	Sparse fine-grained fragments			Sparse medium/fine vegetable material	Mudstone
252	Gi	2833					p		?						*	*	*	*	Sparse fine-grained fragments				Medium-size calcite and sandstone

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
HALAWA																							
253	Ci	2839	S				p															Sparse fine vegetable material	Moderate very fine quartz/sand
254	Ci	2840	S				o								*	*							Very fine sandy matrix Sparse magnetite
SUWARI																							
255	Aii	2872	A	S			o&p		*	*	*				*	*	*	*	Abundant fine-grained fragments (vitrophyric)	*		Abundant fine vegetable material	Argillaceous fragment Sparse calcite Abundant sandstone
256	Bi	2871	S				o&p	*	*	*					*	*	*	*	Moderate fine-grained fragments (vitrophyric) Volcanic glass	*		Sparse fine vegetable material	Sparry calcite Very fine inclusions in calcite cement
TELL AL 'USIYEH																							
257	Ei	2873	M	S	S		p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)			Sparse fine vegetable material	Abundant calcite
258	Eii	2876	M	M	M		o&p	*	*	*	*				*	*	*	*	Abundant fine-grained fragments				Moderate calcite Voids (quartz)
259	Ei	2874	M	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments Volcanic glass				Moderate calcite Voids (calcite) ooliths?
260	Ei	2875	M	S			o&p	*	*	*	*				*	*	*	*	Moderate fine-grained fragments Volcanic glass			Sparse fine vegetable material	Moderate (sparry) calcite
UR **(Birmingham Museum Collection)**																							
261	Aiv	0017	M				o&p	*	*	*					*	*	*		Sparse fine-grained fragments	*			Abundant calcite Voids (ooliths?)
262	Aiv	0415	M	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments	*			Moderate calcite Argillaceous fragment Moderate magnetite
263	Aiv	0418	A	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments	?		Sparse medium vegetable material	Abundant calcite Glauconite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
264	Av	0275	A	M			o&p		*	*	*				*	*	*	*	Sparse fine-grained fragments			Moderate very fine vegetable material	Abundant calcite (ooliths) Abundant siltstone
265	Ci	0162						*							*	*	*	*		*	?	Abundant fine crushed shell	Sparse coarse sand-size voids (calcite/ sandstone?)
266	Di	0144													*				Fine-grained fragment	*	?	Sparse crushed shell	Fine 'clay' matrix
267	Aii	0320	M	S			o&p		*						*	*	*		Sparse fine-grained fragments volcanic glass	*			Voids possibly formed by dissolution of ooliths
268	Aii	0319		S			o&p	*	*						*	*	*		Sparse fine-grained fragments (vitrophyric)				Voids possibly formed by dissolution of ooliths
269	Aii	0347	S	M			p		*	*	*				*	*	*		Sparse fine-grained fragments				Abundant voids possibly formed by dissolution of ooliths
270	Aiii	0321	M				o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments	*		Abundant fine vegetable material	Moderate calcite (ooliths?) Abundant magnetite
271	Aii	0348	M	S			o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments			Sparse fine-grained material	Voids possibly formed by dissolution of ooliths
272	Aiii	0346	M	S			o&p		*	*					*	*	*	*	Sparse fine-grained fragments	*		Abundant fine vegetable material	Argillaceous fragment Voids (calcite?)
273	Ai	0316	S				o&p		*	*					*	*	*		Fine-grained fragment	*		Sparse medium/fine vegetable material	Voids possibly formed by dissolution of ooliths Argillaceous fragment
274	Aii	0345	M				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)	*		Sparse medium/fine vegetable material	Abundant calcite
275	Aii	0303	M				p		*	*					*	?	*		Fine-grained fragment	*	?	Foraminifera Abundant crushed shell	
276	Aii	0095	S				o&p	*		*					*	*	*		Sparse fine-grained fragments Volcanic glass	*			Sparse (sparry) calcite Argillaceous fragments
277	Aiii	0295	M				o&p		*	*	*				*	*	*		Moderate fine-grained fragments	*		Moderate very fine vegetable material	Abundant calcite Voids (ooliths?)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
278	Aiii	0336	M				p	*	*	*	?				*	*	*		Sparse fine-grained fragments	*		Sparse very fine vegetable material	Moderate calcite inclusions
279	Bi	0039	S						*						*	*	*		Sparse fine-grained fragments	*		Sparse fine vegetable material	Sparse calcite Fine 'silty' matrix
280	Bii	0317	S	S			o&p								*	*	*	?	Sparse fine-grained fragments	*		Sparse fine vegetable material	Sparse calcite Moderate magnetite
281	Bii	0329	A	S			o&p	*	*	*					*	*	*		Sparse fine-grained fragments (vitrophyric)	*		Whole shell and shell fragments	Fine 'clay' matrix
282	Biii	0314	S				o&p		*	*	*				*	*	*	*	Sparse fine-grained fragments				Abundant calcite Voids (ooliths?)
283	Dii	0331	S							*					*	*			Sparse fine-grained fragments		*	Abundant crushed shell	Fine 'clay' matrix
284	Bii	2691	S				o&p		*	*	?				*	*	*		Sparse fine-grained fragments (vitrophyric)				Abundant voids (calcite?) Abundant magnetite
285	Bii	0305	S				o&p			*					*	*	*	*	Sparse fine-grained fragments			Sparse medium/fine vegetable material	Voids (ooliths?) Abundant magnetite
286	Biii	0332	S				o&p		*	?					*	*	*		Sparse fine-grained fragments				Aggregate of calcite, fine quartz and igneous rock fragments Abundant magnetite
287	Biii	0311	S							?					*				Fine-grained fragment	*		Sparse very fine vegetable material	Abundant fine magnetite Fine 'clay' matrix
288	Biii	0313	S				p								*		*		Sparse fine-grained fragments	*		Sparse very fine vegetable material	Abundant fine magnetite Fine 'clay' matrix
289	Biii	0322	S				o&p		?	*	?				*	*	*	*	Sparse fine-grained fragments			Sparse fine vegetable material	Voids (quartz?) Abundant magnetite
290	Biii	0312	S				p			*					*	*	*		Sparse fine-grained fragments	*		Abundant fine shell Foraminifera Sparse medium vegetable material	Voids (quartz?) Argillaceous fragment
291	Biii	0315	S	S			p			*					*	*	*		Moderate fine-grained fragments	*		Large foraminifera	Argillaceous fragments Abundant magnetite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
292	Biii	0323	S	S			p			*					*	*	*		Sparse fine-grained fragments	*		Abundant fine shell Moderate fine vegetable material	Fine 'clay' matrix Glauconite Argillaceous fragments
293	Biii	0324	S	S			o&p								*	*	*		Sparse fine-grained fragments	*		Abundant fine shell Sparse fine vegetable material	Argillaceous fragments Fine 'clay' matrix
294	Biii	0330	S				o&p								*	*	*	*	Sparse fine-grained fragments	*		Moderate fine shell Sparse very fine vegetable material	Argillaceous fragments Fine 'clay' matrix
295	Biii	0334	S				p	?		*					*		*		Sparse fine-grained fragments	*		Abundant fine shell	Argillaceous fragments Fine 'clay' matrix
296	Biii	0333	S								*				*	*	*	*	Sparse fine-grained fragments	*		Abundant fine shell Foraminifera Sparse very fine vegetable material	Argillaceous fragments Fine 'clay' matrix
297	Biii	0325	M				p			*					*	*	*	*	Sparse fine-grained fragments	*		Moderate shell fragments	Argillaceous fragments Fine 'clay' matrix
298	Biii	0327	S				p								*		*		Fine-grained fragment	*		Sparse fine vegetable material	Moderate calcite Abundant fine magnetite Fine 'clay' matrix
299	Biv	0318	S	S	S				*	*					*	*	*	*	Fine-grained fragments	*		Sparse very fine vegetable material	Fine 'silty' matrix
300	Ei	0328	M	S			o&p		*	*					*	*	*		Fine-grained fragments	*		Sparse fine vegetable material	Abundant calcite Moderate siltstone
301	Ei	0257	M	M			o&p		*						*	*	*		Sparse fine-grained fragments	*		Sparse medium/fine vegetable material	Abundant calcite Very coarse inclusions of calcite (>2mm) Moderate magnetite
302	Ei	0256	M	M			p	*		*	?				*	*	*	*	Sparse fine-grained fragments	*		Sparse fine vegetable material	Abundant calcite Argillaceous fragments
303	Gi	0326	S		S		p			*					*					*			
304	Gii	0309	M	S	S	S	o&p			*	?				*	*	*		Fine-grained fragment	*		Sparse fine vegetable material	Argillaceous fragment

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
305	Hi	0308	M	S	S		o&p			*	?				*	*	*		Sparse fine-grained fragments	*		Sparse very fine vegetable material	Voids (ooliths?) Magnetite: coarse sand-size inclusion Argillaceous fragments
306	Hi	0308	M	S	S		o&p			*	?				*	*	*	*	Sparse fine-grained fragments	*			Voids (ooliths?) Sparse calcite Argillaceous fragments
307	Ii	0307	S	S	S	S	o&p		*	*					*	*	*		Sparse fine-grained fragments	*		Sparse coarse and abundant fine shell	Abundant fine magnetite
308	Ji	0304		S	M	S	o			*					*	*	*					Foraminifera	Fine 'clay' matrix
309	Ki	0306	S		S	M	o&p			*	*				*	*	*		Fine-grained fragment			Sparse fine vegetable material	Fine 'clay' matrix
310	Fi	0402							*						*	*					*	Abundant crushed shell	Sparse very coarse sand-size 'clay' inclusions Fine 'silty' matrix
311	Fii	0401													*						*	Abundant crushed shell	Very coarse sand-size void (clay inclusion?) Fine 'clay' matrix
312	Di	0400													*						*	Abundant crushed shell	Fine 'clay' matrix
313	Aii	0079	S	S			o&p	*	*	*	?				*	*	*		Sparse fine-grained fragments	*		Sparse fine vegetable material	Moderate calcite Voids (calcite?)
314	Cii	0276	S				o&p		*	*	*				*	*	*		Sparse fine-grained fragments	*		Sparse medium vegetable material	Abundant calcite Voids (calcite?)
KISH **(Birmigham Museum Collection)**																							
315	Di	2801	S				o&p				*									*	?	Fine crushed shell Voids (shell fragments?)	Sparry calcite Fine 'silty' matrix
316	Ei	2806	A				o&p	*	*	*					*	*	*		Fine-grained fragment	*		Fine shell fragments	Moderate calcite
UR **(Birmingham Museum Collection)**																							
317	Di	0172	S				p	*		*					*	*	*		Fine-grained fragment	*	?	Abundant fine crushed shell	Sparry calcite Glauconite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
318	Ciii	0310					o&p		*						*				Fine-grained fragment			Sparse fine vegetable material	Very fine 'sandy' matrix Sparse calcite
319	Other: 3	0076	S				p								*		*		Fine-grained fragment			Voids: sparse medium vegetable material?	Fine 'clay' matrix
320	Other: 4	0416													*		?					Sparse very fine vegetable material	Fine 'silty' matrix Sparse voids (calcite?) Sparse sparry calcite
321	Eii	0417	M	S			o								*	*	*		Sparse fine-grained fragments (vitrophyric)	*		Abundant fine shell	Medium sand-size siltstone Sparse sparry calcite Voids: quartz?
322	waster Ei?	0098	A	S			o&p			*					*	*	*					Sparse fine vegetable material	Voids (quartz?)
ABU SALABIKH: MAIN MOUND: AREA E																							
323	Di	1245					p	*	*								*			*	?	Fine shell fragments	Fine 'silty' matrix calcite
324	Aiv	1078	A	S			o&p	*			*				*	*	*		Sparse fine-grained fragments				Voids: medium quartz? Voids (calcite?)
325	Aiv	1081	A	S			o&p	*	*		*				*	*	*	*	Sparse fine-grained fragments				Voids (fine quartz?) Voids (calcite?)
326	Aiii	0706	M				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments Volcanic glass				Moderate (sparry) calcite
327	Bvi	0750	A	M?			p	*	*						*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Fine 'silty' matrix Voids: medium quartz?
328	Aii	1267	S	S			p	*			?				*		*					Sparse fine vegetable material	Sparse sparry calcite
329	Aii	0545	S				p	*	*	*	?				*		*					Sparse fine vegetable material	Sparse sparry calcite
330	Aiv	1191	A	S?			o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)				Sparse calcite Voids: medium quartz?
331	Aiii	1054	M				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Moderate calcite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
332	Avi	0668	A				p	*	*	*	*			*	*	*	*		Sparse fine-grained fragments (vitrophyric)				Abundant calcite
333	Avi	0668	A				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)				Abundant calcite
334	Aii	1020	S				p	*	*	*					*	*	*					Sparse fine vegetable material	Sparse calcite Very fine sandy matrix
335	Eii	1250	S	S			p	*		*	*				*	*	*		Sparse fine-grained fragments Volcanic glass			Sparse fine vegetable material	Abundant (sparry) calcite
336	Eii	1249	M	S	S		o	*	*	*	*			?	*	*	*	*	Sparse fine-grained fragments				Moderate calcite Veins of calcite
337	Aiv	0930	A				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments				Moderate calcite
338	Bvi	1143	M	M			o&p		*	*		*			*	*	*	*	Abundant fine-grained fragments				Abundant calcite/ooliths Chert? Moderate large magnetite inclusions Glauconite
339	Bvi	1143	M	M			o&p		*	*		*			*	*	*	*	Abundant fine-grained fragments (vitrophyric)				Moderate siltstone and sandstone
340	Ei	0873	M	S			p	*	*	*	*				*	*	*		Sparse fine-grained fragments	*		Abundant fine shell fragments Very fine vegetable material	Sparse calcite Abundant magnetite
341	Aii	0974	S				o&p	*	*		*				*	*	*		Fine-grained fragments				Very fine sandy matrix Argillaceous fragment
342	Li	1358	S				p	*	*						*	*	*	*	Sparse fine-grained fragments	*		Sparse fine vegetable material	Moderate calcite Large voids (calcite?)
343	Aiv	1357	M	S			o&p	*	*	*	*				*	*	*	*	Moderate fine-grained fragments (some vitrophyric)			Sparse medium/fine vegetable material	Abundant calcite Voids (ooliths?)
344	Aiii	1380	M				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments Volcanic glass			Sparse fine vegetable material	Moderate calcite Moderate siltstone Voids (medium quartz?)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
345	Aiv	0895	A				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)			Sparse fine vegetable material	Voids (calcite) Voids (fine quartz?) Argillaceous fragment
346	Aiii	1411	M				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Moderate calcite Voids (calcite?)
347	Biii	0714	A				o&p	*	*	*	*	*			*	*	*		Sparse fine-grained fragments			Moderate fine vegetable material	Moderate magnetite
348	Li	1410		S			p	*	*	*					*	*	*		Fine-grained fragment	*			Abundant fine magnetite Argillaceous fragment Very sandy matrix
349	Av	0896	A				p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments			Sparse fine vegetable material	Abundant magnetite Argillaceous fragment
350	Bi	0939	M	S			o&p	*	*	*	*				*	*	*	*	Moderate fine-grained fragments				Moderate magnetite Fine 'clay' matrix Argillaceous fragment
351	Bi	0937	M	S			o&p			*	*				*	*	*		Moderate fine-grained fragments Volcanic glass	*			Abundant magnetite Fine 'clay' matrix Argillaceous fragments
352	Bi	0894	M	S			o&p	*		*	*				*	*	*	*	Abundant fine-grained fragments Volcanic glass			Foraminifera	Moderate magnetite Voids (ooliths?)
353	Bi	0936	M	S	S?		o&p	*							*	*	*	*	Moderate fine-grained fragments Volcanic glass			Sparse medium/fine vegetable material	Moderate magnetite Voids (quartz?) Argillaceous fragment
354	Other: 1	1248	S				p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments	*		Sparse fine vegetable material	Moderate (sparry) calcite Chert Large argillaceous fragment Glauconite
355	Bvii	0905					o&p		*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)	*		Abundant fine shell	Argillaceous fragments Moderate magnetite Abundant siltstone
356	Mvi	0804													*	*	*		Fine-grained fragment	*		Foraminifera	Abundant coarse sand-size shelly limestone Coarse sand-size siltstone Sparry calcite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
ABU SALABIKH: NORTH EAST MOUND																							
357	Ci	1529					p	*			*				*	*	*	*	Sparse fine-grained fragments			Sparse very fine vegetable material	Sparse (sparry) calcite Glauconite
358	Ai	1531	S				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)				Moderate (sparry) calcite
359	Ei	1525	S	S			p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Abundant calcite Argillaceous fragment
360	Ei	1527	M	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments			Sparse fine vegetable material	Moderate limestone Argillaceous fragment
361	Ei	1534	M	S			o&p	*	*	*	*				*	*	*	*	Fine-grained fragment			Sparse fine vegetable material	Moderate (sparry) calcite Argillaceous fragments
362	Ei	1516	S	M			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments	*		Abundant fine shell	Abundant medium sand-size calcite and siltstone Moderate magnetite
363	Ei	1521	M	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments				Moderate calcite Argillaceous fragments
364	Ei	1522	M	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments				Abundant calcite Sparry calcite Moderate magnetite Glauconite
365	Biii	1523	A				o&p			*	*				*	*	*	*	Moderate fine-grained fragments	*			Abundant magnetite Abundant limestone
366	Bi	1519	S							*					*	*	*	*	Fine-grained fragments	*			Abundant fine magnetite
367	Bi	1532	S	S			o&p			*					*	*	*		Sparse fine-grained fragments (vitrophyric)				Fine 'clay' matrix Chert?
368	Bii	1528	M				o&p	*		*					*	*	*	*	Moderate fine-grained fragments	*			Abundant magnetite Fine 'clay' matrix

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
ABU SALABIKH: MAIN MOUND, AREA A																							
369	Aiv	1504	S				p	*	*		*				*	*	*		Fine-grained fragment				Abundant fine calcite Argillaceous fragment
370	Ei	1498	M				p	*	*	*	*				*	*	*	*	Sparse fine-grained fragment	*			Moderate siltstone Sparry calcite
371	Ei	1505	M				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragment Volcanic glass				Moderate calcite Sparry calcite
372	Ei	1483	M				o&p	*	*	*	*				*	*	*		Fine-grained fragment				Abundant very fine quartz Abundant fine calcite
373	Ei	1458	M				o&p	*	*	*	*				*	*	*		Moderate fine-grained fragments	*			Abundant fine (sparry) calcite
374	Ei	1486	M	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments				Moderate calcite Fine 'clay' matrix
375	Ei	1466	M	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)			Sparse fine vegetable material	Moderate limestone Moderate calcite
376	Ei	1473	S	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Moderate fine calcite Sparry calcite
377	Ei	1457	M				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments	*		Abundant fine shell	Abundant very fine quartz Sparse calcite Voids (ooliths?)
378	Aiv	1509	S				o&p	*	*	*	*				*	*	*	?	Fine-grained fragments	*		Sparse fine vegetable material	Moderate fine calcite Sparry calcite Very fine sandy matrix
379	Ai	1466	S	S			o&p	*	*	*	*				*	*		*	Sparse fine-grained fragments	*	?	Abundant fine shell	
380	Ai	1512	S	S			o&p	*	*	*	*	*			*	*	*	*	Sparse fine-grained fragments	*	?	Abundant fine shell	Sparse calcite
381	Ei	1506	M				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments				Sparse calcite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
382	Ei	1502	M				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric) Volcanic glass	*			Moderate calcite Fine 'clay' matrix
383	Ei	1485	M	S			o&p	*	*	*	*				*	*	*	?	Fine-grained fragment	*			Moderate calcite
384	Ei	1485	M				o&p	*	*		*	?			*	*	*	*	Sparse fine-grained fragments	*		Sparse fine vegetable material	Abundant calcite Abundant siltstone
385	Ei	1468	M				o&p	*		*	*				*	*	*	*	Sparse fine-grained fragments				Moderate medium to coarse sand-size calcite Moderate siltstone and sandstone
386	Ei	1469	M	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Moderate calcite/voids: possibly ooliths
387	Ei	1477	M	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments				Moderate sparry calcite
388	Ei	1479	M	S			o&p	*	*	?	*				*	*	*	*	Sparse fine-grained fragments Volcanic glass			Sparse fine vegetable material	Moderate sparry calcite Chrondrodite?
389	Ei	1481	S		S		o&p	*	*	*	*				*	?	*	*	Sparse fine-grained fragments (vitrophyric)				Very fine sandy matrix Sparse calcite
390	Ei	1501	M				o&p	*	*	*	*			?	*	*	*	*	Sparse fine-grained fragments	*			Sparse calcite Voids(calcite?)
391	Eii	1513	M				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments			Moderate medium/fine vegetable material	Moderate calcite Moderate magnetite
392	Ciii	1482	S				o&p	*	*	*	*				*	*	*	?	Sparse fine-grained fragments	*		Sparse very fine vegetable material	Moderate (sparry) calcite
393	Eii	1464	S	S			o&p	*	*	*	*				*	?	*	*	Sparse fine-grained fragments			Sparse very fine vegetable material	Moderate calcite: single coarse sand-size fragment Moderate magnetite
394	Eii	1503	M	S			o&p	*	*	*	*	*			*	*	*	*	Sparse fine-grained fragments	*		Foraminifera	Calcite: very coarse sand-size fragment Glauconite
395	Cii	1507	S				o&p	*		*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric) Volcanic glass	?			Moderate (sparry) calcite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
396	Ci	1487	S				o&p	*	*	*	*				*	*	*		Fine-grained fragment			Foraminifera	Abundant voids (calcite/ ooliths?)
397	Cii	1455	S				o&p	*	*	*	*				*	?	*		Fine-grained fragment	*		Sparse fine vegetable material	
398	Cii	1456	S	S			p?	*		*	*				*	*	*	*	Fine-grained fragments			Sparse fine vegetable material	Abundant fine calcite Argillaceous fragment
399	Avi	1475	S				o&p	*	*	*	*			?	*		*	*	Sparse fine-grained fragments	*		Sparse fine vegetable material	Moderate calcite Fine 'silty' matrix Large argillaceous fragment
400	Avi	1474	S	S			o&p	*	*	*	*				*	?	*	*	Sparse fine-grained fragments Volcanic glass	*		Sparse very fine vegetable material	Moderate calcite Fine 'silty' matrix Large argillaceous fragment
401	Ciii	1465	S				o&p	*		*	*				*	*	*	*	Fine-grained fragment Volcanic glass			Sparse medium/fine vegetable material	Abundant fine calcite Sparry calcite
402	Ciii	1488	S				o&p	*		*					*	*	*		Sparse fine-grained fragments	*		Sparse fine vegetable material	Moderate (sparry) calcite
403	Aiv	1489	M	S			o	*	*	*	?				*	*	*	*	Sparse fine-grained fragments			Moderate medium/fine vegetable material	Sparse (sparry) calcite
404	Avi	1508	S				o&p	*	*	*	*				*		*		Sparse fine-grained fragments			Abundant medium/fine vegetable material	Argillaceous fragment
405	Ei	1462	M				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Very fine sandy matrix
406	Ai	1500	S				o&p	*	*	*	?				*	*	*	*	Sparse fine-grained fragments			Moderate fine vegetable material	Argillaceous fragment
407	Ai	1480	S				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments	*			Sparry calcite Large voids: calcite?
408	Ai	1492	S				o&p	*	*	?	*				*	*	*	*	Sparse fine-grained fragments Volcanic glass				Moderate calcite: some inclusions coarse sand-size
409	Ai	1476	S				o&p	*		*	*				*		*		Fine-grained fragment (vitrophyric)	*			Moderate calcite Aggregate of calcite, very fine quartz and ferruginous material

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
410	Av	1510	S				o&p	*		*	*				*	*	*	*	Sparse fine-grained fragments Volcanic glass				Moderate fine (sparry) calcite
411	Av	1511	M				o&p	*	*	*	*	*			*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Moderate (sparry) calcite Moderate magnetite Sillimanite
412	Av	1499	S				o&p	*		*	?				*	*	*		Sparse fine-grained fragments Volcanic glass	?			Sparry calcite Chert
413	Bv	1459	A	S			o&p	*		*	*				*	*	*	*	Moderate fine-grained fragments	*		Voids: shell fragments	Abundant magnetite Calcite (voids): some inclusions > 1mm
414	Aviii	1470	A	S			o&p		*	*	*	*			*	*	*	*	Medium-sand-size fine-grained fragments	*		Sparse fine vegetable material	Medium sand-size (angular) sedimentary rock fragments Argillaceous fragments Chert
415	Dii	1490	M	S			o&p		*	*	*			?	*	*	*	*	Sparse fine-grained fragments (vitrophyric)	*	?	Abundant fine shell	Moderate siltstone Abundant magnetite
416	Biii	1497	S	S			o	*	*	*	*				*	*	?	*	Sparse fine-grained fragments			Sparse medium fine vegetable material	Fine 'clay' matrix
417	Bix	1454	S	S			o&p		*	*	*				*	*	*	*	Fine-grained fragment	*		Sparse medium vegetable material	Abundant magnetite
418	Biii	1491	S	M			o&p		*	*	?		?	*	*	*	*		Moderate fine-grained fragments	*		Sparse fine vegetable material	Calcite: very coarse sand-size inclusion Moderate magnetite Inclusion: weathered olivine with serpentine veining
419	Bi	1471	M				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)				Moderate fine magnetite Argillaceous fragment
420	Biii	1467	S				o&p			*					*	*	*	*	Sparse fine-grained fragments	*		Sparse fine vegetable material	Abundant fine magnetite Fine 'clay' matrix
420 (external margins)	Biii	1467	A				o&p	*		*					*	*	*	*	Medium sand-size fine-grained fragments				Medium sand-size silstone, limestone and chert
421	Biii	1493	S				o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments	*			Abundant fine magnetite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
422	Biii	1494	M	S			o&p			*	*					*		*	Sparse fine-grained fragments	*		Sparse very fine vegetable material	Moderate siltstone Abundant fine magentite Glauconite
423	Ciii	1495	S				o&p	*		*					*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Fine 'silty' matrix Moderate magentite Sparse voids (calcite)
424	Diii	1460	S							*					*	*			Fine-grained fragment		*	Abundant crushed shell	Fine 'clay' matrix
425	Cii	1496	S				o&p	*	*	*	*				*	*	*						Moderate fine calcite
426	Giii	1461	M	S		S	o&p	*	*	*	*				*	*	*	*	Fine-grained fragment Volcanic glass			Sparse medium/fine vegetable material	Abundant very fine calcite Moderate fine magnetite Argillaceous fragments
427	Mii	1463	A	S			o&p		*	*	*	*			*	*	*	*	Moderate fine-grained fragments (vitrophyric)			Abundant pale yellow organic material Abundant very fine vegetable material	Angular quartz grains Abundant siltstone Argillaceous fragments Moderate magnetite
428	Eii?	1478	A				o&p	*	*	*	?				*	*	*		Sparse fine-grained fragments			Abundant very/fine vegetable material	Large argillaceous fragment (2.8mm)
428 (internal margins)	Eii	1478	M	S			p		*						*	*	*	*					Voids: calcite?
ABU SALABIKH: WEST MOUND																							
429	Aiv	2249	A				o	*	*	*					*	*	*	*	Fine-grained fragment				Abundant calcite Large calcite inclusion (> 4mm)
430	Ei	2441	S	S	S		o		*	*	?				*	*	*	?	Sparse fine-grained fragments (vitrophyric)			Sparse fine vegetable material	Fine 'silty' matrix Sparse calcite Coarse sand-size calcite inclusion
431	Bi	2350	S	S			o&p		*	?	*				*	*	*	?	Sparse fine-grained fragments (vitrophyric)				Moderate fine magnetite Argillaceous fragments
432	Bix	1660	S												*					*		Moderate medium and fine vegetable material	Fine 'clay' matrix Abundant ferruginous material
433	Aii	2393	S				o&p	*	*	*	*				*	*	*		Fine-grained fragment				Abundant fine calcite Abundant very fine sand

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
434	Aii	1564	S	S			o&p	*	*						*	*	*	*					Moderate (sparry) calcite
435	Aiv	2446	S		S		o&p	*	*		*				*	?	*	*					Abundant very fine magnetite and (sparry) calcite
436	Cii	2086	S	S			o&p	*	*						*	*	*	*	Sparse fine-grained fragment	?			Sparse fine (sparry) calcite
437	Avii	2109	S	S			o&p	*	*	*	*				*	*	*		Fine-grained fragment: vitrophyric			Sparse fine vegetable material	Moderate calcite
438	Avii	2108	S	S	S		o&p	*		*	*				*	*	*	*	Sparse fine-grained fragments Volcanic glass	*		Sparse fine vegetable material	Moderate (sparry) calcite
439	Aiv	1632	A				o&p	*	*	?	*			*	*		*	*	Fine-grained fragment: vitrophyric				Abundant calcite Glauconite Argillaceous fragments
440	Aiv	2021	M				o&p	*	*	*	*				*	*	*	*	Fine-grained fragments Volcanic glass			Sparse very fine vegetable material	Abundant calcite
441	Ei	1757	M	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments	*			Moderate (sparry) calcite Argillaceous fragments
442	Ei	1730	M	S			o&p	*	*		?				*	*	*	*	Sparse fine-grained fragments Volcanic glass	*		Sparse fine vegetable material	Abundant (sparry) calcite
443	Avii	2378	S	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments			Abundant very fine vegetable material	Moderate calcite Argillaceous fragment
444	Avii	2244	S	S			o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)			Abundant very fine vegetable material	Abundant calcite Argillaceous fragment
445	Eiii	1756	M	S	S		o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments	*		Sparse fine vegetable material	Abundant magnetite Sparse calcite
446	Eiii	2505	M	S			o&p			*	*				*	*	*	*		*		Moderate very fine vegetable material	Abundant siltstone Moderate magnetite Moderate calcite
447	Av	2042	M				o&p	*	*	*	?				*	*	*		Fine-grained fragments Volcanic glass				Abundant fine (sparry) calcite Abundant fine magnetite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
448	Liv	1994	M				o&p	*		*					*		*		Fine-grained fragments Volcanic glass				Argillaceous fragments Moderate (sparry) calcite Fine 'silty' matrix
449	Bi	1565	S												*	*	*	*	Fine-grained fragments	*			Fine 'clay' matrix Abundant fine magnetite
450	Bi	2395	S							*					*		*		Fine-grained fragments	*			Fine 'clay' matrix Abundant magnetite
451	Bi	1927	A				o&p			*	*				*	*	*		Sparse fine-grained fragments				Abundant calcite (voids) Abundant magnetite
452	Bi	1969	A	S			o&p								*	*	*	*	Sparse fine-grained fragments	*		Moderate very fine vegetable material	Sparse calcite Abundant voids
453	Bi	2047	M				o&p								*		*		Sparse fine-grained fragments (vitrophyric)	*		Sparse medium/fine vegetable material	Abundant voids probably formed by dissolution of ooliths/calcite
454	Gii	2121	S	S			o&p	*	*	*	*				*	*	*	?	Sparse fine-grained fragments (vitrophyric)				Moderate (sparry) calcite Aggregate of calcite, very fine quartz and ferruginous material
455	Hi	1775	M	M			o&p	*	*	?	*				*	*	*	?	Sparse fine-grained fragments	*		Moderate fine vegetable material	Abundant magnetite Medium sand-size siltstone and limestone inclusions
456	Ci?	2460	S						*										Fine-grained fragment	*	?	Abundant medium/fine shell fragments	Fine 'clay' matrix Argillaceous fragments Sparse voids (ooliths?)
457	Bii	2444	M	S			o&p			*	*				*	*	*		Fine-grained fragments	*		Sparse medium/fine vegetable material	Abundant magnetite and other ferruginous material Fine 'clay' matrix
458	Ei	1552	M	S			o&p		*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric) Volcanic glass				Very coarse sand-size sandstone
459	Aiv	1636	M				o&p	*	*	*	*	?			*	*	*	*	Sparse fine-grained fragments	*		Sparse very fine vegetable material	Abundant calcite Glauconite
460	Ei	1619	M	S			o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Abundant (sparry) calcite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
461	Ciii	2379	S				p	*	*	*					*	*	*		Sparse fine-grained fragments (vitrophyric)			Sparse fine vegetable material	
462	Diii	1759	M	S			o&p		*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)		*	Abundant crushed shell Sparse fine vegetable material	Moderate calcite Argillaceous fragments
463	Aii	1553	S	S			o&p		*						*	*	*	*	Fine-grained fragments	*		Foraminifera	
464	Aiii	1600	M	S			o&p		*	*	*				*	*	*		Sparse fine-grained fragments Volcanic glass	*		Moderate fine vegetable material	Moderate calcite Moderate magnetite
465	Ei	1554	S		S		o&p		*	*	*				*	*	*	*				Sparse fine vegetable material	Very coarse sand-size voids: calcite? Voids: ooliths Argillaceous fragment
466	Li	1156	S				o&p	*	*	*	*				*	*	*	*	Fine-grained fragment Volcanic glass	*		Sparse very fine vegetable material	Abundant sandstone Abundant (sparry) calcite Abundant fine magnetite
467	Diii	1598	A	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)		*	Abundant crushed shell	Abundant calcite (voids) Moderate magnetite
468	Bv	2093	S	S			o&p	*		*	*				*	*	*	*	Fine-grained fragment Coarse-grained fragment				Fine 'clay' matrix Aggregate of calcite and igneous rock fragments Moderate magnetite
469	Biii	2510	M				p	*		*	*					*	*		Sparse fine-grained fragments Volcanic glass	*		Sparse medium/fine vegetable material	Abundant magnetite
470	Ciii	2045	S				o	*	*		*				*	*	*		Sparse fine-grained fragments				Fine 'silty' matrix Large aggregate of sparry calcite, siltstone and igneous rock fragments
471	Ci	1903	S				p		*	*					*			*	Fine-grained fragment			Moderate very fine vegetable material	Fine 'silty' matrix
472	Bii	2024	M				o&p								*	*	*		Sparse fine-grained fragments				Fine 'clay' matrix Abundant magnetite Voids: ooliths?

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
473	Bii	2005	M	S			o&p			*					*	*	*		Sparse fine-grained fragments	*		Argillaceous fragment with shell inclusions Abundant fine shell	Fine 'clay' matrix Moderate magnetite
474	Lii	1863	S				o&p	*	*	*	*				*	*	*	*					Abundant calcite Glauconite
475	Ji	2236	S	S	S	S				*					*	?		*	Fine-grained fragment	*			Fine 'clay' matrix Moderate magnetite Quartz/calcite aggregate
476	Mi	1852													*		*					Foraminifera	Mudstone/shale Grog Abundant very fine calcite
477	Miii	1930			S		p			*			*	*	*	*	*		Microsulphurous gabbro			Pale yellow organic material	Weathered olivine with serpentine veining Very coarse sand-size calcite Abundant coarse magnetite
478	Bix	2552		S											*		*		Fine-grained fragment	*	?	Abundant medium vegetable material Abundant fine shell	Fine 'clay' matrix Sparse coarse sand-size voids: calcite?
479	Mvii	1882					o								*		*	*				Abundant very fine vegetable material	Abundant coarse sand-size mudstone and shelly limestone Sparse coarse magnetite
480	Clay	-	M	M	S	S	o&p			?	?					*						Sparse fine vegetable material	Quartz grains > 2mm Argillaceous fragments Moderate magnetite
481	Aii	2055	S	S			o&p	*	*						*		*		Fine-grained fragment	*		Sparse fine vegetable material	Abundant very fine sand Argillaceous fragments
482	Aii	1995	S	S			o&p		*	*					*		*		Fine-grained fragment (vitrophyric)	*		Sparse medium vegetable material	
483	Aii	1678	S				o&p			*					*	*	*		Fine-grained fragments	*		Pale yellow organic material	Abundant voids: calcite?
484	Ei	2279	S		S		o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments	*		Sparse fine vegetable material	Voids: calcite?
485	Ii	1816	S				o&p								*				Fine-grained fragments			Sparse fine vegetable material	Fine 'clay' matrix

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
486	Bi	2563	S				o&p			*	*				*	*			Sparse fine-grained fragments	*		Abundant fine vegetable material	Moderate magnetite Abundant very fine sand
487	Liii	1866					p	*		*					*		*			*		Sparse fine vegetable material	Sparry calcite
488	Gi	2012	A	S	S	S	o&p			*	*				*	*	*		Sparse fine-grained fragments	?		Abundant fine vegetable material	Abundant magnetite
489	Ki	2548									*				*	*	*						Very coarse sand-size siltstone and sparry calcite
490	Hix	2187			S	M	o&p				*				*	*	*		Fine-grained fragment	*			Mudstone/shale Fine 'silty' matrix
491	Hix waster	2188			S	M											*						Fine 'clay' matrix Voids: calcite Abundant magnetite
492	Miv	2003			S		o	*	*		*				*	*	*	*	Fine-grained fragments	*			Abundant coarse sand-size sandstone and siltstone Abundant (sparry) calcite
493	Miv	1934						*							*	*	*	*	Fine-grained fragment	*		Moderate fine vegetable material	Abundant coarse sand-size sandstone, siltstone calcite and magnetite Mudstone
494	Hvii	2309	M	S	A	M	o&p		*	*					*	*	*					Sparse fine vegetable material	Sparry calcite Coarse sand-size sandstone
495	Dii	1965	M				o&p		*		*				*	*	*		Sparse fine-grained fragments Volcanic glass		*	Abundant crushed shell	Moderate magnetite Fine 'silty' matrix
496	Ci	1621	S				o&p	*	*	*					*	*	*		Sparse fine-grained fragments (vitrophyric)	*		Sparse fine vegetable material	
497	Ci	1731	S				o&p	*	*	*	?				*	*	*		Volcanic glass			Sparse medium vegetable material	
498	Cii	2565													*		*					Moderate medium vegetable material	Very fine 'granular' matrix
499	Ci	2553					p	*	*	*					*	*	*		Fine-grained fragment	*		Sparse very fine vegetable material	Argillaceous fragment Voids: calcite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
500	Ci	2080	S				p	*	*	*					*	*	*		Sparse fine-grained fragments			Void: vegetable material?	Abundant fine magnetite
501	Ci	1906	S				p	*	*	*					*	*	*		Sparse fine-grained fragments	*			Moderate fine magnetite
502	Ci	2477						*	*	*					*	*	*		Fine-grained fragment	*		Sparse fine vegetable material	Argillaceous fragment
503	Cii	1907					o&p	*	*	*					*		*		Sparse fine-grained fragments				Abundant very fine sand Moderate fine magnetite and calcite
504	Bi	1881	M				o&p		*	*					*	*		*	Sparse fine-grained fragments (vitrophyric) Volcanic glass	*		Sparse fine vegetable material	Moderate magnetite Fine 'clay' matrix
505	Bi	1908	S				o	*		*					*		*			?		Sparse fine vegetable material	Abundant fine magnetite
506	Piii	2544	M				o&p	*		*	*				*	*			Sparse fine-grained fragments	*	?	Abundant medium vegetable material Abundant fine shell	Abundant magnetite Fine 'clay' matrix
507	Bvi	1586	A				o&p	*	*	*	*				*	*			Sparse fine-grained fragments (vitrophyric)			Sparse fine vegetable material Abundant fine shell	Moderate magnetite Fine 'clay' matrix
508	Biii	1605	S				o		*	*	*				*	*			Sparse fine-grained fragments	*		Moderate fine vegetable material	Moderate magnetite Fine 'silty' matrix Argillaceous fragment
509	Bi	2057	S				o&p			*	*				*	*	*		Sparse fine-grained fragments	*		Sparse fine vegetable material	Fine mottled 'clay' matrix Abundant magnetite
510	Ei	1928	M			S	o&p		*	*	*				*	*	*	*	Fine-grained fragments				Abundant calcite
511	Ei	1926	M	S			o&p	*	*	*	*				*	*	*		Fine-grained fragment	*		Sparse very fine vegetable material	
512	Ei	2088	M	S			o&p	*	*	*					*	*	*		Sparse fine-grained fragments				Moderate magnetite
513	Aiv	2101	M			S?	o&p	*	*	*	*	*			*	*	*			*		Sparse very fine vegetable material Foraminifera	Moderate fine calcite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
514	Aii	2414	S				o&p	*			*				*	*	*		Fine-grained fragments	*		Sparse very fine vegetable material	Argillaceous fragment
515	Aiv	2524	M				o&p	*	*		*				*		*		Sparse fine-grained fragments			Sparse medium vegetable material	Argillaceous fragment
516	Ei	2528	M	S			o&p	*	*	*	?				*	*	*		Sparse fine-grained fragments (vitrophyric)			Sparse very fine vegetable material	Abundant calcite
517	Aiv	2530	M	S			o&p	*	*	*					*	*	*		Fine-grained fragment	*		Sparse very fine vegetable material	Moderate fine magnetite Voids: calcite? Argillaceous fragments
518	Aiv	2547	M	M			o&p	*	*		*				*	*	*		Sparse fine-grained fragments (vitrophyric)				Moderate calcite
519	Aiv	2567	A	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments				Abundant (sparry) calcite
520	Cii	1935	S				o&p		*						*	*	*		Sparse fine-grained fragments	*		Moderate fine shell Sparse medium/fine vegetable material	Moderate calcite Abundant very fine sand
521	Av	2566	A				o&p			*	*				*	*	*		Sparse fine-grained fragments			Abundant fine vegetable material	Abundant magnetite Voids: ooliths?
522	Cii	2426	S				o&p				*				*	*		*		*		Abundant fine shell Sparse medium/fine vegetable material	Abundant fine magnetite
523	Fi	2119					o&p								*		*			*		Moderate very fine shell	Abundant very fine calcite Sparse coarse calcite
524	Ci	1689													*							Sparse medium/fine vegetable material	Sparse very fine sand
525	Jiii	2235	A		S	S				*					*		*			*		Sparse fine vegetable material	Fine 'clay' matrix Abundant magnetite
526	Di	2053	S	S					*						*		*			*	?	Moderate fine shell Foraminifera	Fine 'clay' matrix Moderate magnetite
527	Biii	2063	S	S							*				*	*	*		Sparse fine-grained fragments	*		Sparse medium vegetable material Abundant fine shell	Abundant magnetite Fine 'clay' matrix
528	Bii	2180	M	S			o&p								*	*			Moderate fine-grained fragments	*		Sparse medium vegetable material Moderate fine shell	Abundant magnetite Abundant very fine sand

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
529	Bii	2182	M	S			o&p								*	*			Moderate fine-grained fragments	*		Sparse medium vegetable material Moderate fine shell	Abundant magnetite Abundant very fine sand
530	Ei	2416	M	M			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments	*			Abundant (sparry) calcite Moderate siltstone and sandstone
531	Mii	2113		A	A	S	o&p		*	*	*				*	*	*		Sparse fine-grained fragments	*		Abundant very fine vegetable material	Fine red 'clay' matrix
532	Jii	2183	S		M	S		*							*		*			*		Sparse fine vegetable material Abundant fine shell	Fine 'clay' matrix
533	Ji	2181	S		S			*		*					*				Fine-grained fragment	*		Sparse fine vegetable material	Moderate very fine sand Abundant magnetite Fine 'clay' matrix
534	Hii	1920	A				o&p	*		*	*				*				Fine-grained fragments (vitrophyric) Volcanic glass	*		Moderate fine shell	Abundant magnetite
535	Hii	2002	A				o&p	*		*	*				*	*	*		Fine-grained fragments	*		Moderate fine shell	Abundant magnetite Moderate calcite Glauconite
536	Hiii	2013	A	S			o&p	*		*	*				*	*	*	*	Sparse fine-grained fragments			Abundant very fine vegetable material	Sparse coarse magnetite Abundant calcite Moderate siltstone and sandstone
537	Hiii	1910	A	S			o&p	*		*	*				*	*	*	*	Sparse fine-grained fragments			Abundant very fine vegetable material	Sparse coarse magnetite Abundant calcite Sparse siltstone and sandstone
538	Hiii	2194	A	S			o&p	*		*	*				*	*	*	*	Sparse fine-grained fragments			Moderate very fine vegetable material	Moderate magnetite Abundant calcite Sparse siltstone and sandstone
539	Hiii	2191	A	S			o&p			*	*				*	*	*	*	Moderate fine-grained fragments			Sparse very fine vegetable material	Moderate magnetite Abundant calcite Sparse siltstone and sandstone
540	Hiii	2335	A	S	S		o&p		*	*	*				*	*	*	*	Sparse fine-grained fragments Volcanic glass	*		Abundant very fine and sparse medium vegetable material	Sparse magnetite Moderate calcite and siltstone Sparse sandstone

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
541	Hiii	2526	A	S			o&p			*	*				*	*		*	Sparse fine-grained fragments Volcanic glass			Sparse very fine vegetable material	Abundant magnetite Moderate siltstone
542	Hiv	2040		S	M		o&p	*			*				*	*	*	*	Sparse coarse-grained fragments	*		Abundant very fine vegetable material	Abundant coarse sand-size siltstone and sandstone and sparse calcite Grog
543	Hv	1974		A	S		o								*	*	*	*	Sparse coarse-grained fragments	*		Moderate very fine vegetable material	Abundant coarse sand-size siltstone Sparse coarse sand-size sandstone and calcite Mudstone
544	Hvi	1956		M	S		o								*	*	*	*	Fine-grained fragments Volcanic glass				Dolomite Abundant coarse and very coarse sand-size siltstone
545	Hvii	1949	A		A		o&p	*		*	*				*	*	*	*	Sparse fine-grained fragments	*		Abundant fine/very fine vegetable material	Sparse very coarse sand-size siltstone and calcite Voids: ooliths?
546	Hviii	1946	S	M	M	S	o&p	*		*					*	*			Fine-grained fragments	*		Moderate very fine vegetable material	Sparse coarse sand-size siltstone
547	Hix	1913	S		S	M	o&p	*	*		*				*	*	*		Sparse fine-grained fragments Volcanic glass	*		Sparse medium/fine vegetable material	Abundant fine calcite Sparse coarse sand-size siltstone
548	Hx	1964	M	S	M	S	o&p?	*		*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)			Abundant very fine vegetable material	Abundant magnetite Abundant voids: calcite? Mudstone
549	Hix	1954	S		S	M	o&p			*	*				*	*	*	*	Sparse fine-grained fragments				Abundant fine calcite Abundant magnetite Sparse coarse sand-size siltstone Fine 'silty' clay matrix
550	Hxi	2172	A		M		o&p	*		*	?				*	*	*	*	Fine-grained fragment	*		Sparse medium vegetable material	Sparse medium sand-size siltstone
551	Hxii	1938	S	M	S		o&p								*	*	*	*	Coarse sand-size coarse-grained fragments	*		Abundant fine vegetable material Foraminifera	Abundant coarse and very coarse sand-size siltstone Sparse sandstone Aggregate of calcite, fine quartz and ferruginous material

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
552	Hxiii	1921	S	M	S		o	*											Coarse-grained fragment	*		Sparse very fine vegetable material	Moderate medium to very coarse sand-size siltstone, sandstone and calcite Ferruginous sandstone Argillaceous inclusion (2mm)
553	Hi	2018	A	S			o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)	*		Moderate very fine vegetable material	Abundant calcite Moderate magnetite Argillaceous fragments
554	Qi	2117	A			M	o&p	*		*	*				*		*		Fine-grained fragment			Abundant yellow organic material	Sparse coarse sand-size calcite Moderate magnetite
555	Qi	1839	A	S		M	o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments			Abundant yellow organic material Foraminifera	Adundant magnetite
556	Hix	2301	S	S	S	M	p		*		*				*	*	*	*	Fine-grained fragment	*		Sparse fine vegetable material	Sparse very coarse sand-size calcite/limestone Abundant fine magnetite Fine 'silty' matrix
557	Hix	2171		S	M	M	p	*		*	*				*				Fine-grained fragment	*		Moderate fine vegetable material	Fine 'clay' matrix
558	Iii	1981			?		o								*	*	*		Sparse fine-grained fragments	*		Foraminfera	Fine 'clay' matrix Abundant (sparry) calcite (voids)
559	Waster	1799													*	*	*			?			Moderate very fine sand Voids: calcite? Abundant fine magnetite
560	Other: 2	1251	S				o&p	*	*	*	*				*		*		Fine-grained fragment			Abundant very fine vegetable material	Abundant fine (sparry) calcite Moderate fine magnetite Abundant very fine sand
561	Mv	1917	A	M			o&p	*	*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)			Sparse medium/fine vegetable material	Sparse sparry calcite Sparse very coarse sand-size siltstone and sandstone Glauconite
562	Sickle	-	A	A	?	?	o&p	?		*						*		*				Sparse medium vegetable material	Abundant magnetite Vitrified matrix
563	Sickle	-	A	A	?	?	o&p			*						*		*				Sparse medium vegetable material	Abundant magnetite Vitrified matrix

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
UMM AN NAR																							
564	Aiv	2903	A				o&p		*	*					*		*	*				Abundant yellow organic material	Sparse magnetite
565	Aiii	2877	M				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Abundant voids possibly formed by dissolution of calcite Moderate magnetite
566	Aiii	2894	M				o&p	*	*	*	*				*	*	*	*	Moderate fine-grained fragments (vitrophyric)				Abundant voids possibly formed by dissolution of calcite Moderate magnetite
567	Ii	2899					o								*				Fine-grained fragment				Fine 'clay' matrix Argillaceous fragments
568	Aiii	2889	M				o&p	?	*	*	?				*	*	*	*	Fine-grained fragment Volcanic glass			Sparse fine vegetable material	Abundant voids possibly formed by dissolution of calcite
569	Aiii	2885	M				o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Abundant voids possibly formed by dissolution of calcite Abundant large muscovite Moderate magnetite
570	Ei	2898	A	S			o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments			Foraminifera Sparse medium/fine vegetable material	Abundant medium sand-size siltstone Voids: calcite?
571	Gi	2895	S	M	M	S	o&p	*	*	*					*	*	*		Fine-grained fragments	*		Sparse fine vegetable material	Abundant voids: calcite? Argillaceous fragment Sparse fine magnetite
571 (clay added to jar rim/neck)		2895	S	M	S				*						*	?	*		Fine-grained fragment				Moderate magnetite Argillaceous fragment
572	-	2905					p			*			*	*	*		*		Gabbro: basaltic dolerite				Weathered olivine with serpentine veining Moderate coarse magnetite Abundant very fine sand
573	UNii	2902		S			p		*						*	*		*	Fine-grained fragments			Sparse fine vegetable material	Fine 'clay' matrix
574	UNi	2901		M	M	S	o		*		*				*	*		*				Abundant fine vegetable material	Sparse magnetite Argillaceous fragments Coarse sand-size quartz in calcite cement

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
575	UNi	2901		M	M	S	o		*						*			*				Abundant fine vegetable material	Sparse magnetite Argillaceous fragments
576	UNi	2906	A	A	S													*				Abundant yellow organic material	Moderate coarse sand-size mudstone
577	Ei	2886	A	S			o&p		*	*	*				*	*	*		Sparse fine-grained fragments (vitrophyric)			Sparse fine vegetable material	Moderate calcite Abundant magnetite
578	Ei	2888	A	M			o&p	*		*					*	*	*	*	Fine-grained fragments				Moderate magnetite
579	Gii	2890	A		S	S	o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments				Abundant voids: ooliths? Abundant magnetite Very coarse sand-size quartz inclusion
580	Gii	2897	A	S	S		p		*	*					*	?	*	?		*			Voids: quartz? Voids: ooliths? Argillaceous fragments
581	Gii	2893	A	S	M	S	o&p	*		*	*				*	*		*	Fine-grained fragments				Moderate magnetite
582	Bi	2891	M	M	S		o&p				*				*	*			Sparse fine-grained fragments				Sparse magnetite Fine 'clay' matrix
583	Fi	2892		S	S	S									*								Fine 'clay' matrix
584	Bi	2882	A	M	S		o&p	?	*						*	*			Sparse fine-grained fragments			Sparse fine vegetable material	Moderate magnetite Fine 'clay' matrix
585	Bi	2900	A	M	S		o&p		*		?				*	*			Sparse fine-grained fragments				Abundant magnetite Fine 'clay' matrix
586	Bi	2883	A	M	S		o&p	*	*	?					*	*			Sparse fine-grained fragments				Sparse magnetite Fine 'clay' matrix
587	Bvi	2881	M	S			o&p								*	*	*	*	Sparse fine-grained fragments			Sparse fine vegetable material	Abundant voids possibly formed by dissolution of ooliths Moderate magnetite Fine 'clay' matrix
588	Gi	2895	M		S	S	o&p	*	*	*					*	*	*		Sparse fine-grained fragments			Sparse fine vegetable material	Voids possibly formed by dissolution of ooliths Argillaceous fragment
589	Bvi?	2878	S	M			o&p			*				*	*	*	*	?	Sparse fine-grained fragments (vitrophyric)			Sparse very fine vegetable material	Abundant voids possibly formed by dissolution of ooliths Moderate magnetite

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
590	Bvi	2885		M	S		o&p	*		*					*	*	*		Sparse fine-grained fragments				Abundant voids: coliths? Fine 'clay' matrix Abundant magnetite
591	Bvi	2896	A	M	S		o&p	*		*	*				*	*	?		Sparse fine-grained fragments (vitrophyric)				Abundant magnetite Glauconite
592	Bvi	2887	A				o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments (vitrophyric)				Abundant voids possibly produced by dissolution of coliths Abundant magnetite
593	UNiii	2904	S												*							Sparse fine vegetable material	Fine 'silty' matrix Argillaceous fragments
594	UNiii	2909	S					*							*		*					Sparse medium/fine vegetable material	Fine 'silty' matrix
595	UNiii	2910	S					*							*	*							Fine 'silty' matrix
596	UNiv	2907	M	S			o&p	*		*	*				*	*	*		Sparse fine-grained fragments				Abundant fine calcite Sparse magnetite Very fine granular matrix Mudstone
597	UNiv	2907	M	S			o&p		*	*	*				*	*	*		Fine-grained fragment Volcanic glass				Abundant fine (sparry) calcite Sparse magnetite Very fine granular matrix Argillaceous fragment
598	UNv	2908	S						*						*	*	*						Fine 'silty' matrix
HILI																							
599	UNvi	2912	S	S												*			Fine-grained fragment	?		Sparse fine vegetable material	Fine 'silty' matrix
600	Ei?	2913	M	S			o&p	*	*	*	*				*	*	*	*	Sparse fine-grained fragments			Sparse fine vegetable material	Abundant voids: calcite? Sparse (sparry) calcite Moderate magnetite Very fine 'granular' matrix
601	Ei?	2914	M	S			o&p	*		*	*				*	*	*	*	Sparse fine-grained fragments (vitrophyric)	*		Sparse fine vegetable material	Abundant voids: calcite? Sparse (sparry) calcite Sparse magnetite Very fine 'granular' matrix Argillaceous fragment

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
TELL AL RUBEIDHEH																							
602	Mvi	2841	S							*					*	*	*	*				Abundant very fine vegetable material	Coarse sand-size sandstone, siltstone, mudstone (shale) chert and calcite Red and black argillaceous fragments
603	Mvii	2842	S	S				*							*	*	*	*				Abundant medium vegetable material	Coarse and very coarse sand-size siltstone sandstone, mudstone chert and calcite
604	Mviii	2843		S	S			*							*	*	*	*		*		Medium and coarse shell fragments	Abundant fine calcite Coarse sand-size sandstone, siltstone mudstone, chert and calcite
605	Mv	2844	S	S	M	S									*	*	*	*	Coarse-grained fragment			Sparse fine vegetable material	Abundant very coarse sand-size siltstone Very coarse sand-size sandstone, mudstone (shale), chert and argillaceous fragments
606	Aii	2846	S	M	M		o&p								*	*	*	*	Coarse sand-size fine-grained fragment		*		Medium to coarse sand-size siltstone, mudstone (shale), calcite (sparry) and argillaceous fragments
607	Diii	2849	S	S											*	*	*	*		*	*	Abundant coarse shell Foraminifera	Medium to coarse sand-size siltstone, sandstone, calcite and argillaceous fragments
608	Dii	2850	S	S			o		*						*	*	*	*	Sparse fine-grained fragments	*		Sparse medium and fine vegetable material	Sparse coarse sand-size siltstone, chert and calcite
609	Bii	2848	S		S		o&p								*	*	*		Fine-grained fragment	*		Sparse fine vegetable material	Abundant calcite/ooliths Voids: calcite/ooliths? Sparse coarse magnetite
610	Bi	2845	S	S	S										*	*	*		Fine-grained fragment	*			Moderate coarse and very coarse sand-size siltstone and calcite Argillaceous fragment Fine 'clay' matrix

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
611	Biii	2847	S	S		S			*		?				*	*	*	*	Fine-grained fragment	*		Moderate fine vegetable material Foraminifera	Sparse coarse sand-size siltstone, sandstone and calcite Argillaceous fragments Fine 'clay' matrix
612	Bii	2848	S	S					*		*				*	*	*	*	Sparse fine-grained fragments	*		Abundant medium/coarse vegetable material	Mudstone (shale) Argillaceous fragments Voids: calcite?
613	Diii	2850	S	S					*						*	*	*	*	Sparse fine-grained fragments			Abundant medium vegetable material	Fine 'clay' matrix Voids: quartz
614	Ai	2851	A	S			o&p		*		?				*	*	*		Sparse fine-grained fragments (vitrophyric)	*		Moderate fine shell Abundant fine vegetable material	Abundant calcite Ooliths Medium sand-size siltstone Argillaceous fragments
615	Hvi	2854	M	S	S	S	o&p		*	*					*	*	*	*	Medium sand-size fine grained-fragments	*		Sparse fine shell vegetable material	Abundant coarse sand-size siltstone Coarse sand-size sandstone, mudstone, chert and calcite
616	Hvii	2852		A	S		p?	*		*					*	*	*	*	Coarse sand-size fine grained-fragment			Sparse fine vegetable material	Abundant coarse sand-size siltstone and sparry calcite Mudstone (shale)
617	Ai	2853	S	S	S		o&p		?	*					*	*	*		Coarse grained-fragment	*		Sparse medium/fine vegetable material	Moderate medium sand-size siltstone Siltstone in calcite cement Argillaceous fragment
618	Ci	2855	M	S					*						*	*	*		Fine grained-fragment			Sparse fine vegetable material	Sparse coarse sand-size siltstone and calcite Voids: calcite? Argillaceous fragments Fine 'clay' matrix
619	Ci	2855	M	S					*						*	*	*		Fine grained-fragment				Moderate calcite Sparse coarse sand-size siltstone and calcite
620	Div	2856	S				o&p	*							*	*	*	*			*	Abundant crushed shell	Moderate voids: calcite Sparse magnetite Argillaceous fragments

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
621	Di	2857	S	S				*							*		*			*	*	Moderate crushed shell Foraminifera Sparse fine vegetable material	Fine 'clay' matrix
622	Eii	2858	S	S	S	S		*							*	*	*			*		Foraminifera	Sparry calcite Voids: ooliths?
623	Diii	2849	S					*		*					*	*				*	*	Abundant crushed shell Foraminifera	Very fine sandy matrix Sparry calcite Sparse coarse sand-size siltstone
624	Diii	2849	S				o&p	*	*	*					*	*	*	*	Sparse fine-grained fragments		*	Voids: crushed shell	Abundant coarse sand-size voids: siltstone? Mudstone Argillaceous fragments
625	Bv	2859	S	S						*					*	*	*	*	Sparse fine-grained fragments	*		Abundant fine shell Foraminifera	Abundant coarse sand-size siltstone, sandstone and calcite Voids: ooliths? Fine 'clay' matrix
626	Bv	2859	S	S			p								*	*	*	*	Sparse fine-grained fragments	*		Abundant foraminifera	Coarse sand-size siltstone and sandstone Abundant ooliths (voids) Fine 'clay' matrix
627	Ei	2860	S	S			o&p		?						*	*	*					Abundant medium vegetable material	Abundant fine (sparry) calcite Very fine 'granular' matrix Coarse sand-size siltstone
628	Ei	2860	S	S	S		o&p	*	*		?				*	*	*		Fine-grained fragment			Abundant medium vegetable material	Abundant fine (sparry) calcite Very fine 'granular' matrix Coarse sand-size siltstone
629	Ciii	2863	S	S											*	*	*		Fine-grained fragment			Sparse fine vegetable material	Abundant coarse sand-size ooliths/voids Moderate magnetite
630	Cii	2870	S	S			o&p		*						*	*	*		Fine-grained fragment			Sparse fine vegetable material	Abundant fine (sparry) calcite
631	Bitumen (2715) sample		S												*	*	*	*				Abundant carbonised vegetable material Coarse chaff and grain	Sparry calcite Polycrystalline quartz

8.3.4 Pottery fabric classification

INTRODUCTION

The pottery has been classified according to fabric type, using the conventional criteria of composition, texture and colour. Fabric descriptions follow the conventions recommended by Peacock (1977, 21-33) and reference is made to the concordance of fabric types (Table 8.3) and the petrographic analysis of thin sections (Table 8.5).

The fabric descriptions are based on material examined from Ur, Abu Salabikh and Kish. The categories are broadly comparable for each site although variations occur as a result of differences between the local clays from different sites. The fabrics have been identified initially by visual comparisons and subsequently by a microscopic examination of thin sections of pottery samples. In some instances a specific fabric group may not occur at all three sites, Groups Aviii and Aix, for example, are not represented in the pottery examined from Ur (Table 8.3) and whilst shell-tempered wares are represented in pottery from Ur and Abu Salabikh this group is replaced by grog-tempered ware in the assemblage from Kish.

The fabric groups, however, generally represent the same type of pottery manufactured at different sites. By comparing these groups with pottery samples taken from the remaining twenty sites included in the corpus an identified fabric type has been assigned to each sherd. Separate fabric descriptions have been included for the pottery from Tell al Rubeidheh and local pottery from the Gulf sites of Umm an Nar and Hili.

In the following descriptions of each group a brief synopsis is followed by detailed description of the sub-types which have been identified. This precedes discussion of the petrology for each group.

CLASSIFICATION

Fine sandy wares (Group A)

Description

For all sites fine sandy wares have been assigned to Group A and together with the green-buff wares (Group B) form the largest group of fabrics represented in the pottery assemblages examined from Ur, Abu Salabikh and Kish. Fine sandy wares have been recorded at twenty-four of the twenty-three sites included in the pottery corpus (Table 8.3) although Fabrics Aviii, Aix and Ax are confined to pottery from the Abu Salabikh pottery assemblage, with the exception of Fabric Aix from Kish (Abu Salabikh, Fabric Aviii). Chronological distinctions between the late Uruk/ED I and ED II/ ED III fabric types from Abu Salabikh are illustrated by fabrics Aviii, Aix and Ax which are almost exclusively confined to pottery from early contexts. Although some added ring bases and spouts are manufactured from fabric Aviii this fabric is a typical transitional bowl ware (Table 6.1, Type 1.2) and Fabrics Aix and Ax are restricted to middle to late Uruk pottery types (Table 6.1).

Ai Yellow-orange core with red-orange margins. Cream slip frequently applied to external surface. Hard, smooth texture. Fairly rough fracture. Moderate to sparse fine sand, sparse fine limestone visible as specks in fracture. Fine inclusions of mica ranging from abundant, in Kish fabrics, to moderate and sparse in Ur and Abu Salabikh fabrics respectively. Sparse fine vegetable material present in Ai fabrics from Ur. No other visible inclusions (Fig. 8.94, Sample nos. 0511 and 2817).

Aii Colours range from red-brown to red-pink core indistinguishable from surfaces. Fairly hard, smooth texture. Rough, occasionally laminated fracture. Moderate fine sand and sparse fine limestone visible as white specks in fracture. Sparse fine inclusions of mica. Sparse fine inclusions of magnetite visible as black specks in

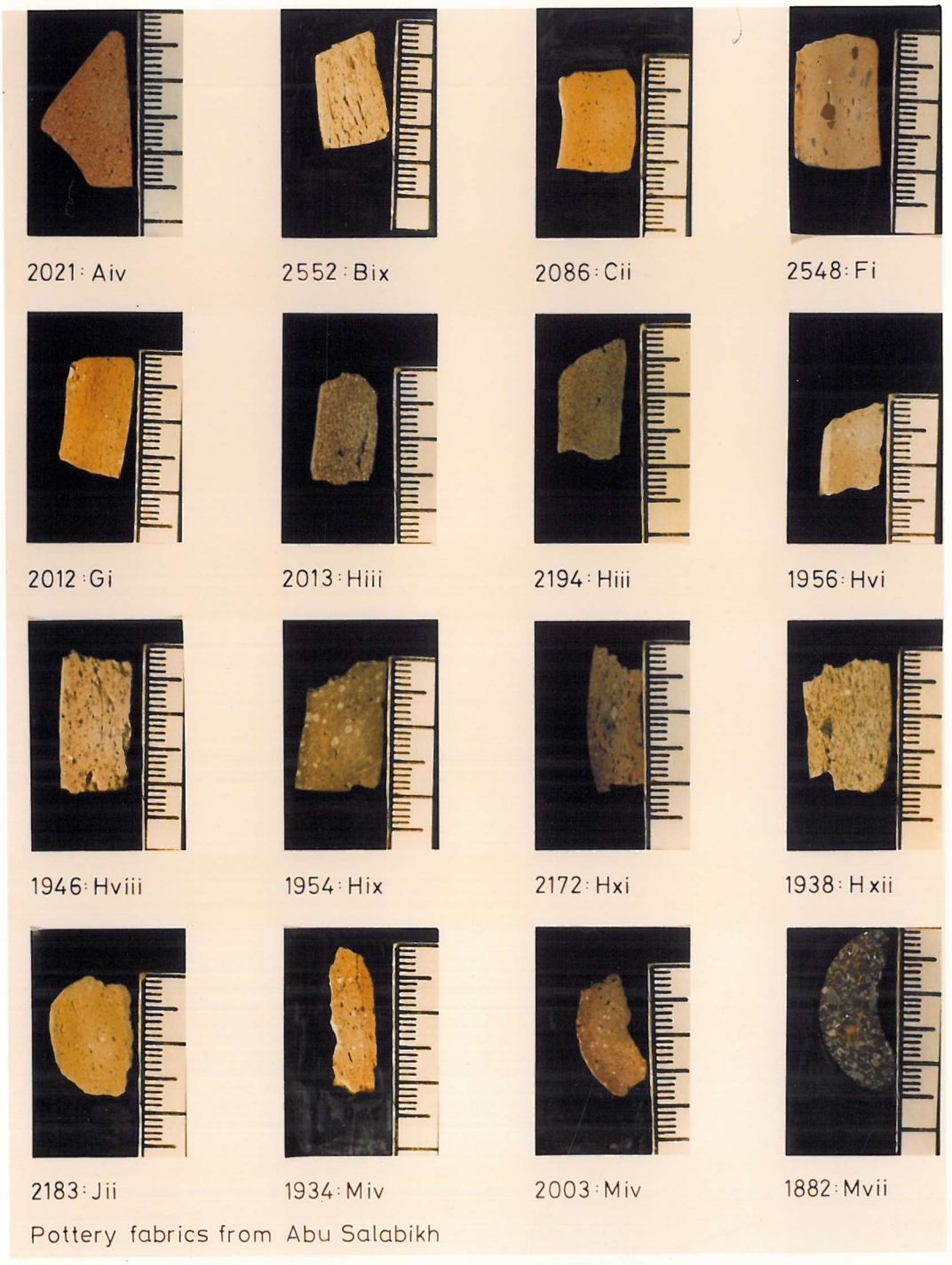


Fig. 8.93 Cross sections of samples photographed prior to thin sectioning to illustrate a selection of pottery fabrics from Abu Salabikh (1:1)

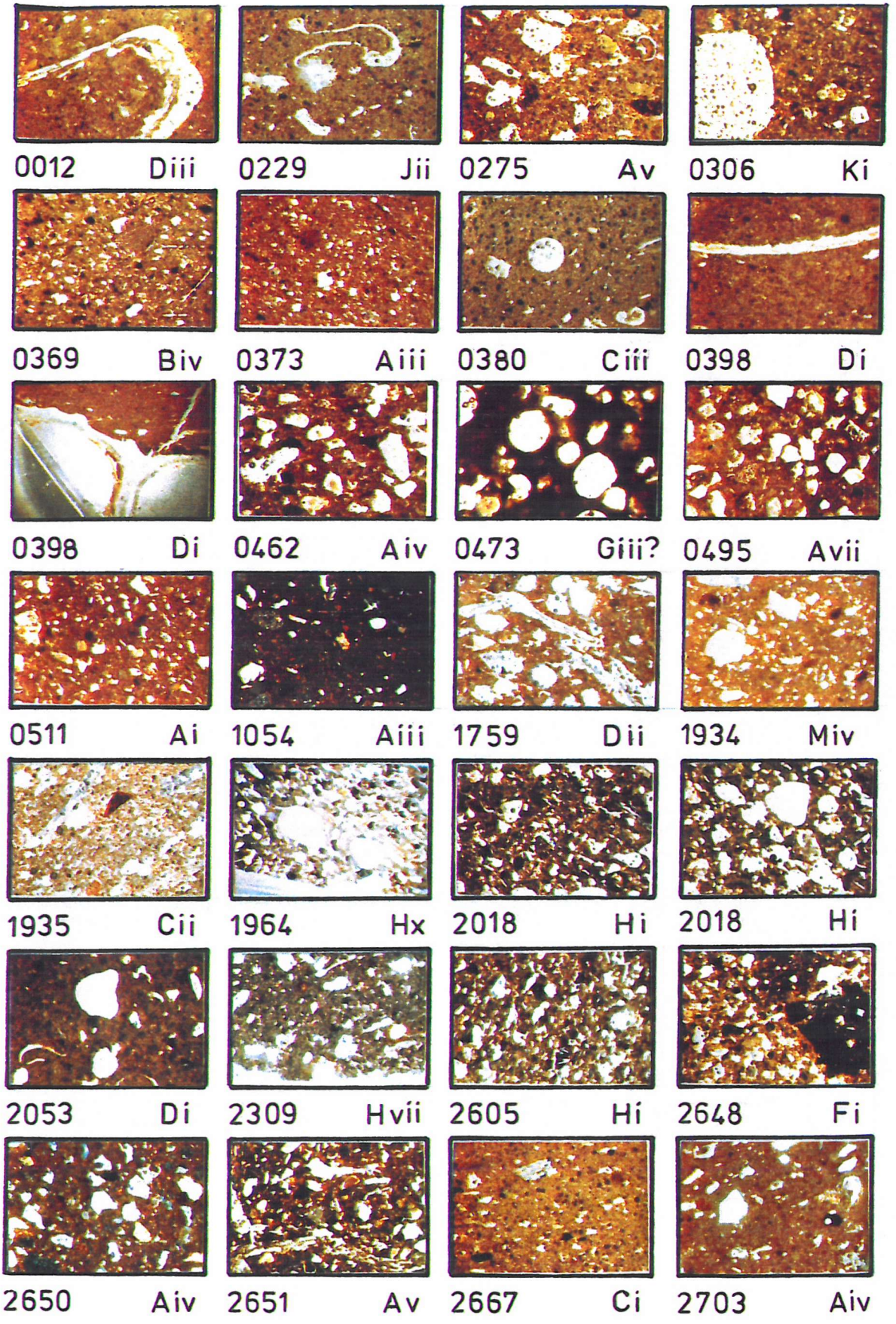


Fig. 8.94A Photomicrographs illustrating a selection of late fourth and third millennium fabric types from Ur, Al 'Ubaid, Eridu and Abu Salabikh. (All photomicrographs at magnification X200 except 0398: magnification X20)

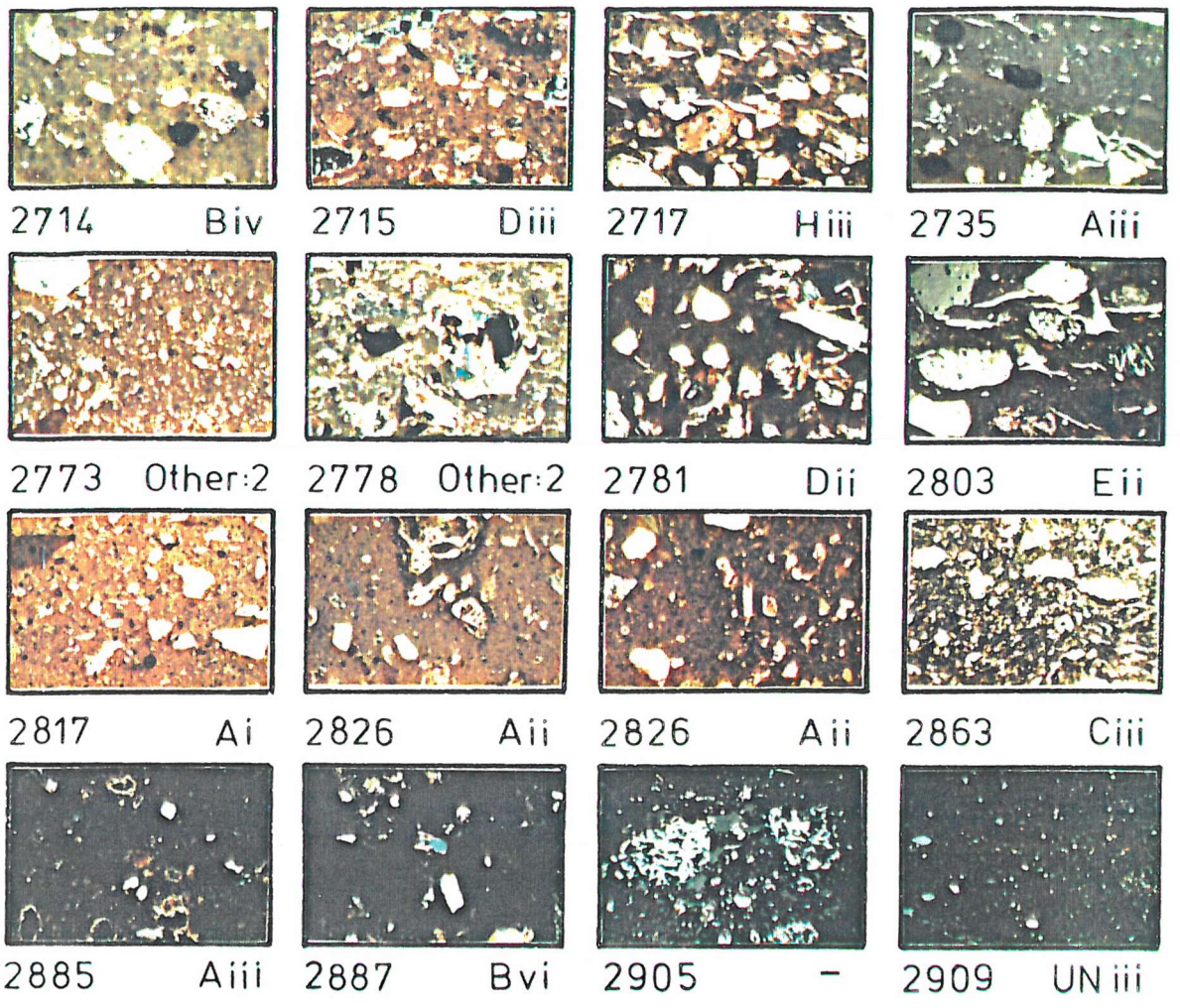


Fig. 8.94B Photomicrographs illustrating a selection of late fourth and third millennium fabric types from Kish, Jamdat Nasr, Khafajah, Tell al Rubeidheh and Umm an Nar. (All photomicrographs at magnification X200)

fracture. Moderate fine vegetable material. Sparse large limestone inclusions visible in Aii fabrics from Ur (Fig. 8.94, Sample no. 2826).

Aiii Pink-buff core with cream-slipped external surface. Hard, fairly smooth texture. Fairly rough, occasionally laminated fracture. Moderate fine sand. Sparse limestone visible as white specks in fracture. Although similar to Aii this fabric is distinguished by the presence of abundant fine inclusions of magnetite, visible as fine black specks in fracture, and abundant fine vegetable material. The vegetable material present in Aii fabrics from Ur is of a slightly coarser nature. Aiii fabrics from Abu Salabikh contain, in addition, sparse red argillacious fragments (Fig. 8.94, Sample nos. 0373, 1054 and 2735).

Aiv Colours range from pink-buff to pink-red core frequently with self-slipped external surface. Fairly hard, harsh texture. Rough fracture. Medium/fine sand ranging from sparse to moderate in Kish fabrics to abundant in Aiv fabrics from Abu Salabikh and Ur. Abundant to moderate fine limestone visible as a dense scatter of white specks in fracture. Sparse fine magnetite inclusions visible as black specks in fracture. Faintly micaceous with sparse fine vegetable material. Abu Salabikh Fabric Aiv contains less calcite than Fabric Aiv from Ur and Kish (Fig. 8.93, Sample no. 2021 and Fig. 8.94, Sample nos. 0462, 2650 and 2703).

Av Over fired fabric. Colours range from red-brown to brown-black core indistinguishable from surfaces. Hard, harsh texture. Rough fracture. Abundant fine sand. Abundant to moderate fine limestone occasionally visible as fine white specks in fracture. Abundant fine magnetite inclusions. Av fabrics from Kish are distinguished by the presence of abundant mica and occasionally by abundant fine shell fragments (Fig. 8.94, Sample nos. 0275 and 2651).

Avi Colour varies from pink-red core indistinguishable from surfaces to pink-grey core with pink-red margins. Cream-slipped external and occasionally internal surfaces. Hard, harsh texture. Fairly rough laminated fracture. Moderate to sparse fine sand. Abundant to moderate magnetite visible as black specks in fracture. Faintly micaceous. Although similar to Aiii this fabric contains moderate to sparse medium vegetable material possibly added as a tempering agent which gives the fabric a semi-porous property. Avi fabrics from Abu Salabikh usually contain less vegetable material but as these fabrics are more sandy they retain the semi-porous property which is a characteristic of all Avi fabrics.

Avii Distinctive red-orange core indistinguishable from surface. Thin wash frequently applied to external surface. Hard, fairly harsh texture. Fairly rough fracture. Abundant fine sand and moderate fine limestone visible as white specks in fracture. This fabric is characterised by its bright red-orange colour combined with abundant mica visible as mica dusting on the surfaces of these vessels. Owing to the micaceous appearance of the clay this is principally a Kish fabric, although a similar fabric with less mica is to be found in the Abu Salabikh pottery assemblage (Fig. 8.94, Sample no. 0495).

Aviii (Kish and Jamdat Nasr only). Similar to fabric Avii but with abundant medium/fine chaff temper and abundant magnetite visible as black specks in fracture.

Aviii (Kish Fabric Aix). Similar to Avi but with abundant fine sand, some colourless and some red and grey grains, and moderate medium chaff-temper. The chaff temper in Kish fabrics is usually more abundant.

Aix (Abu Salabikh, West Mound only). Pink core with thick cream-slipped external surface. Hard,smooth texture. Smooth fracture. Moderate medium straw/chaff temper. No other visible inclusions.

Ax (Abu Salabikh, West Mound only). Orange-buff margins with reduced pale grey core. Hard, harsh texture. Rough fracture. Moderate fine sand and limestone visible as fine white specks in fracture. Sparse fine vegetable material.

Petrology

The visual diversity of fabric types within the fine sandy wares is less apparent in thin section. Certain visual traits, however, are reflected in a petrographic analysis of thin sections from representative samples. The distinctive characteristic of Fabric Aiv, for example, is the presence of abundant fine white specks in fracture which corresponds to the abundant calcite inclusions visible in thin section (Table 8.5, thin sections 035, 199 and 261). Generally, however, visual distinctions between the sub-groups of fine sandy wares are not identified in a petrological analysis of the fabric types and it is inferred that a variety of similar clays was being used in local pottery production at each site with very little exchange occurring between sites.

The most marked difference between pottery fabrics from Ur, Abu Salabikh and Kish is illustrated by fabric Avii. With the single exception of sample 0370 (Table 8.5) fabric Avii does not occur in pottery fabrics from Ur and from the abundance of mica present in the fabric of the stemmed dish it is therefore assumed that this vessel originally came from Kish.

Green-buff wares (Group B)

Description

For all sites these wares are designated group B. They form a major group of fabrics in the pottery examined from Ur, Abu Salabikh and Kish and have been recorded at eight other sites including Umm an Nar (Table 8.3).

Bi Colours range from yellow-buff to pale yellow-green core indistinguishable from surfaces. External surface frequently cream-slipped. Hard, fairly smooth

texture. Fairly smooth fracture. Sparse fine sand and vegetable material. Abundant fine inclusions of magnetite, visible as black specks in fracture, in Abu Salabikh and Kish Bi fabrics. Sparse fine magnetite in Fabric Bi from Ur. Sparse mica dust on surfaces of Kish fabrics only.

Bii Green core; overfired. External surface self-slipped. Hard, harsh texture. Rough fracture. Moderate to sparse fine sand and sparse medium sand in Bi fabrics from Tell al 'Ubaid, Kish and Abu Salabikh. Moderate to sparse fine sand in Bii fabrics from Ur. Abundant to moderate fine magnetite visible as black specks in fracture. Moderate to sparse fine vegetable material. Sparse coarse vegetable material in Bii fabrics from Ur. Bii fabrics from Kish are faintly micaceous.

Biii Green core; overfired. External surface frequently cream-slipped. Hard, harsh texture. Rough fracture. Biii fabrics from Kish and Abu Salabikh are similar to Bii fabrics but with sparse coarse vegetable material and large inclusions of magnetite giving this fabric a black speckled appearance. Biii fabrics from Ur are distinguished from other Biii fabrics by the presence of sparse limestone inclusions and orange argillaceous fragments. Fabric Biii from Kish Sample no. 2772 (Table 8.4) is similar to Biii fabrics from Ur and is possibly an imported painted ware from Ur.

Biv Cream-buff core indistinguishable from surfaces. Cream-slipped external surface. Hard, fairly smooth texture. Fairly rough fracture. Abundant to moderate fine sand with sparse medium and occasionally sparse coarse sand. Abundant fine magnetite visible as fine black specks in fracture. Abundant fine vegetable material and sparse red argillaceous fragments (Fig. 8.94, Sample nos. 0369 and 2714).

Bv Green-pink core indistinguishable from surfaces. Hard, fairly smooth texture. Rough fracture. Abundant fine magnetite visible as black specks in fracture.

Vegetable material ranging from abundant fine to sparse coarse fragments. Bv fabrics from Ur contain sparse large limestone inclusions.

Bvi Yellow-buff core with pale green margins. Hard, harsh texture. Rough, hackly fracture. Abundant fine sand and abundant medium sand, possibly added as temper. Abundant yellow organic material gives this fabric a speckled appearance. Abundant fine vegetable material. Abundant magnetite. Abu Salabikh and Kish fabrics are faintly micaceous.

Bvii (Abu Salabikh only) Similar to above but with sparse fragments of coarse siltstone and sparse argillaceous fragments.

Bvii (Sakheri Sughir only) Although visually similar to Abu Salabikh, Fabric Avii the harsh texture is due to medium sand temper and not fragments of siltstone. Sparse red argillaceous fragments.

Bviii (Kish fabric Bvii) Yellow-buff core indistinguishable from surfaces. Hard, harsh texture. Rough hackly fracture. Abundant medium sand temper. Abundant magnetite visible as black specks in fracture. Abundant medium chaff-temper.

Bix (Abu Salabikh only) Green core indistinguishable from surfaces. Hard, harsh texture. Rough hackly fracture. Sparse fine sand. Sparse limestone inclusions. Moderate coarse/medium straw/chaff temper (Fig. 8.93, Sample no. 2552).

Petrology

Whilst the green-buff wares exhibit considerable diversity of fabric when examined in the hand specimen, in common with Group A fabrics many of these differences are less obvious from a petrological analysis of the fabrics. Coarse vegetable material, for example, is frequently lost in the grinding of thin-sections. There are, however,

differences between the Group B fabrics which are equally distinct in thin section. The presence of argillaceous fragments in Group Biii fabrics from Ur (Table 8.5, thin section numbers 290-297) and the analysis of quartz grains (Table 8.5, columns 4-7) reinforce the fabric subdivisions obtained by a visual examination. In addition, petrographic analyses reveal differences in the clay matrix. Group B fabrics from Ur are frequently shown to consist of a fine 'silty' or 'clay' matrix. These fine clays are a feature of the pottery fabrics from Ur and this is reflected in the mineral assemblage of such fabrics where a fine 'silty' or 'clay' matrix contains fewer accessory minerals. In general all Group A fabrics are more sandy than those of Group B and this constitutes the major difference between the two wares. The difference in colour between these groups, however, is often more apparent in a visual examination of the fabrics. The green colour of some Group B fabrics suggests that they have been fired at a higher temperature then those of Group A. This is demonstrated by the increase in the number of voids recorded in the petrological analysis of Group Biii fabrics, together with their hard, harsh texture. Fabrics Biv and Bv, however, have not been subjected to high firing temperatures and owe their colour to a lower iron content in the clays used in their manufacture.

Most of the green-buff wares appear to be manufactured locally at each site. However, the presence of sparse coarse limestone inclusions and orange argillaceous fragments in the fabric of a painted sherd from Kish (Table 8.4, Sample no. 2772) suggests the vessel was imported from Ur since this is typical of a Biii fabric from that site.

Fine wares (Group C)

Description

The fine wares are distinguished by their very smooth, occasionally burnished surface finish. Painted wares from Abu Salabikh and Kish are frequently manufactured from Ci and Cii fabrics. These same fabrics, however, occur in middle to late Uruk pottery from the West Mound at Abu Salabikh (Table 8.4, Sample nos. 2565 and 2566), sometimes in combination with thick cream slips containing vegetable

material (Table 8.4, Sample no. 2460). Ci and Cii fabrics are commonly found amongst the later ED III and Akkadian pottery types of Ur. Ciii fabrics, however, represent vegetable tempered fine wares used in the manufacture of large bowls, large jars and stemmed dishes.

Fabric Civ is a rare type found only at Ur. Two pots of this type were noted at Ur: a conical bowl (Table 8.4, Sample no. 0070) and a small jar (Table 8.4, Sample no. 0147)

Besides Ur, Abu Salabikh and Kish, fine wares have been recorded from Sakheri Sughir, Tell al Ubaid, Warka, Jamdat Nasr, Abu Qasim, Kheit Qasim and Tell al Rubeidheh (Table 8.3).

Ci Pink-cream core indistinguishable from surfaces. External surface frequently cream-slipped. Occasionally in fine wares from Abu Salabikh the cream slip is chaff-tempered. Red paint is applied over a slip to the external surfaces of Abu Salabikh and Kish fabrics. (Table 8.4, Sample nos. 2368 - 2370). Fairly hard, smooth texture. Smooth fracture, sparse fine/very fine sand. Sparse fine limestone/calcite inclusions visible as white specks in Ci fabrics from Ur and Abu Salabikh. Abundant fine vegetable material and abundant fine magnetite, visible as black specks in fracture of Ci fabrics from Abu Salabikh and Kish and sparse argillaceous fragments in Ci fabrics from Kish (Fig. 8.94, Sample no. 2667).

Cii (Kish only) Brick red core indistinguishable from surfaces. Black paint applied over cream-slipped external surface. Soft, smooth texture. Fairly smooth fracture. Sparse fine limestone/calcite inclusions visible as fine white specks in fracture. Sparse fine vegetable material. Inclusions of mica. (Table 8.4, Sample no. 2606; Fig. 8.93, Sample no. 2086; Fig 8.94, Sample no. 1935).

Cii (Kish fabric Ciii) Red-orange core indistinguishable from surfaces. Thick cream slip applied to external surface of Cii fabrics from Ur. This fabric includes some of the painted wares from Abu Salabikh and Kish (Table 8.4, Sample no. 2379 and Sample no. 2777). Sparse fine sand. Sparse fine magnetite visible as black specks in fracture. Sparse fine limestone/calcite inclusions, sparse coarse

limestone and red argillaceous fragments in Cii fabrics from Ur. Sparse fine vegetable material (Fig. 8.94, Sample no. 0380).

Ciii (excluding Kish). Colour ranges from yellow-buff core indistinguishable from surfaces to yellow-buff core with wide pink-buff margins. Cream-slipped external surface. Hard, smooth texture. Rough fracture. Sparse coarse limestone inclusions in fabrics from Ur. Sparse coarse vegetable material.

Civ (Ur only). Buff yellow core indistinguishable from surfaces. Chaff tempered cream slip applied to external surface. Soft, smooth 'chalky' texture. Fairly smooth fracture. Sparse fine magnetite and fine vegetable material. Sparse coarse sand temper.

Petrology

Fine wares from Ur contain very few accessory minerals (Table 8.5, columns 11 - 15) The fine wares from other sites also contain fewer accessory minerals than the coarser fabrics in the assemblages. In most cases fine wares are characterised by a fine clay matrix with sparse fine quartz grains. Even such fine grains, however, are absent from the majority of these wares from Ur.

Shell-tempered wares (Group D)

Description

Shell-tempered wares form a comparatively small proportion of the fabrics from Ur, Abu Salabikh and Kish and have only been recorded at three other sites: Tell al'Ubaid, Jamdat Nasr and Tell al Rubeidheh.

Di (Ur and Abu Salabikh only) Colours range from pink-orange to pink-buff indistinguishable from surfaces. Hard, smooth texture. Smooth fracture. Sparse whole shell

inclusions and coarse fragments of shell causing spalling of the surface. Moderate medium coarse vegetable temper. Sparse coarse limestone inclusions in Di fabrics from Ur (Table 8.4, Sample no. 0398; Fig 8.94, Sample nos. 0398 and 2053).

Dii (Ur and Abu Salabikh, West Mound only). Colours range from pink-cream to pale green-pink tinged core indistinguishable from surfaces. Thick cream slip applied to external surface. Hard, smooth texture. Smooth fracture. Abundant fine shell fragments and abundant medium/fine vegetable material. Sparse coarse limestone inclusions in Dii fabrics from Ur (Fig. 8.94, Sample no. 1759).

Dii (Abu Salabikh, Main Mound and Diii fabrics from Abu Salabikh, West Mound). Red-brown core indistinguishable from surfaces. Hard rough texture. Fairly rough fracture. Abundant to moderate fine sand and sparse medium sand. Abundant fine shell temper. Moderate magnetite visible as black specks in fracture.

Dii (Kish and Diii fabrics from Ur). Red core with cream wash applied to external surface. Hard harsh texture. Rough fracture. Abundant fine sand and sparse medium sand. Abundant fine shell temper. Moderate medium/coarse vegetable temper and sparse coarse fragments of sandstone. Abundant mica (Table 8.5, thin sections 102 and 174; Fig. 8.94, Sample nos. 2781 and 0012).

Diii (Abu Salabikh, Main Mound and Di fabrics from Kish and Jamdat Nasr) Pink-buff core indistinguishable from surfaces. Cream-slipped external surface. Hard, fairly smooth texture. Fairly smooth fracture. Sparse medium/fine sand. Abundant magnetite visible as fine black specks in fracture. Moderate to sparse fine vegetable material. (Table 8.5, thin sections 424 and 092).

Diii (Kish only) Grey core with wide yellow-buff margins. Traces of red paint applied to external surface. Hard, harsh texture. Rough, hackly fracture. Abundant fine magnetite and fine mica. Moderate fine sand. Abundant medium/coarse and coarse vegetable temper (Table 8.4, Sample no. 2715 and Table 8.5, thin section 098; Fig. 8.94, Sample no. 2715).

Div (Ur and Tell al Ubaid). Pink-orange core indistinguishable from surfaces. Fairly hard, rough texture. Fairly rough fracture. Sparse medium and coarse sand. Abundant shell fragments. Sparse coarse limestone inclusions. Moderate carbonised organic material possibly carbonised bone (Table 8.5, thin sections 164 and 209).

Petrology

Although the shell-tempered wares as a group are characterised by the inclusion of shell fragments in the fabrics, there are major differences between shell-tempered wares from different sites. Some of the whole shells and large shell fragments in Di and Dii fabrics are probably naturally occuring inclusions and it is difficult to distinguish between shell-tempered fabrics and clay with shell inclusions.

Di and Dii fabrics are similar at both Ur and Abu Salabikh, and it is noticeable that Dii fabrics are restricted to late Uruk/ED I pottery types at both sites. Petrographic analysis indicates the absence of fine and even very fine sand in these fabrics.

Dii, Main mound (Diii, West Mound) fabrics from Abu Salabikh contain abundant crushed shell fragments which appear to be added as a deliberate tempering agent. Whilst crushed shell fragments are not exclusive to Group D fabrics (e.g. Table 8.5, thin sections 096, 125 and 178) they do not constitute a primary tempering agent.

The visual similarity between Di fabrics from Kish/Jamdat Nasr and Diii fabrics from Abu Salabikh is borne out in petrographic analyses. The absence of mica, a characteristic constituent of Kish fabrics in particular, supports the assumption that Di fabrics are imported Diii fabrics from Abu Salabikh (Table 8.5, thin sections 092, 157 and 315). Conversely the micaceous Diii fabrics from Ur probably represent Dii fabrics imported from Kish.

Medium sandy wares (Group E)

Description

Medium sandy wares are most common amongst pottery types of ED I - ED II date and have been recorded at twelve sites, including Umm an Nar. Although visually similar to the fine sandy wares (Group A) these vessels have a coarser texture.

Ei Colour ranges from pink-yellow core with buff external margins to red-brown core with red external and internal surfaces (Kish fabrics). Very hard, rough texture. Rough fracture. Moderate fine sand and sparse medium sand in Ei fabrics from Abu Salabikh and Ur. Abundant fine sand and sparse medium/coarse sand in Ei fabrics from Kish. Abundant to moderate limestone visible as fine white specks in fracture. Sparse coarse calcite inclusions in Ei fabrics from Ur. Abundant fine vegetable material in Ei fabrics from Ur and Abu Salabikh and sparse medium vegetable material in Ei fabrics from Ur. Traces of mica in Ur and Abu Salabikh fabrics. Abundant mica in kish fabrics.

Eii (Abu Salabikh and Kish) Pink-red core indistinguishable from surfaces. Hard, rough texture. Rough laminated fracture. Fine sand ranging from abundant (Kish fabrics) to moderate and sparse medium sand (Abu Salabikh Eii fabrics). Abundant fine limestone/calcite visible as dense scatter of fine white specks in fracture. Sparse pink/red argillaceous fragments. Sparse fine shell fragments. Moderate medium chaff temper (Fig. 8.94, Sample no. 2803).

Eii (Ur and Eiii fabrics from Kish) Core ranges from pink-buff (Ei fabrics from Ur) to pink-red indistinguishable from surfaces. Self-slipped external surfaces. Hard, fairly rough texture. Rough fracture. Abundant to moderate fine sand and sparse medium/coarse sand. Abundant fine shell fragments and sparse red argillaceous fragments.

Abundant fine vegetable material and moderate medium chaff temper in Eii fabrics from Ur. Sparse fine vegetable material in Eiii fabrics from Kish. Magnetite and calcite inclusions in fabrics from both sites. Abundant mica in Eiii fabrics from Kish (Table 8.5, thin sections 059 and 157).

Eiii (Abu Salabikh, West Mound only). Grey core with wide green-yellow margins. Cream slip applied to external surface. Hard, fairly smooth texture. Rough fracture. Moderate fine sand and sparse medium/coarse sand. Abundant argillaceous fragments in some sherds (Table 8.5, thin section 446). Abundant medium straw/chaff temper.

Eiii (Ur only). Red-brown core indistiguishable from surfaces. Soft, flaking surfaces and hackly fracture. Sparse sand ranging from fine to coarse. Sparse red argillaceous fragments and sparse coarse limestone inclusions. Abundant medium straw/chaff temper (No thin sections).

Eiv (Kish only) Similar to Kish fabric Eii but with abundant coarse straw and chaff temper and abundant medium sand, possibly added as temper. (Ring base of Sample no. 2722, Table 8.4).

Petrology

The difference between the fine sandy wares and the medium sandy wares is apparent from the classification of quartz grain sizes in the respective fabric types (Table 8.5, columns 4 - 7). Whilst coarse quartz grains are almost always present, albeit sparse, in medium sandy wares the quartz grain size for fine sandy wares does not exceed the medium sand size category. (Table 8.5, thin sections 001 and 008 compared with thin sections 003, 004 and 010).

Although the density of medium sandy wares is readily determined from a visual examination of the fabrics, one important difference apparent only in thin section is the presence of sparry calcite in many group E fabrics, in addition to which foraminifera occur in thin sections 394 and 396. Whilst neither the sparry calcite

nor the foraminifera are exclusive to Group E from Abu Salabikh they occur less frequently in other fabric types. It is possible, therefore, to suggest that where sparry calcite and/or foraminifera occur in other fabrics at Abu Salabikh the clay used to produce such wares has been mixed with the clay used in Group E fabrics. Unfortunately, there is insufficient evidence to test this theory in the pottery assemblages of Ur and Kish.

Another result from a petrographic analysis of the medium sandy wares is the presence of medium sand-size limestone, siltstone, sandstone and chert in a single Eii fabric from Kish (Table 8.5, thin section 058). Apart from the coarse red wares from Abu Salabikh (Group M) (Table 8.5, thin sections 479, 492 and 493) this is the only example of its kind and the only fabric from Kish apparently tempered with sedimentary rock fragments. It is therefore assumed to be an imported ware.

Shelly-wares (Group F: Abu Salabikh and Ur)

Description

These wares have been found in pottery samples from Ur, Abu Salabikh, Tell al Rubeidheh and there is one example from Umm an Nar (Table 8.4, Sample no. 2892). They are characterised by the presence of fine shell, coarse argillaceous fragments and vegetable temper.

Fi (Abu Salabikh, West Mound only) Grey-brown core with orange-buff margins. Red paint applied to external surface. Hard, smooth surface texture. Rough fracture. Abundant fine and sparse coarse limestone/calcite inclusions. Moderate fine shell fragments sparse coarse argillaceous fragments (Table 8.5, thin section 523; Fig 8.93, Sample no. 2548; Fig. 8.94 Sample no. 2648).

Fi (Ur only) Pink-buff core with pink-orange external margins. Cream-slipped external and internal surfaces. Surface texture fairly hard and smooth. Fairly smooth fracture. Abundant crushed shell fragments. Moderate

medium/coarse argillaceous fragments and sparse coarse vegetable material (Table 8.5, thin section 310).

Fii (Ur only) Pink-buff core with cream-slipped external and internal surfaces. Surface texture fairly hard and smooth. Fairly smooth fracture. Abundant crushed shell fragments. Sparse coarse argillaceous fragments. Abundant medium/fine vegetable material (Table 8.5, thin section 311).

Petrology

Despite the rarity of this fabric petrographic analysis has revealed nothing to suggest a non-local origin for the wares from either of these two sites. Microscopic examination of the samples from Ur indicates that both examples have a fine clay matrix. This, coupled with the absence of any mineral inclusions, suggests that the clay is probably local to Ur.

Grog-tempered wares (Group F: Kish only)

Fi Hand-made with grey core and buff margins. Hard, harsh, 'crumbly' texture. Rough fracture. Moderate medium sand. Sparse whole shell inclusions. Sparse coarse limestone inclusions. Sparse fine vegetable material. Abundant grog temper. Abundant mica. (Table 8.5, thin section 106).

Fii Colour ranges from buff-orange to grey-buff core with narrow pink external margin. Cream-slipped external surface. Hard, harsh texture. Rough fracture. Moderate fine sand and sparse medium sand. Abundant fine limestone/calcite visible as white specks in fracture. Sparse coarse grog temper. Sparse fine shell fragments. Sparse fine and coarse vegetable material. Micaceous (Table 8.5, thin section 103).

Petrology

The Kish grog-tempered wares appear to be unique amongst third millennium Mesopotamian pottery and since only two examples have been found it is possible that they represent the product of an individual potter, a suggestion which is reinforced by the fact that no. 2648 (Table 8.4) is a sherd from a hand-made, hole-mouthed cooking pot (Fig. 8.70, Sample no. 2648).

Coarse sandy wares (Group G)

Description

Coarse sandy wares occur in pottery from Ur, Abu Salabikh, Kheit Qasim and Halawa. In addition, coarse sandy wares are also represented in the Mesopotamian pottery from Umm an Nar.

Gi (Gii fabrics from Ur) Colours range from red to buff-pink core indistinguishable from surfaces. Cream slip frequently applied to external surface. Hard, harsh texture. Rough fracture. Argillaceous fragments in Ur fabrics. Abundant to moderate fine sand and sparse coarse and very coarse rounded quartz grains. Fabrics from Abu Salabikh are characterised by abundant magnetite visible as black specks in fracture (Table 8.5, thin sections 304 and 488; Fig. 8.93, Sample no. 2012).

Gii (Gi fabrics from Ur) Colours range from pink-orange to yellow-buff core indistinguishable from surfaces. External surfaces frequently cream-slipped. Hard, fairly rough texture. Fairly rough fracture. Moderate to sparse fine sand with sparse medium or coarse rounded quartz grains. Sparse coarse inclusions of calcite visible in fabrics from Abu Salabikh (Table 8.5, thin sections 303 and 545).

Giii (Sakheri Sughir, Tell al 'Ubaid and Abu Salabikh) Colours range from red-brown to grey-green (Tell al 'Ubaid)

core indistinguishable from surfaces. Very hard, harsh texture. Rough fracture. Moderate fine sand with abundant medium sand in Giii fabrics from Tell al 'Ubaid. Sparse very coarse rounded quartz grains in all fabrics. Moderate medium-fine vegetable material and sparse argillaceous fragments in Giii fabrics from Abu Salabikh. (Table 8.5, thin sections 191, 210 and 426; Fig. 8.94, Sample no. 0473).

Petrology

Coarse sandy wares are not represented in the pottery from Kish and the quantity of coarse sandy ware from Ur, Tell al 'Ubaid and Abu Salabikh is small. The inclusion of coarse and very coarse rounded quartz grains which are characteristic of this type suggests deliberate tempering with perhaps 'wind-blown sand'. The sparse nature of the quartz grains, however, precludes the use of the term 'temper' in describing the coarse sandy wares. The possibility of all wares being manufactured at one site has been excluded since petrographic analysis does not indicate a single clay source. On the basis of a petrological examination the coarse sandy wares from Umm an Nar appear to correlate most closely with coarse sandy wares from Abu Salabikh, rather than with coarse sandy wares from the more southern site of Ur.

Grey wares (Group H)

Description

Grey wares have been found at all three major sites: Ur, Abu Salabikh and Kish and tempering materials similar to Fabrics Hvi and Hvii have been found in fabrics from Tell al Rubeidheh. The majority of the grey wares, however, come from the West Mound at Abu Salabikh and are primarily restricted to middle to late Uruk contexts. Only two sherds of the grey ware were found in pottery fabrics from Ur, Sample no. 0308 (Fabric Hi) and Sample no. 0307 (Fabric Ii) (Table 8.4) and both examples came from pottery sherds of Late Uruk date which formed part of the limited collection of early material from Ur.

With the exception of Fabric Hi the grey wares from Kish are fine wares and appear to be of a much later date (possibly even Akkadian).

Hi (Abu Salabikh and Ur) Pale grey core indistinguishable from surfaces. Hard, smooth texture Fairly rough fracture. Abundant fine sand in Hi fabrics from Ur. Sparse medium sand. Hi from Ur also contains sparse coarse rounded quartz grains. Abundant magnetite in Hi fabrics from Abu Salabikh compared with a single large inclusion in the Hi fabric from Ur. Both fabrics contain sparse vegetable material and abundant to moderate calcite inclusions visible as fine white specks in fracture (Table 8.5, thin sections 305, 306 and 553; Fig. 8.94, Sample nos. 2018 and 2605).

Hii (Abu Salabikh, West Mound only) Pale grey core indistinguishable from surfaces. Fairly hard, smooth texture. Fairly rough fracture. Moderate fine shell fragments. Abundant magnetite visible as fine black specks in fracture. Sparse fine vegetable material (Table 8.5, thin sections 534 and 535).

Hiii (Abu Salabikh, West Mound and Hi fabrics from Kish) Grey core indistinguishable from surfaces. Fairly hard, harsh texture. Rough, laminated fracture. Abundant fine sand and sparse medium and coarse rounded quartz grains. Sparse coarse fragments of siltstone and sandstone. Abundant fine vegetable material. Abundant mica in Hi fabrics from Kish (Table 8.5, thin sections 099, and 536 - 541; Fig. 8.93 nos. 2013 and 2194).

Hii (Kish only) Dark grey core indistinguishable from surfaces. External surface is grey-burnished. Hard, smooth texture. Fairly smooth fracture. Abundant mica, some large inclusions. Sparse fine sand and sparse very coarse sand (Table 8.5, thin section 057). The foot/ring-base of this pot is added and is of a similar fabric with abundant medium/coarse vegetable temper (Table 8.4; Sample no. 2605).

Hiii (Kish only) Grey core indistinguishable from surfaces. Self-slipped burnished external surface. Hard, smooth texture. Fairly smooth fracture. Sparse fine sand. Abundant calcite visible a fine, white specks in fracture. Sparse coarse fragments of vegetable material; straw and chaff. Moderate mica (Table 8.5, thin section 071; Fig. 8.94, Sample no. 2717).

Hiv (Kish only) Pale grey core indistinguishable from surfaces. Grey burnished external surface. Hard, smooth texture. Smooth fracture. Sparse fine vegetable material. Sparse fragments of grog temper. Sparse mica dusting (Table 8.5, thin section 070).

Hiv (Abu Salabikh, West mound only) Grey core, indistinguishable from surfaces. Hard, rough texture. Rough, hackly fracture. Sparse medium sand. Moderate coarse sand temper. Abundant coarse fragments of sandstone and siltstone. Sparse fragments of grog temper (Table 8.5, thin section 542).

Hv (Abu Salabikh, West Mound only) Grey core indistinguishable from surfaces. Hard, fairly rough texture. Rough, hackly fracture. Abundant medium sand temper. Sparse coarse rounded quartz grains and sparse coarse fragments of sandstone and calcite inclusions. Abundant coarse fragments of siltstone (Table 8.5, thin section 543).

Hvi (Abu Salabikh, West Mound) Grey core indistinguishable from surfaces. Thick cream slip applied to external surface (Fig 8.93, Sample no. 1956). Hard, harsh texture. Rough, hackly fracture. Moderate medium sand and sparse coarse rounded quartz grains (Sparse very coarse quartz grains in fabric Hvi from Tell al Rubeidheh). Abundant coarse and very coarse fragments of siltstone (Fabric Hvi from Tell al Rubeidheh also contains abundant coarse fragments of mudstone, chert and calcite) (Table 8.5, thin sections 544 and 615; Fig. 8.93, Sample no. 1956).

Hvii (Abu Salabikh, West Mound) Grey core indistinguishable from surfaces. Hard, harsh texture. Rough, hackly fracture. Abundant fine sand and abundant coarse sand temper (Tell al Rubeidheh Fabric Hvii also contains abundant medium sand temper). Sparse coarse fragments of siltstone and calcite. (Abundant coarse fragments of siltstone, calcite and shale used as temper in Hvii fabrics from Tell al Rubeidheh). Abundant fine vegetable material (Table 8.5, thin sections 545 and 616; Fig. 8.94, Sample no. 2309).

Hviii (Abu Salabikh, West mound only) Grey core indistinguishable from surfaces. Hard, harsh texture. Rough, hackly fracture. Sparse fine sand. Moderate medium and coarse sand temper and sparse very coarse sand temper. Sparse coarse fragments of siltstone. Moderate fine vegetable material. (Table 8.5, thin section 546; Fig. 8.93, Sample no. 1946).

Hix (Abu Salabikh, West Mound and Ur Fabric Ii) Colour ranges from grey to grey-brown core indistinguishable from surfaces. Hard, harsh texture. Rough, hackly fracture. Sparse fine sand. Sparse coarse and moderate very coarse sand temper (rounded quartz grains). Sparse coarse fragments of siltstone in Fabric Hix from Abu Salabikh. Sparse medium/fine vegetable material in some sherds. (Table 8.5, thin sections 490, 491, 547, 549, 556 and 557). Sparse coarse and abundant fine shell fragments in Fabric Ii from Ur (Table 8.5, thin section 307; Fig. 8.93, Sample no. 1954).

Hx (Abu Salabikh, West Mound only) Grey core indistinguishable from surfaces. Hard, harsh texture. Rough, hackly fracture. Moderate fine sand, sparse medium sand and moderate coarse, sparse very coarse sand temper (angular quartz grains). Abundant fine/very fine vegetable material (Table 8.5, thin section 548; Fig. 8.94, Sample no. 1964).

Hxi (Abu Salabikh, West Mound only) Grey core with narrow buff-brown margins. Hard, harsh texture. Rough, hackly fracture. Abundant fine sand and moderate coarse sand temper (rounded quartz grains). Sparse medium fragments of siltstone. Sparse medium vegetable material (Table 8.5, thin section 550; Fig. 8.93, Sample no. 2172).

Hxii (Abu Salabikh, West mound only) Pale grey core indistinguishable from surfaces. Hard, harsh texture. Rough, hackly fracture. Sparse fine sand. Moderate medium and sparse coarse sand temper. Abundant coarse and very coarse fragments of siltstone sparse coarse fragments of sandstone. Abundant medium/fine vegetable temper (straw and chaff (Table 8.5, thin section 551; Fig. 8.93, Sample no. 1938).

Hxiii (Abu Salabikh, West Mound only) Grey core indistinguishable from surfaces. Hard, fairly smooth texture. Rough, hackly fracture. Sparse fine sand. Moderate medium and sparse coarse sand temper. Moderate medium to very coarse fragments of siltstone and sandstone. Sparse coarse inclusions of limestone/calcite. Sparse very coarse red argillaceous inclusions. Sparse fine vegetable material. (Table 8.5, thin section 552).

Petrology

Apart from the fine grey wares from Kish which are later than the coarser fabrics from Abu Salabikh and probably belong to the Akkadian period, all the samples of grey ware which were thin sectioned are tempered with coarse sandstone, siltstone, occasionally limestone and coarse sand temper. The source of such tempering materials is difficult to isolate (Section 3.4) With the exception of Fabrics Hv, Hvi, Hxii and Hxiii, however, a foreign origin for these wares is not suspected. Fine sandstone, siltstone and limestone inclusions occur naturally in almost all the sandy wares (Group A and E) from Abu Salabikh and it can be inferred from the characteristically rounded inclusions of sedimentary rocks added as temper that they are from a relatively local source. Since the inclusions are rounded it is probable that such fabrics were

manufactured by the mixing of different sedimentary clays with the addition of sand in the form of coarse rounded quartz grains. The presence of mica and at least one other accessory mineral, for example pyroxene or epidote, reinforces the supposition that the majority of grey wares are local. The absence of any accessory minerals in Fabrics Hv, Hvi, Hxii and Hxiii (Table 8.5, thin sections 543, 544, 551 and 552), however, implies a non-local origin. The presence of mudstone in Fabric Hv, of dolomite in Fabric Hvi, and of coarse igneous rock fragments in Fabric Hxii is also consistent with the identification of these vessels as imports. Fabric Hxiii is more difficult to categorise. The absence of ferruginous material makes it unlikely that a local clay was used in the manufacture of this fabric, despite the presence of muscovite.

In view of the lack of specific geological information it is not possible to identify sources for the clays used in these wares.

Fine (levigated) wares (Group I)

Description

Fine (levigated) wares occur among the pottery from Kish and from the West Mound at Abu Salabikh. This ware is characterised by the very fine paste from which pots are made but although the fabrics from Kish and Abu Salabikh are similar, their respective pottery types have very little in common. Fine (levigated) wares are represented only among the pottery from the West Mound and in late Uruk contexts at Abu Salabikh. Fabric Ii is almost solely restricted to vertical sided bowls. (Table 8.4, Sample nos. 1810, 1811 and 1816). By contrast only three pots from Kish have been identified as fine (levigated) wares: a painted bowl, a spouted jar and an upright handled jar. (Table 8.4, Sample nos. 2607, 2674 and 2729) all of which have been assigned an ED III date.

Ii Colours range from pale green (Abu Salabikh) to pale green core with broad pale yellow external margin (Kish). Self-slipped external surface. Red paint applied on Sample no. 2607. Fairly soft, very smooth texture. Smooth fracture. Fine sand absent or sparse. Very fine vegetable

material in fabrics from Abu Salabikh. No other visible inclusions (Table 8.5, thin sections 073, 074 and 485).

Iii Green-yellow core indistinguishable from surfaces. Cream slip applied to external surface. Hard, fairly smooth texture. Fairly smooth fracture. No visible inclusions in Fabric Iii from Abu Salabikh. Moderate fine vegetable material and very sparse coarse rounded quartz grains in Fabric Iii from Kish (Table 8.5, thin sections 091 and 558).

Petrology

Apart from sparse fine fragments of shell in all the fine (levigated) wares from Kish and foraminifera in thin section 558 (Table 8.5) from Abu Salabikh, petrographic analyses revealed little more than sparse fine-grained igneous rock fragments in all fabrics. Ferruginous material, fine siltstone and sandstone fragments occur in fabrics from Abu Salabikh. Since these wares are so fine, petrographic analysis is not suited to the identification of a provenance for these samples.

Medium sand-tempered buff wares (Group J)

Description

Medium sand-tempered buff wares are from ED II contexts or earlier and the majority of these wares occur during the period from late Uruk to late ED I (See Table 8.4, Sample nos. 0229, 0304 and 0378 from Ur and Sample nos. 0931, 0968 and 1050 from Abu Salabikh).

Much of the early material included in the pottery corpus is from Abu Salabikh and to a lesser extent Ur. It is from these two sites and the site of Tell Sakheri Sughir that medium sand-tempered buff wares have been recognised.

Medium sand-tempered buff wares are present in the pottery assemblages from both Area E and the West Mound at Abu Salabikh. However, they are restricted to the ED I and ED II levels of Area E with the single exception of 0932 (Table 8.4) which is from an ED III context.

Ji (Abu Salabikh and Ur) colour ranges from yellow-buff core with cream-slipped external surface (Abu Salabikh) to a pink-buff fabric with cream-slipped external surface (Ur) Hard, harsh texture. Rough fracture. Sparse find sand and sparse coarse sand (rounded quartz grains) in Ji fabrics from Abu Salabikh. Sparse medium sand with moderate very coarse/coarse sand temper (rounded quartz grains) in fabrics from Ur. Abundant magnetite visible as black specks in fracture in Abu Salabikh fabrics only (Table 8.5, thin sections 308 and 533).

Jii (Abu Salabikh, Ur and Tell Sakheri Sughir) colour ranges from pale green-buff core occasionally with grey external and internal surfaces (Abu Salabikh) to yellow core indistinguishable from surfaces (Ur). Hard, harsh texture. Rough, hackly fracture. Sparse find sand in Jii fabrics from Abu Salabikh and abundant medium/fine sand in Jii fabrics from Tell Sakheri Sughir. Moderate very coarse/coarse sand temper (rounded quartz grains) in fabrics from all three sites (Table 8.5, thin sections 178, 193 - 195 and 532; Fig. 8.93, Sample no. 2183; Fig. 8.94, Sample no. 0229).

Jiii (ABu Salabikh, West Mound only) Yellow core with pale green margins. Hard, harsh texture, Rough, hackly fracture. Abundant fine sand with sparse coarse and very coarse rounded quartz grains. Sparse fine vegetable material. Abundant magnetite visible as black specks in fracture (Table 8.5, thin section 525).

Jiv (Abu Salabikh, West Mound : spouts only) Mottled yellow-green core with yellow external and internal surfaces. Hard, fairly smooth (sandy) texture. Rough fracture. Abundant medium sand temper. Abundant fine vegetable material. Sparse mica. (No thin sections).

Petrology

Although this fabric group is tempered with very coarse/coarse sand temper, with the exception of Fabric Jii from Tell Sakheri Sughir, very few additional inclusions are observed in thin section. Shell fragments are common to all fabrics with the exception of Thin section 308 (Fabric Ji) which contains foraminifera. Traces of pyroxene together with sparse very fine calcite are common to fabrics from both sites and the fine clay matrix of these fabrics precludes any attempt to determine an absolute provenance. It is assumed that the vessels are local to each site since the fabrics from Abu Salabikh are more micaceous and usually contain more fine sand than the fabrics from Ur.

Coarse sand-tempered buff wares (Group K)

Description

Coarse sand-tempered buff wares appear to be local to Ur and Sakheri Sughir. Two sherds from the West Mound at Abu Salabikh have been designated coarse sand-tempered buff wares but the tempering materials are actually sedimentary rock fragments.

Ki (Abu Salabikh, West Mound Only) Buff core indistinguishable from surfaces. Hard, harsh texture. Rough, hackly fracture. Moderate very coarse fragments of siltstone and sparry calcite (Table 8.5, thin section 489).

Ki (Ur only) Yellow-buff core indistinguishable from surfaces. Hard, rough texture. Rough fracture. Sparse fine sand and moderate very coarse/coarse sand temper (rounded quartz grains). Sparse fine vegetable material. No other visible inclusions (Table 8.5, thin section 309; Fig. 8.94, Sample no. 0306).

Kii (Ur and Tell Sakheri Sughir) Buff-pink core with cream and external surfaces. Hard, harsh texture. Rough fracture. Moderate medium/fine sand with moderate very

coarse/coarse sand temper (rounded quartz grains) Moderate magnetite visible as fine black specks in fracture. Sparse fine vegetable material (Table 8.5, thin section 192).

Petrology

Coarse sand-tempered buff wares from all three sites, are readily distinguished both visually and in thin section. The coarse fragments of siltstone temper and sparry calcite are confined to Ki fabrics from Abu Salabikh and coarse rounded quartz grains occur in only Ki and Kii fabrics from Ur and Tell Sakheri Sughir. Petrographic analysis of Fabric Kii from Tell Sakheri Sughir indicates the presence of muscovite, biotite, pyroxene and epidote. This contrasts with pyroxene and epidote in Fabric Ki from Ur and only traces of epidote in Fabric Ki from Abu Salabikh. The comparative rarity of mineral inclusions in Fi fabrics from Ur and Abu Salabikh may be explained by the very fine, possibly sieved, clay which has been used in the manufacture of these wares.

Fine red wares (Group L)

Description

The occurrence of fine red wares is confined to Abu Salabikh. With the exception of Liv they span the period from ED I to ED III and are found on the Main Mound and the West Mound at Abu Salabikh but as a group the fine red wares form a relatively small proportion of the Abu Salabikh pottery assemblage. Fabric Lii frequently occurs in pots from grave groups and it is suspected that this is a funary ware. The walls are often thin and fragile and this fabric is particularly susceptible to post deposition conditions.

Li (Abu Salabikh, Area E and the West Mound) Red-brown core indistinguishable from surfaces. Hard, fairly smooth texture. Fairly smooth fracture. Sparse fine sand. Moderate fine limestone/calcite visible as white specks in fracture. Abundant magnetite visible as black specks in fracture. No other visible inclusions. (Table 8.5, thin section 466)

Lii (Abu Salabikh, Area E and the West Mound). Dark red core indistinguishable from surfaces. Hard, rough texture with flaking surfaces. Rough, hackly fracture. Sparse fine sand. Abundant fine limestone/calcite visible as a dense scatter of white specks in fracture. Sparse magnetite visible as fine black specks in fracture. No other visible inclusions. (Table 8.5, thin section 474)

Liii (Abu Salabikh, Area E and the West Mound) Red core indistinguishable from surfaces. Hard, smooth texture. Smooth fracture. Sparse vegetable material. No other visible inclusions. (Table 8.5, thin section 487).

Liv (Abu Salabikh, West Mound only) Red core indistinguishable from surfaces. Pink-slipped external surface. Hard, very smooth texture. Smooth fracture. Moderate fine sand. No other visible inclusions in fabric although the slip is tempered with medium coarse fragments of vegetable material (Table 8.5, thin section 448)

Petrology

Petrographic analyses show that with the exception of Thin sections 342 and 348 (Table 8.5) the majority of fine red wares are probably local to Abu Salabikh with traces of mica, pyroxene and epidote in almost all fabrics. Fabric Liv, however, contains fewer mineral inclusions since the clay matrix is very fine. Apart from sparse inclusions of biotite and pyroxene it contains only sparse argillaceous fragments and fine inclusions of sparry calcite.

Abundant sandstone inclusions are visible in thin section in Fabric Li, sample 1156 (Table 8.5, thin section 466). Although this is not a common feature of Abu Salabikh fabrics (apart from the sandstone temper present in grey wares and some coarse red wares) sparse fine sandstone inclusions occur in many of the local fabrics. The presence of mica, pyroxene and epidote suggests a relatively local source for this clay.

Coarse red wares (Group M)

Description

A possible foreign provenance for several of the coarse red wares from Abu Salabikh and the comparative rarity of this fabric type suggests that these wares were used as container pots. Apart from the coarse red wares found at Abu Salabikh these fabrics occur as a middle to late Uruk fabric in the pottery examined from Tell al Rubeidheh.

Mi (Abu Salabikh, Area E and West Mound) Pink-red core with slightly darker margins. Hard, fairly smooth texture. Rough, hackly fracture. Abundant coarse red grog temper and sparse fragments of mudstone. No other visible inclusions (Table 8.5, thin section 476).

Mii (Abu Salabikh, Area E, Area A and West Mound) Dark red core mottled with pale yellow organic material. Hard, rough texture. Rough fracture. Abundant sand temper ranging from medium/fine to abundant very coarse/coarse quartz grains. Sparse red argillaceous fragments and moderate magnetite visible in some fabrics. (Table 8.5, thin sections 427 and 531).

Miii (Abu Salabikh, Area E and West Mound) Dark red core indistinguishable from surfaces. Hard, harsh texture. Rough, hackly fracture. Sparse coarse sand temper and sparse coarse calcite inclusions. Abundant black inclusions visible. Sparse pale yellow organic material. (Table 8.5, thin section 477).

Miv (Abu Salabikh, Area E and West Mound) Pink-orange core with red-orange external margin. Hard, rough texture. Rough fracture. Sparse coarse sand temper. Abundant coarse fragments of sandstone and siltstone. Moderate to sparse fine vegetable material (Table 8.5, thin sections 492 and 493; Fig 8.93, Sample nos. 1934 and 2003; Fig. 8.94, Sample no. 1934).

Mv (Abu Salabikh, Area E and West Mound. See also Fabric Mv, Tell al Rubeidheh). Red-brown core with red external surface. surface. Hard, harsh texture. Rough, hackly fracture. Abundant medium/fine sand. Sparse coarse fragments of siltstone and sandstone. Sparse medium/fine vegetable material. (Table 8.5, thin section 561).

Mvi (Abu Salabikh, Area E only. See also Fabric Mvi Tell al Rubeidheh). Dark grey core with red-brown external surface. Hard, harsh texture. Rough, hackly fracture. Abundant coarse fragments of shelly limestone and siltstone. No other visible inclusions (Table 8.5, thin section 356).

Mvii (Abu Salabikh, West Mound only. See also Fabric Mvii, Tell al Rubeidheh). Red-brown core with dark brown surfaces. Hard, harsh texture. Rough, hackly fracture. Abundant coarse fragments of shelly limestone. Abundant fine vegetable material. Sparse large inclusions of magnetite (Table 8.5, thin section 479; Fig. 8.93, Sample no. 1882).

Mviii (Abu Salabikh, West Mound only. See also Fabric Mviii, Tell al Rubeidheh). Deep pink core with grey external and internal margins. Sparse medium/fine sand. Sparse limestone/calcite visible as fine white specks in fracture. Sparse fine magnetite visible as black specks in fracture. Sparse argillaceous fragments (No thin section).

Petrology

Fabrics Mi,Miii, Mvi and Mvii (thin sections 476,477, 356 and 479) from Abu Salabikh are not manufactured from local clays. Among these imported coarse wares the most striking example is Fabric Miii (Table 8.5, thin section 477). Petrographic analysis shows that the large black inclusions are coarse igneous rock fragments composed of magnetite and weathered olivine with serpertine veining; the product of a micro-sulphorous gabbro (I. Freestone pers. comm.). The only other fabric with similar igneous rock inclusions was found in sample 2778 (Table 8.4) from Kish.

The remaining imported red coarse wares are less distinctive petrologically. Most of these fabrics are isolated by the absence of mineral inclusions common to local wares from Abu Salabikh. The presence of abundant fragments of shelly limestone distinguishes Fabric Mvi (Table 8.5, thin section 356) and this fabric is again devoid of mica and other accessory minerals. Most of the fabrics do not even contain traces of feldspar.

Fabric Mii and Mv are local wares (Table 8.5, thin sections 427, 531 and 561) with inclusions of mica, pyroxene and epidote.

Medium vegetable-tempered wares (BRB fabric) (Group N)

Description

Medium vegetable-tempered wares form a distinctive fabric group common among bevel-rim bowls (BRB) and, to a lesser extent transitional bowls from both Abu Salabikh and Kish. Differences between fabrics in Group N are largely confined to colour and degree of hardness, reflecting variability in the conditions under which the pots were fired.

Ni (Kish fabric Gi) Pink-buff core indistinguishable from surfaces. Cream-slipped external surface with sparse coarse chaff temper. Fairly soft, smooth texture. Fairly rough fracture. Sparse fine sand. Sparse medium/fine vegetable material and moderate medium/coarse vegetable temper. Mica visible in Fabric Gi from Kish (Table 8.5, thin section 097).

Nii (Kish fabric Gii) Colour ranges from green-buff (Kish) to buff core indistinguishable from surfaces. External surface cream-slipped with fragments of chaff temper in the slip. Fairly hard, harsh texture. Rough fracture. Sparse fine sand. Moderate medium/coarse sand temper in Abu Salabikh Fabric Nii only. Abundant medium vegetable temper. Sparse limestone/calcite inclusions (Table 8.5, thin section 096).

Niii (Abu Salabikh only) Red-orange core indistinguishable from surfaces. External and internal surfaces self-slipped. Hard, fairly harsh texture. Rough fracture. Abundant fine sand. Moderate medium/coarse vegetable temper. Abundant magnetite visible as black specks in fracture.

Niv (Abu Salabikh only) Pale grey core with pink-red margins. Hard, fairly smooth texture. fairly smooth fracture. Sparse fine sand. Moderate medium/fine vegetable temper with some carbonised fragments.

Nv (Abu Salabikh only) Green core indistinguishable from surfaces. Very hard, harsh and brittle texture. Rough fracture. Voids left by moderate medium/coarse vegetable temper. Moderate magnetite visible as fine black specks in fracture.

Nvi (Abu Salabikh only) Grey core with pale grey-buff surfaces. Hard, fairly smooth texture. Rough fracture. Abundant moderate carbonised vegetable material in the form of coarse inclusions of straw and chaff. No other visible inclusions.

Nvii (Abu Salabikh only) Buff core indistinguishable from surfaces. External surfaces pink-slipped. Hard, smooth texture. Fairly smooth fracture. Moderate, medium vegetable temper. Sparse limestone/calcite inclusions.

Petrology

Apart from minor variations attributable to local clays from Abu Salabikh the medium vegetable tempered fabrics are consistent as a group. Fabric Gi from Kish (Table 8.5, thin section 097) is characterised by the presence of large inclusions of biotite and glauconite contrasting with fine inclusions of muscovite and biotite in Group N fabrics from Abu Salabikh.

Coarse vegetable-tempered wares (Group P)

Description

Coarse vegetable-tempered wares are not restricted to any particular type of pot. They occur in both large bowls and large jars and also in coarse added ring bases from jars with bodies made from a finer fabric. Examples of coarse vegetable-tempered wares have been found in the pottery assemblages of Ur, Tell al 'Ubaid, Tell Sakheri Sughir, Abu Salabikh and Kish.

Pi (Abu Salabikh and Ur, Fabric Li) Green-buff core indistinguishable from surfaces. Hard, harsh texture. Rough, hackly fracture. Moderate fine sand in Fabric Pi from Abu Salabikh only. Abundant fine shell fragments. Abundant vegetable temper ranging from medium to very coarse fragments of straw and chaff (Table 8.5, thin section 096).

Pii (Abu Salabikh, West Mound and Tell al 'Ubaid, Fabric Lii) Red core indistinguishable from surfaces. Hard, fairly rough texture. Rough fracture. Moderate fine sand and sparse medium/coarse sand. Abundant argillaceous fragments. Abundant vegetable temper ranging from medium to very coarse fragments of straw and chaff.

Piii (Abu Salabikh, West Mound, Kish Fabric Li and Tell Sakheri Sughir, Fabric Kii) Pink-buff core with cream surfaces. Hard, harsh texture. Rough fracture. Abundant magnetite visible as fine black specks in fracture. Moderate fine sand in Fabric Piii from Abu Salabikh and Fabric Li from Kish, compared with moderate coarse/very coarse sand temper in Fabric Kii from Tell Sakheri Sughir. Abundant vegetable temper, ranging from medium to coarse/very coarse fragments of straw and chaff, is common to fabrics from both sites (Table 8.5, thin sections 192 and 506).

Petrology

All three samples of coarse vegetable-tempered ware which have been thin sectioned contain fine shell fragments. The sherds from Abu Salabikh and Kish are similar, with a fine clay matrix and abundant fragments of crushed shell which may have been added as tempering material. There is no evidence to suggest that any of the coarse vegetable-tempered wares are imported.

Very coarse sand- and vegetable-tempered Wares (Group Q)

Description

The pottery made from these fabrics is frequently massive and often coated with bitumen either on the internal or external surface or on both surfaces. The storage bins, jar-hearths (Postgate 1984 pl.8) and bread ovens are likely to have been constructed in situ and sherds from these pots are rarely retained amongst the finds from excavations. Examples of very coarse wares are therefore restricted to the pottery from Abu Salabikh which was examined on site.

Qi (Abu Salabikh, Area E and West Mound) Buff core indistinguishable from surfaces. Very hard, harsh texture. Rough, hackly fracture. Abundant fine sand. Moderate very coarse sand temper. Sparse coarse inclusions of limestone/calcite. Abundant very coarse vegetable temper; straw and chaff. (Table 8.5, thin sections 554 and 555).

Qii (Abu Salabikh, Area E and West Mound) Dark grey core with buff margins. Very hard, harsh texture. Rough hackly fracture. Fabric similar to Qi.

Qiii (Abu Salabikh, Area E and West Mound) Pink-buff core indistinguishable from surfaces. Fabric similar to Qi and Qii but with sparse coarse sand temper.

Qiv (Abu Salabikh, West Mound only) Green core indistinguishable from surfaces. Hard, very harsh, brittle

texture. Rough, hackly fracture. Abundant fine sand and moderate coarse sand temper. Abundant very coarse vegetable material, straw and chaff. Abundant magnetite visible as a dense scatter of fine black inclusions in fracture.

Qv (Abu Salabikh, Area E and West Mound) Grey-green core speckled with abundant orange vegetable material. Very hard, harsh texture. Rough, hackly fracture. Abundant coarse fragments of chert, sandstone, siltstone and limestone. Abundant very coarse sand temper (rounded quartz grains). Abundant coarse vegetable temper.

Petrology

Thin sections were obtained from only two samples of very coarse wares from Abu Salabikh. Both contained mica, pyroxene and epidote consistent with clays local to Abu Salabikh. Qv contained inclusions of sedimentary rock fragments found as tempering material in the grey wares and coarse red wares from Abu Salabikh. The presence of such inclusions in very coarse wares, which owing to their size must have been produced locally, reinforces the assumption that sedimentary rock fragments in other fabrics from Abu Salabikh are derived from a local source.

Other Fabrics

At each of the three principal sites several fabrics could not be assigned to a specific group. In such cases the fabric has been given a separate number and individual discriptions appear below.

Ur

Description

Other: 1 Red-brown core indistinguishable from surfaces. Cream-slipped external surface. Hard, smooth texture. Rough, hackly fracture. Abundant moderate vegetable temper,

in the form of "chopped straw". Sparse inclusions of mica. Similar to Aiii from Ur but less sandy.

Other: 2 Red-brown core indistinguishable from surfaces. Chaff-tempered cream slip applied to external surface. Fairly soft, rough texture. Rough, hackly fracture. Abundant medium/fine sand. Sparse limestone inclusions visible as fine white specks in fracture. Sparse red argillaceous fragments. The presence of complete or near complete shells (gastropods) in the fabric of this vessel is typical of many Ur fabrics (Table 8.5, thin section 177).

Other: 3 Pink core indistinguishable from surfaces. Thick cream-yellow slip applied to external and internal surfaces. Very hard, smooth texture, smooth fracture. Sparse fine sand. Sparse fine vegetable material. No other visible inclusions (Table 8.5, thin section 319).

Other: 4 Pink-orange core with pink margins. Fairly hard, fairly smooth texture. Smooth fracture. Abundant limestone/calcite visible as dense scatter of fine white specks in fracture. No other visible inclusions (Table 8.5, thin section 320).

Other: 5 Pink-buff core indistinguishable from surfaces. Hard, fairly rough texture. Rough fracture. Sparse very coarse sand temper. Sparse magnetite visible as fine black inclusions in fracture. Abundant complete or near complete shells. Sparse coarse vegetable temper. Sparse mica (Table 8.4, Sample no. 0224).

Other: 6 Dark red core indistinguishable from surfaces. Hard, fairly smooth surface texture with occasional spalling caused by limestone inclusions. Sparse shell inclusions. Sparse mica. Sparse fine vegetable material (Table 8.4, Sample no. 0225).

Other: 7 Orange core indistinguishable from surfaces. Hard, harsh texture. Rough fracture. Abundant magnetite visible as fine black specks in fracture. Variable sand temper visible as medium/coarse red, black and transluscent grains. Sparse fine shell fragments. abundant medium/fine vegetable material. Abundant mica. (Table 8.4, Sample no. 0268).

Petrology

With the exception of Other: 7, all fabrics appear to be local to Ur with a fine 'clay' matrix, complete and near complete shell inclusions and abundant vegetable material. The fabric of Sample no. 0268, however, is more akin to Kish Fabric Aviii and is thus probably imported from Kish.

Abu Salabikh

Description

Other: 1 Red-brown core indistinguishable from surfaces. Hard, fairly smooth texture. Smooth fracture. Sparse fine sand. Large brown argillaceous fragments. Sparse fine fragments of chert. Moderate fine limestone/calcite inclusions visible as white specks in fracture. (Table 8.5, thin section 354)

Other: 2 Buff-brown core with wide red external margin and red internal surface. Hard, smooth texture. Very smooth fracture. Sparse fine sand. Sparse fine magnetite visible as black specks in fracture. Sparse fine calcite inclusions visible as fine white specks in fracture. (Table 8.5, thin section 560).

Petrology

Thin section 560 appears to be local with mica, pyroxene and epidote present in thin section. Thin section 354 is unusual since it contains fine fragments of chert and traces of glauconite more common to fabrics from Kish. (see Table 8.5, thin sections 007, 042, 058, 097, 101, 102 and 106).

Kish

Description

Other:1 Grey-green core indistinguishable from surfaces. Hard, harsh texture. Rough fracture. Sparse fine sand. Abundant large black inclusions (igneous rock fragments). Sparse coarse inclusions of calcite (Table 8.5, thin section 095; Fig. 8.94, Sample no. 2778).

Other:2 Red core indistinguishable from surfaces. Hard, fairly smooth texture. Smooth fracture. Sparse medium sand. Sparse coarse fragments of sandstone and limestone/calcite (Table 8.5, thin section 105); Fig 8.94, Sample no. 2773).

Petrology

Neither fabric is local to Kish but sample 2778 (thin section 095) is a particularly distinctive fabric both visually and in thin section. The presence of coarse igneous rock fragments identified in thin section as inclusions of magnetite and weathered olivine with serpentine veining (see also Table 8.5, thin section 477) indicates a gabbro source. (I. Freestone. pers. comm.) Reference to the Geological Map of North Africa (1963) suggests a northern origin, in the area encompassing the northern border of Iraq with Syria. Petrographic analysis of Sample no. 2773 (thin section 105) reveals only sparse inclusions of mica (muscovite and biotite) and inclusions of pyroxene. Sample no. 2773 is more likely to have been produced in the region of Abu Salabikh where fabrics contain less mica and more epidote.

TELL AL RUBEIDHEH : FABRIC CLASSIFICATION

Many of the fabrics from Tell al Rubeidheh are similar to the major fabric groups identified from the pottery assemblages of Ur, Abu Salabikh and Kish (Table 8.3) and more specifically, to pottery from middle to late Uruk contexts. Pottery from the Hamrin Basin however, is generally coarser than its fabric counterpart from the Mesopotamian plain. In common with middle to late Uruk pottery from the South, the pottery from Tell al Rubeidheh exhibits a considerable diversity of fabric types.

Fine sandy wares (Group A)

Description

It is difficult to subdivide vessels within this group. Two broad categories are defined however, Fabric Ai which comprises oxidised wares and the reduced grey wares of Fabric Aii.

Ai Pink-brown to brick red core indistinguishable from external and internal surfaces (Table 8.5, thin section 617) red painted external surface. Hard, smooth texture. Slightly rough, laminated fracture. Sparse medium/fine sand temper visible as fine white specks in fracture. Sparse fragments of siltstone inclusions. Faint sparse mica dusting (Table 8.5, thin section 614).

Aii Grey surfaces indistinguishable from core. Surface texture hard, smooth. Rough, hackly fracture. Moderate coarse/medium sand temper visible as fine white specks in fracture. Sparse medium siltstone and sparse mica dusting (Table 8.5, thin section 606).

Petrology

Unlike fine sandy wares from sites in the Mesopotamian plain these wares frequently contain sparse coarse quartz grains. All fabrics from sites in the Diyala region are considerably more sandy than the equivalent fabrics from the Mesopotamian plain, although the

quartz grains do not seem to have been added as temper. Medium to coarse fragments of siltstone and shale are visible in thin section. One vessel (Sample 2851 (Table 8.4)) is particularly interesting since the fabric is very distinctive and inclusions of epidote, a high proportion of ferruginous material and an abundance of fine rounded quartz grains. This fabric is more akin to the clays of the Mesopotamian plain than those of the Hamrin Basin and is probably a southern import.

Green-buff wares (Group B)

Description

This represents the largest single group of vessels examined. It is difficult to sub-divide fabrics within this group but the following categories may be equated with similar fabric groups from sites in the Mesopotamian plain.

Bi Yellow-green core with cream-yellow external and internal surfaces. Hard, fairly harsh texture. Rough fracture. Abundant medium/fine sand partly visible as fine white specks in fracture. Abundant fine fragments of chert. Only one example in this 'group' (Table 8.5, thin section 610).

Bii Colours range from green-yellow to green-pink core indistinguishable from surfaces. Most of the fabrics are cream-slipped. Surface texture hard, fairly smooth. Rough, hackly fracture. Abundant medium/fine sand temper partly visible as fine white specks in fracture. Abundant fine vegetable material and occasional sparse fine fragments of chert (Table 8.5, thin sections 609 and 612).

Biii Buff core indistinguishable from surfaces. Self-slipped external surface, usually cream. Surface texture hard, fairly smooth. Rough, hackly fracture. Sparse medium/fine sand and sparse very coarse sand temper. Sparse coarse fragments of siltstone and sandstone. Moderate fine vegetable material (Table 8.5, thin section 611).

Biv Pink core with green-yellow margins. (Orange speckled appearance in fracture). Buff external and internal surfaces. Fairly hard, smooth powdery texture. Frequently with smooth powdery slip on external surface. Rough, hackly fracture. Sparse medium/fine sand. Abundant coarse fragments of siltstone and sandstone. Abundant vegetable temper ranging from fine to medium. No other visible inclusions (Table 8.5, thin sections 625 and 626)

Petrology

Although consistent as a group the diversity of fabrics suggests production on a wider local scale from a number of different potteries or workshops. Thin section 609 contains coarse inclusions of magnetite not found in other fabrics in this group and thin section 611 is characterised by the presence of foraminifera. Fragments of chert have been used as a tempering agent in Fabrics Bi and Bii and fragments of sandstone and siltstone temper are found in Fabrics Biii and Bv.

Fine wares (Group C)

Description

This group forms the fine ware of the Tell al Rubeidheh pottery assemblage. Although the degree of sand versus vegetable material varies, the sherds are consistent as a group.

Ci. Buff core indistinguishable from external and internal surfaces. Buff-yellow slip applied to external surface. Moderate to sparse medium/fine sand. Sparse coarse fragments of sandstone. Sparse fine calcereous inclusions. Sparse fine vegetable matter and sparse inclusions of mica (Table 8.5, thin sections 618 and 619).

Cii Yellow orange core. External surfaces brick-red. Orange-pink paint applied over self-slip to external surface. Hard very smooth texture. Very smooth fracture.

Sparse medium/fine sand and sparse fine vegetable matter (Table 8.5, thin section 630).

Ciii Pale green core indistinguishable from surfaces. Cream-yellow slip applied to surfaces. Hard, smooth texture with pitted surfaces. Fairly smooth fracture. Abundant fine sand with sparse coarse sand 'temper'. Fine vegetable matter ranging from abundant to sparse and visible as orange specks in fracture (Table 8.5, thin section 629; Fig 8.94, Sample no. 2863).

Civ Core ranges from pink-brown to pink-orange. Colour variations owing to differential firing conditions are evident within a single vessel. Buff-pink or cream-white slip applied to external surfaces. Hard, smooth texture, Smooth fracture. Sparse very fine sand occasionally visible as fine white specks in fracture. No visible inclusions.

Petrology

It is difficult to isolate diagnostic inclusions in these very fine wares. Although the fabrics are very fine and with the exception of Fabric C appear to contain no tempering material, the clays are probably not levigated but merely finely sieved.

Shell tempered wares (Group D)

Several of the pottery samples from Tell al Rubeidheh contain fragments of shell as natural inclusions in the clay. Shell tempered wares, however, contain abundant, frequently coarse, fragments of crushed shell which give these wares a distinctive rough and irregular (hackly) fracture and a grey/white speckled surface. The fabric is used in the manufacture of bevelled rim bowls and other hand-made bowls and wheel-made jars.

Di Colours range from buff-pink to yellow-pink core indistinguishable from surfaces. External surfaces usually self-slipped. Fairly hard, smooth texture. Fairly rough,

laminated fracture. Sparse medium/fine sand. Moderate fragments of crushed shell. Sparse fine vegetable material (Table 8.5, thin section 621).

Dii Pink-buff core indistinguishable from surfaces. Pink wash applied to external and internal surfaces. Hard, fairly smooth texture. Rough fracture. Medium/fine sand. Sparse coarse fragments of siltstone, chert and calcite. Sparse coarse fragments and abundant fine fragments of crushed shell (Table 8.5, thin section 608).

Diii Pink-buff core indistinguishable from surfaces. External surface cream-slipped. Hard, fairly smooth texture. Rough, hackly fracture. Sparse fine sand. Abundant coarse fragments of crushed shell. Abundant to sparse coarse fragments of siltstone (Table 8.5, thin sections 607, 623 and 624).

Div Grey core with grey-green margins and grey-green external and internal surfaces. The external surface is usually cream-slipped. Very hard, smooth texture. Fairly rough fracture. Sparse fine sand. Moderate fine limestone/calcite inclusions. Sparse fine magnetite visible as black specks in fracture. Abundant fragments of crushed shell (Table 8.5, thin section 620).

Petrology

Most of the shell-tempered wares appear to be local. The identification however, of volcanic inclusions, epidote, muscovite and abundant hematite in one bevelled-rim bowl (Table 8.5, thin section 624) implies an imported fabric. From petrographic analysis the most likely source is the southern Mesopotamian plain since the petrology of this fabric is similar to fabrics found at Abu Salabikh.

Medium sandy wares (Group E)

Description

Medium sandy wares are distinguished from fine sandy wares by the addition of sand and vegetable temper. The fabric is restricted to jars and large bowls.

Ei Buff-brown core with pink-red margins. Cream-buff slip to external and internal surfaces. Very hard, smooth powdery texture. Smooth, laminated fracture. Sparse medium/fine sand and sparse coarse sand. Moderate fragments of coarse siltstone. Abundant medium vegetable material (Table 8.5, thin sections 627 and 628).

Eii Yellow-pink core with pink-orange margins. Fairly soft, harsh, crumbly texture. Rough, hackly, laminated fracture. Sparse medium/fine sand and very coarse/coarse sand temper. Abundant vegetable temper ranging from fine to medium. (Table 8.5, thin section 622).

Petrology

Fabric Eii is shown to contain inclusions of sparry calcite together with foraminifera. Whilst these inclusions are rare in pottery samples from Tell al Rubeidheh (Table 8.5, thin sections 607, 711, 622, 623 and 625) the petrology otherwise indicates a local clay. Such fabric differences illustrate the diversity of clays used in local pottery production at Tell al Rubeidheh.

Grey wares (Group H)

Description

Two vessels from Tell al Rubeidheh are of a fabric similar to the Uruk grey wares from Abu Salabikh.

Hvi Grey-brown core indistinguishable from surfaces. Hard, fairly smooth texture. Fairly rough fracture. Moderate medium/fine sand and sparse very coarse/coarse sand temper. Abundant coarse fragments of siltstone, sandstone, chert and mudstone. Sparse limestone/calcite visible as white specks in fracture. Sparse mica (Table 8.5, thin section 615).

Hvii Pink-red core with pale grey margins. Surface texture hard, fairly smooth. Rough, hackly fracture. Abundant medium/coarse sand temper. Abundant coarse fragments of siltstone and shale (Table 8.5, thin section 616).

Petrology

The tempering materials used in these fabrics compare closely with those used in grey wares from Abu Salabikh but the fabrics differ in thin section. Although Fabric Hvi from Abu Salabikh is not local to Abu Salabikh it does not appear to be imported from the Diyala region. Fabric Hvi from Abu Salabikh contains dolomite which is absent in Fabric Hvi from Tell al Rubeidheh (Table 8.5, thin section 544). The present of pyroxene and mica in both grey wares from Tell al Rubeidheh however indicates a clay source from further south. Petrological analysis of fabrics from several sites spanning the region from the Diyala southwards to Ur and Lagash indicates a clay source more akin to fabrics from Tell al Wilayah.

Coarse wares (Group M)

Description

At Abu Salabikh these types are designated as coarse red wares since the fabrics are all or partially oxidised giving them a distinctive red core. Similar fabrics from Tell al Rubeidheh exhibit more variable firing conditions and range from oxidised to partially oxidised and reduced. All the coarse wares are from large jars which may have functioned either as containers or in the case of Sample 2844 (Table 8.4) as a cooking pot.

Mv Pink-orange external and internal surfaces with red-brown core, Hard, harsh texture. Rough fracture. Sparse medium/fine sand. Moderate coarse/very coarse sand temper. Abundant very coarse fragments of siltstone. Coarse fragments of sandstone, shale and chert. Sparse argillaceous fragments. Sparse mica (Table 8.5, thin section 605).

Mvi Grey core indistinguishable from surfaces. External surface burnished. Hard, smooth texture. Rough, hackly fracture. Sparse fine sand. Sparse fragments of coarse angular chert. Coarse fragments of siltstone, sandstone and shale. Red angular argillaceous inclusions. Sparse mica (Table 8.5, thin section 602).

Mvii Grey-core indistinguishable from surface. Hard, smooth texture. Rough, laminated fracture. Moderate fragments of coarse angular chert, sparse crushed shell and sparse medium/fine sand. Coarse fragments of sandstone and siltstone. Abundant small fragments of vegetable matter (Straw/chaff impressions visible in fracture and surface). Sparse mica dusting (Table 8.5, thin section 603).

Mviii Narrow grey core with broad outer red-brown margins. Pink-red external and internal surfaces. Exterior surface self-slipped. Hard, smooth texture. Rough hackly fracture. Variable temper ranging from sparse coarse angular fragments of chert with sparse, medium coarse sand to abundant medium/coarse sand with little or no chert. All fabrics contain coarse fragments of sandstone, siltstone and mudstone. Sparse crushed shell and traces of abundant carbonised, coarse vegetable matter. Sparse mica dusting (Table 8.5, thin section 604).

Petrology

It is assumed that these coarse wares are all local to Tell al Rubeidheh. The use of coarse tempering materials is common among all sherds in this group but there is a degree of variability apparent in the range of tempering materials used. Fabric Mvii contains no

chert and Fabric Mv contains no sand temper. Fabrics Mv and Mvi contain fragments of shale as a tempering agent while Fabric Mviii is distinguished by abundant coarse temper from a wide range sedimentary rock fragments (Table 8.5, thin section 604, column 24) and the presence of shell fragments. It seems likely that the variable petrology of these fabrics reflects differences between the products of several local potteries/production centres.

UMM AN NAR AND HILI

Description

Of the thirty pottery samples taken from the Gulf sites of Umm an Nar and Hili nineteen showed affinities with fabrics from sites in Southern Iraq. Amongst these fabrics are representative types of five groups (Table 8.3); fine sandy wares (Group A), green-buff wares (Group B), medium sandy wares (Group E), shelly wares (Group F) and coarse sandy wares (Group G). These are classified, therefore, according to the Mesopotamian fabric typology. The remaining samples form six distinct groups and are numbered from i - vi accordingly.

Description

UNi Colour ranges from red-orange to red-brown with brown external surface. Hard, harsh texture. Rough, hackly fracture. Abundant to moderate medium/fine sand. Moderate coarse and sparse very coarse sand temper. Moderate coarse fragments of mudstone and calcite. Sparse red argillaceous fragments. Abundant medium/fine organic material (Table 8.5, thin sections 574 -576).

UNii Red-brown are indistinguishable from surfaces. Hard, smooth texture. Smooth fracture. Sparse medium sand and sparse fine vegetable material. No other visible inclusions (Table 8.5, thin section 573).

UNiii Colours range from pink-orange core indistinguishable from surfaces to yellow core with pink-orange margins. Very hard, very smooth texture. Smooth fracture. Sparse fine sand. Sparse fine vegetable material. Sparse argillaceous fragments in thin section 593 (Table 8.5, thin sections 593 -595; Fig. 8.94, Sample no. 2909).

UNiv Pale grey-green core with darker margins and grey-black external surface. Very hard, very smooth texture. Smooth fracture. Moderate to sparse medium/fine sand. Abundant limestone/calcite visible as fine white

specks in fracture. Sparse magnetite visible as fine black specks in fracture. Sparse argillaceous fragments (Table 8.5, thin sections 596 and 597).

UNv Dark grey core indistinguishable from surfaces. Hard, very smooth texture. Very smooth fracture. Sparse fine sand. No other visible inclusions (Table 8.5, thin section 598).

UNvi (Hili only) Dark grey core indistinguishable from surfaces. Very hard, very smooth texture. Smooth fracture. Sparse medium/fine sand. Sparse fine vegetable material (Table 8.5, thin section 598.

Petrology

The visual identification of five groups characteristic of Mesopotamian wares is supported by an examination of the fabrics in thin section. It is possible from the mineral inclusions to suggest at least two sources for the production of these wares. The majority of fine sandy wares (Group A) and medium sandy wares (Group E) resemble most closely fabrics from Abu Salabikh with inclusions of mica, pyroxene, and epidote and fragments of siltstone, limestone and sandstone. Green-buff wares, however are more difficult to identify since the clay matrix is very fine and mineral inclusions are rare. From a visual examination these fabrics are very similar to green-buff wares from Ur. The absence of sandstone and the fine clay matrix tends to support this assumption although Ur fabrics usually contain shell fragments and few are recorded in the fabrics from Umm an Nar. Nevertheless the most likely source of these green-buff wares is from the region of Ur.

Petrographic analysis also isolates a single sherd with particularly coarse temper (Table 8.5, thin section 572). The presence of abundant, feldspar in the clay matrix implies that the clay originates from a basaltic dolerite, probably from an area in the extreme north of Iraq (Geological Map of North Africa 1963)

One other sherd merits special attention (Fabric UNiv). A visual examination reveals nothing concerning the origin of this vessel but in thin section the presence of mica, pyroxene and epidote together with siltstone and limestone implies that this is another Mesopotamian ware.

The remaining sherds from Umm an Nar and Hili are not readily categorised. Fabric UNi appears to be a local coarse ware. Fabrics UNii, UNiii, UNv and UNvi are too fine for any identification in thin section.

DISCUSSION

Distinctive ceramic traits can best be identified by visual examination combined with petrographic analysis. The evidence from these two methods of examination is often complimentary but case studies have shown that while some identifications can be made from inspection of the hand specimen identification of certain wares depends upon assessment of their mineralogical composition.

Ur

A characteristic feature of local pottery fabrics from Ur is the fine clay matrix frequently tempered with abundant fragments of coarse vegetable material, usually of chopped straw visible as large burnt out voids. Much of the pottery from Ur may be distinguished by the presence of complete shells or large fragments of shell visible in fracture and embedded in the surface of large pots. In thin section almost all fabrics from Ur are shown to contain fine shell fragments either as naturally occuring inclusions or added as temper. Inclusions of epidote and amphibole are rare but fine fragments of siltstone are almost always present.

The presence of ooliths, glauconite and abundant sparry calcite and the absence of siltstone in thin Sections 124, 127, 137 and 138 (Table 8.5) indicates that these fabrics are more akin to pottery fabrics from Kish.

Sakheri Sughir

Although a relatively small sample of pottery was thin sectioned from Tell Sakheri Sughir it is immediately apparent that there is a considerable difference between fabrics from here and the neighbouring site of Ur. The major difference between pottery from the two sites is apparent from the texture of the fabrics. The fine smooth clay used in the manufacture of pottery from Ur is in marked contrast with the very sandy clay common among pottery from Sakheri Sughir. The difference between these two fabrics is equally clear in thin section where the coarser fabrics of Sakheri Sughir pottery

contain a wider range of mineral inclusions including epidote, occasionaly amphibole and fragments of sandstone and chert not generally observed in fabrics from Ur. Two clay samples from Sakheri Sughir (Table 8.5, thin sections 196 and 198) are petrologically more akin to fabrics from Ur since they do not contain siltstone or abundant sand. A coarser clay source must therefore have been chosen for the manufacture of pottery from Sakheri Sughir.

Tell al 'Ubaid

Pottery from Tell al Ubaid is readily identified by visual examination since it is invariably fired to a higher temperature giving it a dark red-brown or dark-green appearance. The texture of fabrics from Tell al 'Ubaid is usually rough and very sandy with abundant sand temper added in the form of rounded quartz grains (Fig. 8.94A no. 0473). Tell al 'Ubaid pottery fabrics are less easily distinguished on the basis of this mineralogical composition although the selection of samples for thin section was limited. The majority of typical sandy Tell al 'Ubaid fabrics were not available for analysis and were therefore identified by visual examination alone.

Kish, Jamdat Nasr and Abu Salabikh

Pottery fabrics from Kish and Jamdat Nasr are difficult to differentiate although in thin section the occurrence of voids produced by the dissolution of ooliths is more common in samples of Jamdat Nasr pottery. Abundant mica, combined with a distinctive orange-red sandy fabric is a unique characteristic of Group A pottery (Fine sandy wares) from Kish and Jamdat Nasr. Such fabrics may be identified without the aid of petrographic analysis. Other wares are less easily identified as specifically local to Kish and Jamdat Nasr. Comparisons between fabrics from Kish/Jamdat Nasr and Abu Salabikh require both a visual examination and an assessment of their respective mineralogical assemblages. There is a considerable overlap between fabrics from all these sites and no single inclusion is diagnostic of pottery fabrics from a particular site. Inclusions of sparry calcite and glauconite are generally more abundant in thin sections from Kish, while epidote occurs more frequently in fabrics

from Abu Salabikh. The presence of mica, both muscovite and biotite) and pyroxene is common in pottery from all these sites although these inclusions are sparse and finer in thin sections of the Abu Salabikh wares. While much of the disparity between the mineralogical assemblages from these sites is reflected in the fabric group to which the sherd or pot belongs the technology of pottery production of Kish and Jamdat Nasr appears to be of a consistent nature. The majority of fabrics from these two sites are fine sandy wares (Group A). This has been verified by petrographic analyses. There is, however, considerable diversity of fabric within the pottery assemblages from Abu Salabikh. This is demonstrated by the variability of mineral inclusions from one fabric group to another. In most cases therefore, the principal criteria for distinguishing between pottery from Kish and Jamdat Nasr and pottery from Abu Salabikh is the presence of abundant mica, visible in the hard specimen in fabrics from the two former sites.

Other Early Dynastic sites

Regional variations in the mineral assemblages of pottery samples have been examined from a further fifteen sites. It has been established from studies of the Tigris and Euprates sediments that the frequency of accessory minerals varies along the major river coarses (Berry et al. 1970, 131-139; Philip 1968, 35-44).

Although the limited ceramic sample available from each site precludes any definitive assessment of these mineralogical assemblages variations in the river sediments are reflected to a certain extent in the petrographic analysis of pottery fabrics from individual sites.

Fabrics from sites on the Diyala river in the Hamrin region such as Kheit Qasim (Table 8.5, thin sections 217-220) Abu Qasim and Tell al Rubeidheh (Table 8.5, thin sections 249-252) rarely contain inclusions of muscovite, biotite and epidote. Pyroxene however, is invariably recorded in petrographic analyses. Sherds from Tell Asmar (Table 8.5, thin section 248) Khafajah (Table 8.5, thin sections 244-247) and Tell Agrab (Table 8.5, thin sections 239-243) reflect a similar mineral assemblage although inclusions of biotite are common in fabrics from these sites. A characteristic feature of all fabrics from the Diyala region is abundant sand temper containing distinctive

angular quartz grains, in sharp contrast to the rounded, weathered quartz found in fabrics from the alluvial plain.

The only fabric likely to have strong affinities with Tigris river sediments is the sample from Tell al Wilayah (Table 8.5, thin section 235). The presence of amphibole in this sample is consistent with Tigris sediments. Sites which might be expected to draw on clays originating in Euphrates sediments such as Nippur (Table 8.5, thin sections 234-236) Fara (Table 8.5, thin sections 225-233), Warka (Table 8.5, thin sections 221-224) Eridu (Table 8.5, thin sections 211-214) and Lagash (Table 8.5, thin sections 215-216) have produced pottery with relatively abundant mica and pyroxene and occasionally epidote which accords well with the presence of these minerals in Euphrates sediments. The best examples of pottery fabrics manufactured from Euphrates river sediments are to be found in the material from Tell al 'Usiyeh and Suwari, in the Haditha region of the Euphrates (Table 8.5, thin sections 255-260) and Fara (Table 8.5, thin sections 225-233).

Finally, it should be noted that some fabrics from Abu Salabikh and Kish contain mineral inclusions which are typical of both Tigris and Euphrates river sediments. Owing to the location of these two sites, which are situated between the rivers, an explanation may be sought in frequent floods and occasional changes of the water courses. It is probable that the deposition of sediments mixed Tigris and Euphrates clays and that this is reflected in the pottery fabrics represented at these two sites. Similar circumstances doubtless account for the anomalous fabrics at Ur and Tell Sakheri Sughir which also have a mixed mineralogical composition (Table 8.5, thin sections 127 and 185). The small sample of material so far available from other sites, however, precludes realistic quantification of the extent to which the phenomenon is characteristic of other pottery assemblages found elsewhere on the alluvial plain.

Imported wares

Whilst the majority of fabrics are local to each site, imported wares constitute a small, but significant, percentage of the pottery assemblages from each of the three main sites. The combination of a visual examination of the fabrics with thin section analysis has identified limited exchange of pottery between sites south of the middle Euphrates on the alluvial plain. A number of

vessels found at Ur have been identified as possible imports from Kish (Table 8.4, Sample nos. 0255, 0258, 0361 and 0370). Conversely a painted body sherd found at Kish (Table 8.4, Sample no. 2772) is probably imported from Ur.

In addition to the local exchange of pottery among sites in Sumer a number of vessels, principally from Ur and Kish, but also including some of the grey wares and coarse red wares from Abu Salabikh, are likely to have been imported from further afield. Apart from imported wares which have been identified prior to analysis and classified as 'other fabrics' these imported wares have been isolated on the basis of their petrology.

Petrographic analyses of pottery from Kish have shown that all fabrics local to Kish contain abundant muscovite and biotite, pyroxene, and frequently epidote. The absence of one or more of the first three mineral inclusions is sometimes indicative of a non-local source. The lack of mica and pyroxene in thin section nos. 075, 076, 084, 089, 091, 092, 096, and 100 (Table 8.5) points to a foreign origin for these wares. The mineral assemblage of these fabrics is similar to pottery from sites in the Diyala and the Hamrin Basin, such as Tell Asmar, Khafajah or Kheit Qasim. Neutron activation analysis of two of these vessels (Table 8.4, Sample nos. 2647 and 2782) reinforces this supposition. (See Section 8.4.4). Thin section 101 however, contains weathered serpentine with olivine veining (Table 8.5), which is a feature of basaltic clays. A possible origin for this particular sherd may therefore be from one of the Mesopotamian sites in Syria, such as Tell Brak.

Imported wares are less easy to identify amongst the pottery samples from Ur owing to the fine silty clay matrix of many of the fabrics and the range of variability within the mineral assemblage of local wares. Thin sections 176, 178, 283, 309, 310 and 321 (Table 8.4, Sample nos. 0180, 0229, 0331, 0306, 0402 and 0417) are examples of pottery which may also have been imported from the Diyala region and/or Hamrin Basin. Results of neutron activation analyses on Sample nos. 0331, 0402 and 0417 support this assumption (see Section 8.4.4).

Finally it is interesting to note that, where imported wares at Ur, Kish and Abu Salabikh have been detected by petrographic analyses they appear to be early pottery types, either ED I painted wares or decorated jars of late Uruk to early ED I date. Furthermore, almost all the fabrics are medium coarse to coarse sand tempered wares, or medium coarse vegetable tempered wares, implying a trade in utilitarian vessels - possibly containers - rather than fine wares.

8.4 NEUTRON ACTIVATION ANALYSIS

8.4.1 Introduction

The assumption implicit in petrographic analysis is that pottery produced in a particular area possesses a specific mineralogical assemblage by which it may be characterised. An alternative method of finger-printing local fabrics is based on determining the elemental composition of pottery. Neutron activation is an established method of trace element analysis which has been used extensively in studies concerned with pottery manufacture and trade including the examination of pottery distribution from sites in Syria and Iraq (Artz et al. 1967; Davidson 1981, 21-32; Davidson and McKerrell 1976, 45-56; 1980, 155-167).

Few studies of Mesopotamian pottery combine petrographic and trace element analysis (Blackman 1981; Oates et al. 1977). Although an alternative approach has been to use petrology in conjunction with microprobe analysis (Kamilli and Lamberg-Karlovsky 1979, 41-61; Courtois and Velde 1983a, 56-51; 1983b, 147-161). Neutron activation analysis was therefore employed in the preliminary stages of research in order to compare the suitability of two very different methods of physical examination applied to a study of third millennium Mesopotamian ceramics.

Attention has recently been focussed on the possible effects of post-burial changes on elemental concentrations in pottery fabrics. It has been argued that post-deposition conditions would have little effect on trace element concentrations in buried ceramics (Franklin and Hancock 1981, 111-119) although subsequent analyses suggest that the physical condition of the ceramic may be significant. Sherds which show signs of weathering such as surface erosion or flaking should not be sampled (Franklin and Vatali 1985, 14).

Neutron activation analysis conducted on pottery samples from the southern Mesopotamian plain (Mynors 1983, 380) indicates that chemical changes brought about by post-deposition conditions may seriously alter trace element concentrations and thus affect attempts to provenance pottery from this region. A greater degree of success, however, has been achieved by employing neutron activation in an analysis of sherds from sites situated in geographically distinct areas.

8.4.2. Methodology

Neutron activation analysis : theory

The theoretical physics of neutron activation analysis has been outlined in early studies employing the technique (Gordus et al. 1967; Perlman & Asaro 1969) and by Tite (1972, 273-278) and Hawkin (1977). Only a brief discussion of the principles is therefore required.

Neutron activation analysis of pottery is based on an estimate of the trace element concentrations in the fabric. Pottery samples are bombarded with slow neutrons in a nuclear reactor producing unstable radioisotopes. The subsequent decay of radioisotopes to stable isotopes is accompanied by the emission of Beta particles and gamma rays at specific energies which are characteristic of individual elements. By determining these energies of emission elements contained in the sample are identified and an estimate of the concentration of each element is calculated from the intensity of the emission spectra. Conditions within the reactor vary and elemental concentrations are determined by the use of standards of known and similar composition to the samples (Harbottle 1982, 74-75; Perlman and Asaro 1969, 38-51). The inclusion of standards is doubly valuable since it corrects for variations within a single sample matrix (Hancock 1985, 98). Both the standard and samples are irradiated together under the same conditions and the emitted gamma rays are detected with the aid of a semi-conductor crystal detector. The activites of the radiosotopes in both the samples and the standard are ascertained and the mass of a particular element may be calculated thus:-

$$\frac{A_s \text{ Activity of isotope in sample}}{A_{std} \text{ Activity of isotope in standard}} = \frac{N_s \text{ Unknown concentration of element in sample}}{N_{std} \text{ Known concentration of element in standard}}$$

Hence the fraction of an element in ppm (parts per million) is obtained.

$$\frac{\text{element : ppm in sample}}{\text{element : ppm in standard}} = \frac{N_S \ / \ N_{std}}{\text{Sample mass / standard mass}}$$

In practice the gamma ray spectra are analysed by statistical analysis. Hammon et al. (1976, 155) used the computer programme BRUTAL devised by the Brookhaven laboratories. The present study employs a similar programme, the SPECT programme, developed at Bradford University.

Sampling

Pottery samples originate from sites as far apart as Syria and Iran and the Arabian Gulf. A total of 124 sherds has been analysed by neutron activation analysis from twelve different sites. Initially samples were selected for the purpose of direct comparison between neutron activation and petrographic analyses and the sample area was confined to sites on the alluvial plain in southern Iraq. Neutron activation analyses based on third millennium ceramics from these sites proved difficult to evaluate (Figs. 8.101 and 8.104) and the sampling area was extended to include later fourth and third millennium pottery from the Diyala region and the Hamrin Basin (Kheit Qasim, Tell al Rubeidheh and Tell Ahmed al Hattū) and Tell al 'Usiyeh in the Haditha area (Figs. 8.111 and 8.113).

Twenty-five pottery samples from the Gulf sites of Umm an Nar and Hili, eighteen of which display affinites with Early Dynastic pottery types, are included among the analyses in an attempt to isolate vessels which may have been imported from Mesopotamia.

Finally, six sherds from the excavations at Habūba Kabira, (Sürenhagen, 1974-75) and a further three sherds from Tepe Farukhabad (Wright 1982) extend the geographical limits of the neutron activation analysis into Syria and Iran.

Sampling for analysis

Chemical analysis for minor and trace elements has been used extensively in pottery studies ranging from fine textured wares (Banterla et al. 1973) to coarse tempered wares (Krywonos et al. 1982). Inclusions in pottery, however, may act as a dilution factor by reducing the elemental concentrations measured and thus affect

comparisons between groups of sherds with widely differing tempers. The problem may be overcome either by relating sample size to size and frequency of inclusions or by sieving coarse wares (Bromund et al. 1976, 218-221). However, since coarse wares are readily distinguished visually and comparisons between fabrics may be made from a microscopic examination of the pottery, the majority of samples analysed by neutron activation have been confined to fabrics with few visible inclusions.

Neutron activation analysis : method

Powder samples are removed from the pottery core with the aid of a diamond drill bit. In most cases the maximum weight of 100 to 150 mg has been obtained, thus reducing errors arising from potential inhomogenities within a single vessel (Hancock 1983, 355; Mommsen 1981, 209). The powder samples are irradiated at the Aldermaston Herald Reactor in batches of thirty (RUNS) and each batch contains a pottery standard (NPS1) similar in composition to the standard developed at the Berkley Laboratories (Perlman and Asaro 1969, 26). Following an irradiation period of twenty four hours (Thermal neutron flux density of 2.4 x 10.12 neutrons/cm-2 sec-1) the activity of a range of long-lived isotopes is counted with the aid of a semi-conductor crystal detector linked to 1024 channels multi-channel analyser. After a period of 21 days the long-lived activity is counted for 6000 seconds and the output for each sample is recorded on magnetic tape. The resultant gamma ray spectra are then analysed with an HP 2116B computer (University of Bradford) using the SPECT programme coupled with the relevant isotope data tape.

Computer analysis of the spectra

The SPECT programme calibrates the spectrum read in from the magnetic tape with the result that, using a proper calibration, peaks appear in the spectrum with their associated specific energies. The peaks are subsequently identified using the isotope data. Inaccuracies in peak areas may arise where peaks are close together resulting in interference and consequently reducing the measure of the total peak width. This effect is partly overcome by data from the pottery standard, irradiated with the batch, being stored in the SPECT PROGRAM for use in the calculation of isotope concentrations in the

remaining samples. The peak area is transformed to a count rate per unit time, per unit mass, and the activity at the time of leaving the reactor is calculated from each sample. The concentrations of the various trace elements are finally printed out in ppm together with their associated errors.

The peaks most frequently used in an analysis of the data are those with high energies occuring in areas of low background, hence minimising peak interference (e.g. Fe 59; Co 60 and Sc 46). It has been stressed by Perlman and Asaro (1969, 21) that defining pottery groups on the basis of chemical comparisons between samples is only possible where a wide range of minor and trace elements may be analysed simultaneously. The number of trace elements used in neutron activation analysis of pottery varies from eight (Davidson and McKerrell 1976 and 1980) up to as many as thirty-two (Hancock 1976) While it is considered preferable, however, to use no fewer than eleven elements (Winter-Neilsen 1981, 90-91) it has been shown that an increase in the number of chemical elements analysed may not necessarily achieve a greater resolution between products of workshops from similar geological environments (Lemoine et al. 1982, 61-62).

In view of the fact that concentrations of elements such as sodium (Na), potassium (K), calcium (Ca) and magnesium (Mg) which form salts are most likely to be affected by post-deposition leaching or absorption (Hedges and McLellan 1976, 206-207) these elements have been excluded from the present study. A total of seventeen trace elements was analysed for, out of which twelve have been included in the final data analysis. Values for the elemental concentrations of strontium (Sr), zirconium (Zr), barium (Ba) and lanthanum (Lu) have not been recorded for the majority of samples since their peak energies are below minimum detectable levels. Whilst these elements are included in the table of trace element concentrations (Table 8.6) they are masked from the statistical groups of the data.

It is recognised that for a further three elements (antimony (Sb), rubidium (Rb) and protoactinium (Pa)) absent values in some samples might disproportionately affect the final groups produced by cluster analysis. Cluster analyses have therefore been carried out to test this possibility (Figs. 8.95 - 8.102). The total number of samples has been clustered using all twelve elements (Fig. 8.95) followed by cluster analyses performed on the same number of samples but with each of the three elements masked singly (Figs. 8.96; 8.98; 8.100) and subsequently in pairs (Figs. 8.97; 8.99; 8.102) with the

exception of plots where antimony has been masked (Figs. 8.99-8.102) the vessels cluster in the same groups in each of the dendrograms. Reference to the raw data, coupled with comparisons between pottery groups produced from the inclusion of antimony and those produced when antimony is excluded from the cluster analysis, suggests that the samples for which no antimony value has been detected are not placed outside their original groups.

Individual samples do however move around within the three main clusters of Mesopotamian wares. In addition a tighter clustering with few sub-groups is imposed when antimony is masked. It is therefore apparent that the inclusion of all three elements, in particular antimony, does not affect the major pottery groups with which the present study is concerned. They have not therefore been excluded from the final data processing.

Considerable variation in the raw data resulting from dilution effects and changes in flux across the batch container frequently prove to be a source of systematic error in neutron activation analysis. This effect is reduced by a process of internal normalisation and has been implemented by scaling the data to scandium (Sc). Thus the trace element concentrations for each individual sample are divided by the specific value for scandium in each sample. The choice of this element for normalising data has been recommended by Aspinall (1977). It has the advantage of possessing the properties of an internal monitor since it is of a comparable concentration in each sample, it is evenly dispersed throughout the clay matrix and it may be measured with great accuracy. Table 8.6 therefore includes both the raw data of the trace element concentrations and the values normalised to Scandium. Subsequent cluster analyses, however, involve only the normalised data.

Table 8.6 Late fourth and third millennium Mesopotamian ceramics. Neutron activation analysis: Trace element concentrations

NEUTRON ACTIVATION ANALYSIS OF MESOPOTAMIAN CERAMICS: Trace element concentrations (ppm)

	Sc	1 Fe	2 Eu	3 Tb	4 Sb	5 Co	Sr	6 Rb	Zr	Ba	7 Cs	8 Ce	9 Hf	Lu	10 Cr	11 Ta	12 Pa	Sample No.
RUN 745 and 776																		
Std	17.08	60409	1.76	0.90		15.79		131			11.41	79.00	5.89		115.1		10.69	-
		3537	**0.10**	**0.05**		**0.93**		**7.67**			**0.67**	**4.63**	**0.34**		**6.74**		**0.63**	
2440 G	13.80	42054.8	1.05	0.71		20.71		72.90			4.67	45.97	4.06		215.37		8.26	0812
		3047	**0.08**	**0.05**	**0.001**	**1.50**		**5.28**			**0.34**	**3.33**	**0.29**		**15.61**		**0.60**	
2440 H	16.15	47781.1	0.96	0.66		21.46		123			10.40	36.94	4.33		197.65		9.72	0937
		2959	**0.06**	**0.04**		**1.33**		**7.62**			**0.64**	**2.29**	**0.27**		**12.24**		**0.60**	
2440 I	13.37	38062.2	0.86	0.40		22.09		33.12			2.74	12.97	2.89		371.09		3.86	0896
		2844	**0.06**	**0.03**		**1.65**		**2.48**			**0.21**	**0.97**	**0.22**		**27.76**		**0.29**	
2440 J	9.10	129.97	0.86	0.51		11.32		80.69			7.07	57.87	3.07		89.71		5.57	0714
		0014	**0.09**	**0.06**		**1.26**		**8.87**			**0.78**	**6.36**	**0.34**		**9.86**		**0.61**	
1029 A	14.34	38132.48	0.81	0.28		20.97		34.90				7.54	2.24		466.87		3.10	1250
		2659	**0.06**	**0.02**		**1.46**		**2.43**				**0.53**	**0.16**		**32.56**		**0.22**	
1029 B	16.37	57837.76	1.31	0.47		35.64					2.26	12.08	4.51		773.05		3.59	1251
		3533	**0.08**	**0.03**		**2.18**					**0.14**	**0.74**	**0.28**		**47.22**		**0.22**	
1235 A	13.57	37689.8	0.79	0.45		21.36		39.50			2.18	14.56	3.50		545.03		3.47	0885
		2777	**0.06**	**0.03**		**1.57**		**2.91**			**0.16**	**1.07**	**0.26**		**40.16**		**0.26**	

	Sc	Fe	Eu	Tb	Sb	Co	Sr	Rb	Zr	Ba	Cs	Ce	Hf	Lu	Cr	Ta	Pa	Sample No.
RUN 745 and 776																		
1235 B	14.52	40974.73	0.93	0.40		23.55		37.93			2.37	14.66	3.28		641.31		3.53	0989
		2822	0.06	0.03		1.62		2.61			0.16	1.01	0.23		44.17		0.24	
1235 C	15.50	44096.71	0.93	0.42		24.98		42.65			3.24	12.85	3.28		360.01		4.19	0852
		2845	0.06	0.03		1.61		2.75			0.21	0.83	0.21		23.23		0.27	
1235 D	15.83	43702.76	0.96	0.41		25.56		38.75			2.30	15.29	2.88		507.17		3.16	0904
		2761	0.06	0.03		1.61		2.45			0.15	0.97	0.18		32.04		0.23	
1235 E	16.12	45493.18	0.92	0.43		23.55		50.67			3.37	16.40	3.01		342.07		4.90	0903
		2822	0.06	0.03		1.46		3.14			0.06	1.02	0.19		21.22		0.30	
1235 F	14.63	41767.86	0.89	0.44		22.91		54.32			3.01	19.75	2.94		369.28		4.53	0871
		2855	0.06	0.03		1.57		3.71			0.21	1.35	0.20		25.24		0.31	
1235 G	15.86	43742.27	1.00	0.45		24.17		41.23			2.52	14.68	2.66		318.74		4.32	0877
		2758	0.06	0.03		1.52		2.60			0.16	0.93	0.17		20.10		0.27	
1235 H	13.33	37966.52	0.91	0.37		20.47		34.76			2.53	11.70	3.45		352.76		3.72	0887
		2848	0.07	0.03		1.54		2.61			0.19	0.88	0.26		26.46		0.28	
1235 I	11.02	31804.57	0.79	0.35		15.21		39.48			3.28	16.64	3.64		188.25		4.04	0843
		2886	0.07	0.03		1.38		3.58			0.30	1.51	0.33		17.08		0.37	
2440 A1	13.15	37882.04	0.88	0.46		19.48		48.99			3.48	20.23	2.78		192.32		5.04	1410
		2881	0.07	0.04		1.48		3.73			0.26	1.54	0.21		14.63		0.38	
2440 A2	11.82	34666.09	0.76	0.37		17.54		47.35			3.30	18.40	2.64		164.29		4.53	1410
		2933	0.06	0.03		1.48		4.01			0.28	1.56	0.22		13.90		0.38	

	Sc	Fe	Eu	Tb	Sb	Co	Sr	Rb	Zr	Ba	Cs	Ce	Hf	Lu	Cr	Ta	Pa	Sample No.
RUN 745 and 776																		
2440 B1	16.65	45619.36	0.96	0.47		24.38		37.45			2.88	8.32	3.07		565.53		3.16	1411
		2740	0.06	0.03		1.46		2.25			0.17	0.50	0.18		33.97		0.19	
2440 B2	14.96	41658.37	0.87	0.40		22.99		38.78			2.28	4.32	3.01		585.59		2.89	1411
		2785	0.06	0.03		1.54		2.59			0.15	0.29	0.20		39.14		0.19	
2440 E	15.18	43884.10	0.94	0.44		23.26		49.47			2.15	12.61	3.63		670.42		3.60	1357
		2891	0.06	0.03		1.53		3.26			0.14	0.83	0.24		44.16		0.24	
2440 F	16.40	46583.55	0.87	0.44		25.72						14.99	3.26		276.60		5.21	0974
		2841	0.05	0.03		1.57						0.91	0.20		16.87		0.32	
584 A	17.81	50397.41	0.93	0.56		27.25		34.54			3.09	10.47	3.53		289.84		5.07	1267
		2830	0.05	0.03		1.53		1.94			0.17	0.59	0.20		16.27		0.28	
584 B	10.88	28375.73	0.95	0.49		14.64		70.50			4.66	33.79	8.70		174.10		6.15	1191
		2608	0.09	0.05		1.35		6.48			0.43	3.11	0.80		16.00		0.59	
584 C	25.63	66081.12	1.07	0.61		33.69		81.56			6.25	3.72	3.52		266.80		7.57	1054
		2578	0.04	0.02		1.31		3.18			0.24	0.15	0.14		10.41		0.30	
584 D	23.41	62828.89	1.06	0.64		34.41		85.45			7.31	0.35	3.73		303.49		6.59	0668
		2684	0.05	0.03		1.47		3.65			0.31	0.02	0.16		12.96		0.28	
Surface (Abs)	23.27	62731.03	1.11	0.56		32.93		67.11			7.34	0.73	3.79		290.87		7.00	-
		2696	0.05	0.02		1.42		2.88			0.32	0.13	0.16		12.50		0.30	
404 A	17.73	55706.65	1.38	0.97		21.14		147.23			10.67	60.45	4.34		118.23		15.34	1078
		3142	0.78	0.06		1.19		8.30			0.60	3.41	0.24		6.67		0.87	

	Sc	Fe	Eu	Tb	Sb	Co	Sr	Rb	Zr	Ba	Cs	Ce	Hf	Lu	Cr	Ta	Pa	Sample No.
RUN 745 and 776																		
404 B	12.60	38142.73	1.04	0.55		19.97		86.37			3.77	30.97	7.09		106.56		6.51	1081
		3027	0.08	0.04		1.59		6.85			0.30	2.46	0.56		8.46		0.52	
507	21.32	60306.97	1.21	0.68		33.90					4.24	14.76	3.71		296.19		6.99	0706
		2829	0.06	0.03		1.59					0.20	0.69	0.17		13.89		0.33	
2440 D	16.20	44582.61	0.99	0.51		24.92		42.30			2.85	14.44	4.15		743.78		3.70	0894
		2752	0.06	0.03		1.54		2.61			0.18	0.89	0.26		45.91		0.23	
Std	17.08	60409	1.76	0.90		15.79		131.00			11.41	79.00	5.89		115.10		10.69	-
		3537	0.10	0.05		0.92		7.67			0.67	4.63	0.34		6.74		0.63	
H 54	15.72	45026	0.91	0.45		26.05		49.43			3.11	28.15	3.43		382.53			2915
		2864	0.06	0.03		1.66		3.14			0.20	1.79	0.22		24.33			
H GREY	15.47	43793	0.91	0.46		25.32		40.39			2.79	27.03	2.95		283.29			2912
		2831	0.06	0.03		1.64		2.61			0.18	1.75	0.19		18.31			
H 2 JN	16.57	45430	0.82	0.37		25.42		39.49			2.69		2.51		311.55		4.49	2913
		2742	0.05	0.02		1.53		2.38			0.16		0.15		18.80		0.27	
UN 352	17.73	48776	0.62	0.52		26.42		36.43			2.77	9.61	2.69		437.64		4.88	2906
		2751	0.03	0.03		1.49		2.05			0.16	0.54	0.15		24.68		0.28	
UN 145	16.56	46402	0.95	0.47		27.96		42.38			2.19	16.66	2.56		323.89		4.26	2911
		2802	0.06	0.03		1.69		2.56			0.13	1.01	0.15		19.56		0.26	

	Sc	Fe	Eu	Tb	Sb	Co	Sr	Rb	Zr	Ba	Cs	Ce	Hf	Lu	Cr	Ta	Pa	Sample No.
RUN 745 and 776																		
UN LL	16.57	46011	0.90	0.46		27.88		35.63			2.40	16.08	2.74		303.31		4.13	2905
		2777	0.05	0.03		1.68		2.15			0.14	0.97	0.17		18.30		0.25	
UN 127	13.53	38247	0.86	0.40		21.74		41.56			2.38	13.87	2.36		387.40		3.29	2890
		2827	0.06	0.03		1.61		3.07			0.18	1.03	0.17		28.63		0.24	
UN 177	13.51	37018	0.76	0.39		20.96		44.18			2.44	14.35	2.26		405.01			2887
		2740	0.06	0.03		1.55		3.27			0.18	1.06	0.17		29.98			
UN 403	15.37	41595	0.85	0.44		24.53		36.87			2.38	14.20	2.74		519.90			2889
		2706	0.06	0.03		1.60		2.40			0.15	0.92	0.18		33.83			
UN 149	17.47	47679	1.23	0.55		27.16		27.78			2.81	16.73	3.08		507.83		5.44	2886
		2729	0.07	0.03		1.55		1.59			0.16	0.96	0.18		29.07		0.31	
UN 454	14.71	41942	0.89	0.48		23.35		38.01			2.37	9.71	2.84		485.63		4.48	2898
		2851	0.06	0.03		1.59		2.58			0.16	0.66	0.19		33.01		0.30	
UN 372	14.19	40049	0.83	0.44		25.13		40.56			2.48	8.27	2.36		634.04		3.78	2888
		2822	0.06	0.03		1.77		2.86			0.17	0.58	0.17		44.68		0.27	
UN 421	15.54	42772	1.01	0.49		23.85		49.50				11.05	3.05		487.73		4.52	2878
		2752	0.06	0.03		1.53		3.19				0.71	0.20		31.38		0.29	
RB 40A	19.07	52477	1.14	0.52		30.36		52.26			3.39	26.45	3.49		431.14		5.41	2859
		2752	0.06	0.03		1.59		2.74			0.18	1.39	0.18		22.61		0.28	

	Sc	Fe	Eu	Tb	Sb	Co	Sr	Rb	Zr	Ba	Cs	Ce	Hf	Lu	Cr	Ta	Pa	Sample No.
RUN 745 and 776																		
RB 402	17.81	48305	1.12	0.51		26.86		46.20			3.19	24.47	3.45		372.63		5.18	2870
		2712	0.06	0.03		1.51		2.59			0.18	1.37	0.19		20.92		0.29	
RB 40 16	19.54	53324	1.01	0.53		30.45		48.15			3.21	23.47	3.63		492.41		5.30	2860
		2729	0.05	0.03		1.56		2.46			0.16	1.32	0.19		25.20		0.27	
AL UI	16.83	47360	0.97	0.48		28.43		42.42			3.35	23.06	2.86		358.18		5.04	2873
		2814	0.06	0.03		1.69		2.52			0.20	1.37	0.17		21.28		0.30	
AL UB	17.48	41567	0.86	0.41		24.15		43.69			2.47	21.57	3.00		401.12		4.52	2874
		2812	0.06	0.03		1.63		2.96			0.17	1.46	0.20		27.14		0.31	
UN 398	16.51	45473	0.93	0.45		25.67		53.03			3.09	23.25	2.72		421.22		4.98	2885
		2754	0.06	0.03		1.55		3.21			0.19	1.41	0.16		25.51		0.30	
UN 453	17.52	49041	1.00	0.53		28.03		46.37			3.59	25.39	3.22		319.70		5.58	2882
		2799	0.06	0.03		1.60		2.65			0.20	1.45	0.18		18.25		0.32	
UN 512	15.78	43586	1.06	0.45		23.95		42.10			2.18	23.91	3.22		361.01		5.09	2880
		2762	0.07	0.03		1.52		2.67			0.14	1.52	0.20		22.88		0.32	
UN 517	20.59	57315	1.11	0.57		33.54		63.88			3.34	25.69	3.71		595.38		5.67	2899
		2784	0.05	0.03		1.63		3.10			0.16	1.25	0.18		28.92		0.28	
UN 208	20.97	59166	1.18	0.62		31.48		60.35			3.42	23.71	4.02		718.06		7.21	2909
		2821	0.06	0.03		1.50		2.88			0.16	1.13	0.19		34.24		0.34	

	Sc	Fe	Eu	Yb	Sb	Co	Sr	Rb	Zr	Ba	Cs	Ce	Hf	Lu	Cr	Ta	Pa	Sample No.
RUN 745 and 776																		
UN 1979	18.39	50806 **2763**	1.10 **0.06**	0.49 **0.03**		29.33 **1.59**		54.27 **2.95**			2.99 **0.16**	27.58 **1.50**	3.14 **0.17**		667.32 **36.83**		5.11 **0.28**	2902
UN 0W	19.45	54562 **2805**	0.82 **0.04**	0.68 **0.03**		29.10 **1.50**		55.28 **2.84**			3.83 **0.20**	30.75 **1.58**	3.82 **0.20**		371.18 **19.08**		6.41 **0.33**	2901
UN 243	19.81	55892 **2821**	1.06 **0.05**	0.60 **0.03**		32.27 **1.63**		46.79 **2.36**			3.94 **0.20**	32.75 **1.65**	3.71 **0.19**		393.97 **19.89**		6.29 **0.32**	2891
UN 152	21.55	62937 **2921**	1.74 **0.08**	0.59 **0.03**		35.62 **1.65**		47.99 **2.23**			2.46 **0.11**	17.76 **0.82**	3.85 **0.18**		480.05 **22.28**		7.83 **0.36**	2895
RUN 818																		
Std	17.08	60409 **3536.83**	1.76 **0.10**	0.90 **0.05**	1.71 **0.10**	15.79 **0.92**		131.40 **7.69**		404.00 **23.65**	11.41 **0.67**	79.35 **4.65**	5.89 **0.34**		111.00 **6.50**	0.90 **0.05**	10.60 **0.62**	-
6F05:181	17.80	54352 **3182.20**	1.45 **0.08**	0.74 **0.04**	0.32 **0.02**	32.94 **1.93**		69.20 **4.05**			2.90 **0.17**	47.63 **2.79**	5.02 **0.29**		577.25 **33.80**	0.65 **0.04**		1251
TAH A1	13.69	39861 **2911.69**	1.02 **0.07**	0.48 **0.04**	0.32 **0.02**	22.66 **1.66**				234.73 **17.15**	4.10 **0.30**	31.57 **2.31**	3.56 **0.26**		255.37 **18.65**	0.51 **0.04**		-
TAH A2	11.78	34124 **2896.77**	1.02 **0.09**	0.57 **0.05**	0.17 **0.01**	22.61 **1.92**		43.21 **3.67**		278.28 **23.62**	3.34 **0.28**	30.13 **2.56**	3.14 **0.27**		276.72 **23.49**	0.42 **0.04**		-
TAH A3	12.05	35141 **2916.27**	0.94 **0.08**	0.53 **0.04**	0.46 **0.04**	19.14 **1.59**		60.29 **5.00**			3.45 **0.29**	26.78 **2.22**	2.93 **0.24**		181.20 **15.04**	0.46 **0.04**		-

	Sc	Fe	Eu	Tb	Sb	Co	Sr	Rb	Zr	Ba	Cs	Ce	Hf	Lu	Cr	Ta	Pa	Sample No.
RUN 818																		
TAH A4	14.18	41096 **2898.17**	1.11 **0.08**	0.51 **0.04**	0.15 **0.01**	21.66 **1.53**				424.86 **29.96**	4.31 **0.30**	32.71 **2.31**	3.57 **0.25**		291.77 **20.58**	0.32 **0.02**		-
TAH A5	14.89	43135 **2896.91**	1.11 **0.07**	0.45 **0.03**	0.20 **0.01**	21.91 **1.47**		60.31 **4.05**		338.92 **22.76**	3.66 **0.25**	31.80 **2.14**	3.18 **0.21**		215.89 **14.50**	0.48 **0.03**		-
TAH A6	13.31	39348 **2956.27**	1.11 **0.08**	0.62 **0.05**	0.23 **0.02**	19.72 **1.48**		33.93 **2.55**			4.17 **0.31**	31.01 **2.33**	3.33 **0.25**		227.42 **17.09**	0.44 **0.03**		-
TAH A7	12.09	35364 **2925.06**	0.85 **0.07**	0.50 **0.04**	0.26 **0.02**	18.11 **1.50**		39.46 **3.26**		722.03 **59.72**	3.61 **0.30**	27.26 **2.25**	2.71 **0.22**		166.77 **13.79**	0.44 **0.04**		-
TAH A8	9.26	26928 **2907.99**	0.84 **0.09**	0.36 **0.04**	0.30 **0.03**	14.31 **1.55**		53.36 **5.76**			1.71 **0.18**	22.11 **2.39**	2.37 **0.26**		219.45 **23.70**	0.35 **0.04**		-
HEK S1	20.81	58319 **2802.45**	1.29 **0.06**	0.60 **0.03**	0.43 **0.02**	36.21 **1.74**		22.84 **1.10**			5.03 **0.24**	33.09 **1.59**	3.86 **0.19**		317.25 **15.25**	0.58 **0.03**		-
HEK S2	20.79	59176 **2846.37**	1.34 **0.06**	0.69 **0.03**	0.29 **0.01**	34.37 **1.65**		70.47 **3.39**		460.21 **22.14**	3.27 **0.16**	35.28 **1.70**	3.94 **0.19**		483.95 **23.28**	0.64 **0.03**		-
HEK S3	19.02	53410 **2808.10**	1.20 **0.06**	0.44 **0.02**		30.93 **1.63**						27.00 **1.42**	3.23 **0.17**		355.72 **18.70**	0.47 **0.02**		-
HEK S3	19.58	55674 **2843.41**	1.13 **0.06**	0.63 **0.03**	0.22 **0.01**	31.44 **1.60**		32.49 **1.66**		362.34 **18.51**	2.14 **0.11**	28.40 **1.45**	3.47 **0.18**		365.81 **18.68**	0.48 **0.02**		-
HEK S3	14.51	41066 **2830.19**	1.03 **0.07**	0.41 **0.03**	0.26 **0.02**	24.71 **1.70**				287.83 **19.84**	2.46 **0.17**	23.78 **1.64**	2.49 **0.17**		255.54 **17.61**	0.31 **0.02**		-

	Sc	Fe	Eu	Tb	Sb	Co	Sr	Rb	Zr	Ba	Cs	Ce	Hf	Lu	Cr	Ta	Pa	Sample No.
RUN 818																		
HEK S4	16.70	46685	1.05	0.58	0.20	28.54		59.13			2.93	28.37	3.00		295.39	0.40		-
		2795.51	**0.06**	**0.03**	**0.01**	**1.71**		**3.54**			**0.18**	**1.70**	**0.18**		**17.69**	**0.02**		
HEK S5	17.21	49767	1.25	0.71	0.19	28.56		59.40		464.65	3.02	34.44	3.43		252.46	0.56		-
		2891.75	**0.07**	**0.04**	**0.01**	**1.66**		**3.45**		**27.00**	**0.18**	**2.00**	**0.20**		**14.67**	**0.03**		
TAH C1	15.08	43056	0.97	0.50	0.33	20.21		62.72			4.71	35.22	2.99		189.00	0.59		-
		2855.17	**0.06**	**0.03**	**0.02**	**1.34**		**4.16**			**0.31**	**2.34**	**0.20**		**12.53**	**0.04**		
TAH C2	13.09	38008	1.19	0.49	0.25	19.78		60.36		360.62	2.81	33.83	3.58		237.75	0.44		-
		2903.59	**0.09**	**0.04**	**0.02**	**1.51**		**4.61**		**27.55**	**0.21**	**2.58**	**0.27**		**18.16**	**0.03**		
TAH C3	13.16	37784	0.99	0.36	0.30	19.08		59.83			3.44	30.21	3.73		256.37	0.47		-
		2871.12	**0.08**	**0.03**	**0.02**	**1.45**		**4.55**			**0.26**	**2.30**	**0.28**		**19.48**	**0.04**		
TAH C4	13.80	40247	1.13	0.48	0.27	20.74		38.14			3.61	34.64	3.46		222.45	0.52		-
		2916.45	**0.08**	**0.03**	**0.02**	**1.50**		**2.76**			**0.26**	**2.51**	**0.25**		**16.12**	**0.04**		
TAH C5	17.00	49213	1.07	0.51	0.18	25.79		74.21			3.68	31.56	2.75		222.93	0.56		-
		2894.88	**0.06**	**0.03**	**0.01**	**1.52**		**4.37**			**0.22**	**1.86**	**0.16**		**13.11**	**0.03**		
TAH C6	11.24	33380	1.04	0.41	0.39	17.95		23.38			2.64	31.80	3.15		298.26	0.45		-
		2969.75	**0.09**	**0.04**	**0.03**	**1.60**		**2.08**			**0.23**	**2.83**	**0.28**		**26.54**	**0.04**		
KHEIT Q1	14.64	42649	1.25	0.53	0.18	19.84					2.94	40.66	3.73		297.90	0.48		2835
		2913.18	**0.09**	**0.04**	**0.01**	**1.36**					**0.20**	**2.78**	**0.25**		**20.35**	**0.03**		
KHEIT Q2	12.07	33956	0.96	0.46	0.23	16.32		60.27		584.33	3.07	31.22	3.38		225.72	0.46		2836
		2813.26	**0.08**	**0.04**	**0.02**	**1.35**		**4.99**		**48.41**	**0.25**	**2.59**	**0.28**		**18.70**	**0.04**		

	Sc	Fe	Eu	Tb	Sb	Co	Sr	Rb	Zr	Ba	Cs	Ce	Hf	Lu	Cr	Ta	Pa	Sample No.
RUN 818																		
KHEIT Q3	9.38	26352	0.81	0.39	0.17	13.77		43.69			1.97	23.00	2.28		164.40	0.32		2837
		2809.38	**0.09**	**0.04**	**0.02**	**1.47**		**4.66**			**0.21**	**2.45**	**0.24**		**17.53**	**0.03**		
KHEIT Q4	15.20	44102	1.04	0.42	0.13	20.74		54.13			5.13	34.32	4.00		201.15	0.56		2838
		2901.45	**0.07**	**0.03**	**0.009**	**1.36**		**3.56**			**0.34**	**2.26**	**0.26**		**13.23**	**0.04**		
B 123	14.27	40767	1.00	0.47	0.38	23.14					2.93	25.19	2.48		212.67	0.34		0416
		2856.83	**0.07**	**0.03**	**0.03**	**1.62**					**0.21**	**1.77**	**0.17**		**14.90**	**0.02**		
B 124	12.57	37124	1.09	0.48	0.44	19.50		53.29		406.72	3.03	32.59	3.26		258.82	0.51		0417
		2953.38	**0.09**	**0.04**	**0.04**	**1.55**		**4.24**		**32.36**	**0.24**	**2.59**	**0.26**		**20.59**	**0.04**		
B 59	14.19	41275	0.90	0.35	0.36	24.01					2.50	26.84	3.09		285.62	0.36		0313
		2908.74	**0.06**	**0.02**	**0.03**	**1.69**					**0.18**	**1.89**	**0.22**		**20.13**	**0.03**		
B 119	14.84	41419	1.12	0.42	0.37	23.74		42.11			1.46	27.18	2.44		305.20	0.49		0079
		2791.04	**0.08**	**0.03**	**0.02**	**1.60**		**2.84**			**0.10**	**1.83**	**0.16**		**20.57**	**0.03**		
B 120	18.29	49290	1.24	0.56	0.60	24.71		61.29			3.86	29.79	3.52		241.63	0.54		0076
		2694.92	**0.07**	**0.03**	**0.03**	**1.35**		**3.35**			**0.21**	**1.63**	**0.19**		**13.21**	**0.03**		
B 24	17.08	48127	1.22	0.54	0.12	28.49		13.55			3.24	32.40	3.10		262.73	0.45		0401
		2817.74	**0.07**	**0.03**	**0.007**	**1.67**		**0.79**			**0.19**	**1.90**	**0.18**		**15.38**	**0.03**		
A 220	12.94	35391	0.88	0.31	0.14	22.89		35.62			2.10	24.31	2.57		383.27	0.45		2808
		2735.01	**0.07**	**0.03**	**0.01**	**1.77**		**2.75**			**0.16**	**1.88**	**0.20**		**29.62**	**0.03**		
A 221	12.85	35273	0.86	0.38	0.17	21.06		50.91			2.07	20.24	2.32		325.84	0.34		2813
		2744.98	**0.07**	**0.03**	**0.01**	**1.64**		**3.96**			**0.16**	**1.58**	**0.18**		**25.36**	**0.03**		

	Sc	Fe	Eu	Tb	Sb	Co	Sr	Rb	Zr	Ba	Cs	Ce	Hf	Lu	Cr	Ta	Pa	Sample No.
RUN 818																		
A 236	16.19	45216	1.02	0.45	0.25	25.86		51.54			3.23	26.95	2.91		366.17	0.49		2800
		2792.84	0.06	0.03	0.02	1.60		3.18			0.20	1.66	0.18		22.62	0.03		
A 232	16.08	45183	1.16	0.47	0.25	25.85		69.19			3.00	29.28	3.02		271.43	0.43		2803
		2809.89	0.07	0.03	0.02	1.61		4.30			0.19	1.82	0.19		16.88	0.03		
A 236	16.19	45216	1.02	0.45	0.25	25.86		51.54			3.23	26.95	2.91		366.17	0.49		2800
		2792.84	0.06	0.03	0.02	1.60		3.18			0.20	1.66	0.18		22.62	0.03		
RUN 819																		
Std	17.08	60409	1.76	0.90	1.710	15.79	1.00	131.40	200.00	404.00	11.41	79.35	5.89	1.00	111.00	0.90		-
		3536.83	0.10	0.05	0.10	0.92	0.06	7.69	11.71	23.65	0.67	4.65	0.34	0.06	6.50	0.05		
B 15	20.53	55337	1.92	0.83	0.53	34.72				349.71	4.17	57.09	3.97	1.32	351.60	0.62		0331
		2695.42	0.09	0.04	0.03	1.69				17.03	0.20	2.78	0.19	0.06	17.13	0.03		
B 16	18.51	54252	1.37	0.56	0.25	27.19	2.13				3.68	30.00	3.22	1.73	275.60	0.72		0400
		2930.96	0.07	0.03	0.01	1.47	0.12				0.20	1.62	0.17	0.09	14.89	0.04		
B 19	2.02	1160.9	0.91	0.06	0.20	23.12	0.10	0.01			2.22	0.17	0.07		0.92	0.12		0276
		574.70	0.45	0.03	0.10	11.45	0.05	0.005			1.10	0.08	0.03		0.46	0.06		
B 25	19.79	57743	1.40	0.78	0.35	31.79		55.86	86.24	259.57	3.39	36.34	3.54	1.60	293.29	0.56		0402
		2917.79	0.07	0.04	0.02	1.61		2.82	4.36	13.12	0.17	1.84	0.18	0.08	14.82	0.03		
B 31	17.09	49347	1.26	0.55	0.39	47.42	1.91	64.05	91.94	281.46	2.66	32.34	3.81	1.72	541.80	0.56		0257
		2887.48	0.07	0.03	0.02	2.77	0.11	3.75	5.38	16.47	0.16	1.89	0.22	0.10	31.70	0.03		

	Sc	Fe	Eu	Tb	Sb	Co	Sr	Rb	Zr	Ba	Cs	Ce	Hf	Lu	Cr	Ta	Pa	Sample No.
RUN 819																		
B 34			0.48			3.76												0345
B 36	16.32	46314	1.08	0.52	0.14	35.97	1.88	26.42	68.09	354.17	2.98	24.90	3.51	1.21	384.91	0.59		0305
		2837.87	**0.07**	**0.03**	**0.009**	**2.20**	**0.12**	**1.62**	**4.17**	**21.70**	**0.18**	**1.53**	**0.22**	**0.07**	**23.59**	**0.04**		
B 37	17.33	49117	1.17	0.52	0.19	25.94	0.90		166.07		1.87	27.34	3.39	1.27	311.40	0.47		0310
		2834.22	**0.07**	**0.03**	**0.01**	**1.50**	**0.05**		**9.58**		**0.11**	**1.58**	**0.20**	**0.07**	**17.97**	**0.03**		
B 38	15.26	46261	1.15	0.46	0.24	30.19	1.29	21.31			3.04	28.93	3.44		394.33	0.59		0332
		3031.52	**0.08**	**0.03**	**0.02**	**1.98**	**0.08**	**1.40**			**0.20**	**1.90**	**0.23**		**25.84**	**0.04**		
B 61	17.73	50733	1.11	0.56	0.30	33.33	1.55		101.04	556.00	3.95	29.13	3.55	1.01	365.63	0.64		0304
		2861.42	**0.06**	**0.03**	**0.02**	**1.88**	**0.09**		**5.70**	**31.36**	**0.22**	**1.64**	**0.20**	**0.06**	**20.62**	**0.04**		
B 63	18.28	52236	1.31	0.70	0.48	32.60		32.28			3.80	32.93		1.70	407.82	0.72		0306
		2857.55	**0.07**	**0.04**	**0.03**	**1.78**		**1.77**			**0.21**	**1.80**		**0.09**	**22.31**	**0.04**		
B 33	19.60	55743	1.31	0.57		33.34	1.21	46.29	179.27	300.21		31.76	3.36	1.52	294.39	0.60		0303
		2844.03	**0.07**	**0.03**		**1.70**	**0.06**	**2.36**	**9.15**	**15.32**		**1.62**	**0.17**	**0.08**	**15.02**	**0.03**		
B 49	13.60	39590	0.95	0.45	0.20	21.80	1.76	37.86	80.77		3.58	29.25	3.28		328.01	0.49		0314
		2911.03	**0.07**	**0.03**	**0.01**	**1.60**	**0.13**	**2.78**	**5.94**		**0.26**	**2.15**	**0.24**		**24.12**	**0.04**		
B 50	12.68	35821	0.87	0.48		19.35		17.18	102.26	204.62		23.96	2.48	0.95	249.61	0.51		0329
		2825.00	**0.07**	**0.04**		**1.53**		**1.35**	**8.06**	**16.14**		**1.89**	**0.20**	**0.07**	**19.69**	**0.04**		
B 117	15.57	43340	1.10	0.46	0.30	29.71					3.75	30.85	3.05		325.94	0.63		0098
		2783.56	**0.07**	**0.03**	**0.02**	**1.91**					**0.24**	**1.98**	**0.20**		**20.93**	**0.04**		

	Sc	Fe	Eu	Tb	Sb	Co	Sr	Rb	Zr	Ba	Cs	Ce	Hf	Lu	Cr	Ta	Pa	Sample No.
RUN 819																		
B 118	14.94	42443	0.96	0.54		26.51	2.28	40.75	169.61	174.46		26.31	2.91	0.86	368.65	0.56		0095
		2840.90	0.06	0.04		1.77	0.15	2.73	11.35	11.68		1.76	0.19	0.06	24.68	0.04		
A 85	12.60	38683	0.97	0.34	0.35	26.32	1.65	23.34			2.91	21.03	2.38	1.58	311.74	0.39		2722
		3070.08	0.08	0.03	0.03	2.09	0.13	1.85			0.23	1.67	0.19	0.13	24.74	0.03		
A 95	16.61	48982	1.17	0.41	0.23	31.97		17.09			2.00	24.27	3.33	1.75	377.38	0.55		2744
		2948.95	0.07	0.02	0.01	1.92		1.03			0.12	1.46	0.20	0.11	22.72	0.03		
A 83	18.37	55627	1.43	0.75	0.51	34.65	2.54	32.50			3.27	30.08	3.53		343.32	0.78		2647
		3028.14	0.08	0.04	0.03	1.89	0.14	1.77			0.18	1.64	0.19		18.69	0.04		
A 60	17.84	54831	1.22	0.44	0.13	33.93	2.32	31.79			3.76	28.87	3.39	1.58	415.10	0.64		2679
		3073.49	0.07	0.02	0.007	1.90	0.13	1.78			0.21	1.62	0.19	0.09	23.27	0.04		
A 174	15.66	46968	0.93	0.49	0.41	29.62		27.86			3.05	25.97	3.14	2.23	340.27	0.62		2605
		2999.23	0.06	0.03	0.03	1.89		1.78			0.19	1.66	0.20	0.14	21.73	0.04		
A 86	15.60	47101	1.04	0.51	0.21	29.69		37.57	137.29		2.89	25.35	2.96		349.49	0.58		2742
		3019.29	0.07	0.03	0.01	1.90		2.41	8.80		0.19	1.63	0.19		22.40	0.04		
A 103	16.82	51084	1.20	0.68	0.30	33.24	1.92	37.91	149.39		2.98	31.53	2.91		287.35	0.60		2782
		3037.10	0.07	0.04	0.02	1.98	0.11	2.25	8.88		0.18	1.87	0.17		17.08	0.04		
A 125	17.44	50018	1.07	0.56	0.18	31.20	2.07	35.18	73.30	534.41	3.75	25.90	2.87	1.97	387.11	0.52		2713
		2868.00	0.06	0.03	0.01	1.79	0.12	2.02	4.20	30.64	0.22	1.49	0.16	0.11	22.20	0.03		
A 125	18.12	52384	1.16	0.45	0.36	32.43	2.26			323.77	3.22	28.61	2.74	2.14	403.76	0.67		2713
		2890.95	0.06	0.02	0.02	1.79	0.12			17.87	0.18	1.58	0.15	0.12	22.28	0.04		

	Sc	Fe	Eu	Tb	Sb	Co	Sr	Rb	Zr	Ba	Cs	Ce	Hf	Lu	Cr	Ta	Pa	Sample No.
RUN 819																		
A 158	20.97	62245	1.51	0.63	0.27	41.72	2.06	46.84	157.44	427.78	4.38	35.88	3.87	1.87	455.13	0.70		2701
		2968.29	0.07	0.03	0.01	1.99	0.10	2.23	7.51	20.40	0.21	1.71	0.18	0.09	21.70	0.03		
A 208	17.33	52785	1.08	0.57	0.40	29.08	0.79	43.18	66.49		4.83	28.99	2.87	1.10	261.09	0.74		0387
		3045.87	0.06	0.03	0.02	1.68	0.05	2.49	3.84		0.28	1.67	0.17	0.06	15.07	0.04		
A 211	15.97	48026	1.09	0.54	0.23	29.28		15.65		254.99	2.12	32.06	3.62		721.26	0.77		0351
		3007.26	0.07	0.03	0.01	1.83		0.98		15.97	0.13	2.01	0.23		45.16	0.05		
TF Q	9.80	31255	0.85	0.43	0.36	13.97	2.20	56.22	36.52		3.97	25.44	2.65	0.91	123.80	0.55		-
		3189.29	0.09	0.04	0.04	1.43	0.22	5.74	3.73		0.41	2.60	0.27	0.09	12.63	0.06		
TF R	11.65	34042	0.97	0.55	0.52	19.08	1.57	37.20			4.45	34.58	3.22	1.21	236.33	0.55		-
		2922.06	0.08	0.05	0.04	1.64	0.13	3.19			0.38	2.97	0.28	0.10	20.29	0.05		
TF S	11.32	36256	0.93	0.51	0.45	16.78	2.34	30.26	84.16		4.64	30.15	3.03		146.47	0.57		-
		3202.83	0.08	0.05	0.04	1.48	0.21	2.67	7.43		0.41	2.66	0.27		12.94	0.05		
TF T	5.43	17158	0.54	0.24		5.31	2.73					16.05	1.34	0.29	51.58	0.34		-
		3159.85	0.10	0.04		0.98	0.50					2.96	0.25	0.05	9.50	0.06		

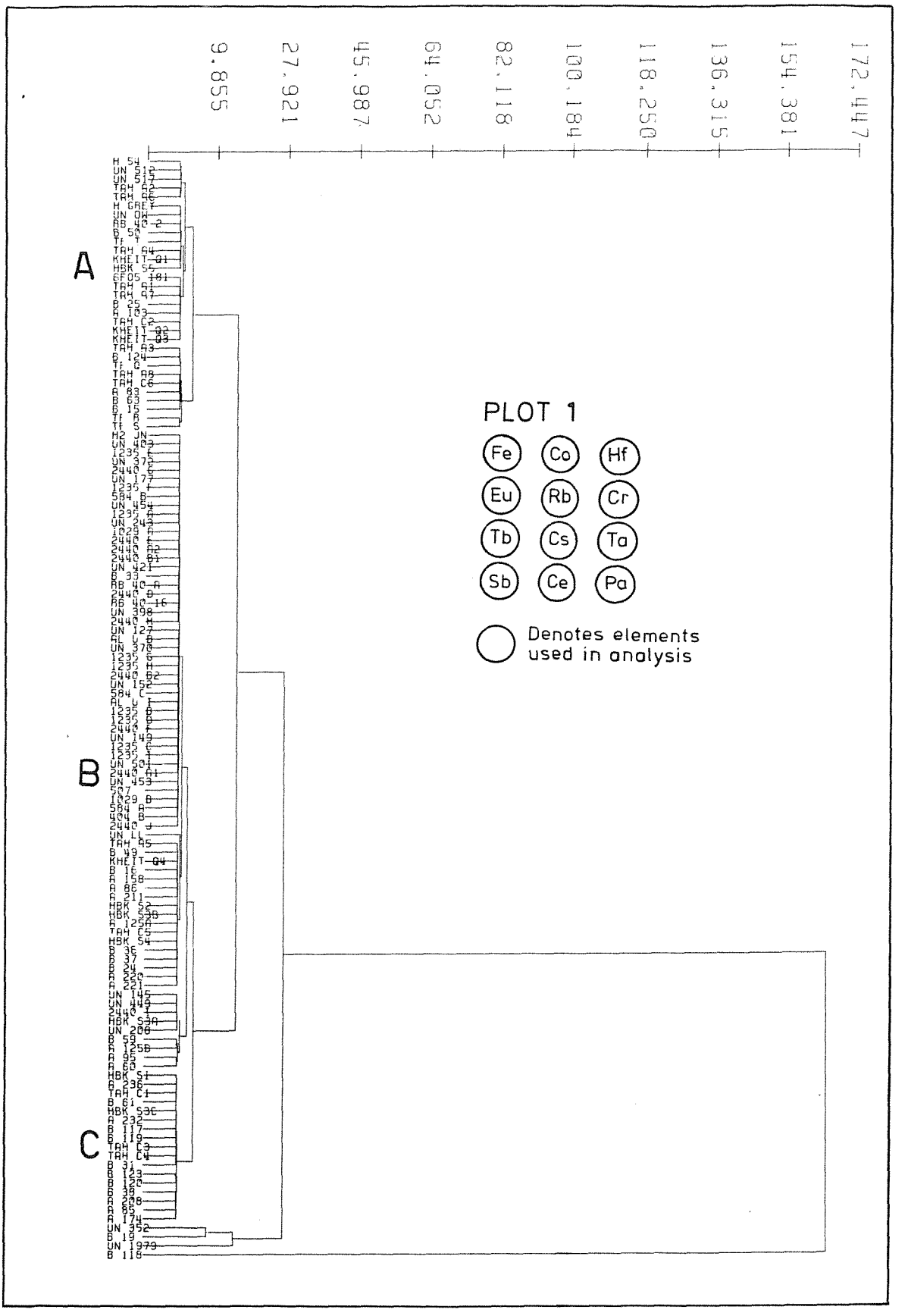


Fig. 8.95 NAA cluster analysis, Plot 1: late fourth and third millennium pottery from Syria (Habūba Kabira); Iraq (Ur, Abu Salabikh, Kish, Jamdat Nasr, Kheit Qasim, Tell al Rubeidheh, Tell Ahmed al Hattū and Tell al Usiyeh); Iran (Tepe Farukhabad) and the Gulf (Umm an Nar and Hili)

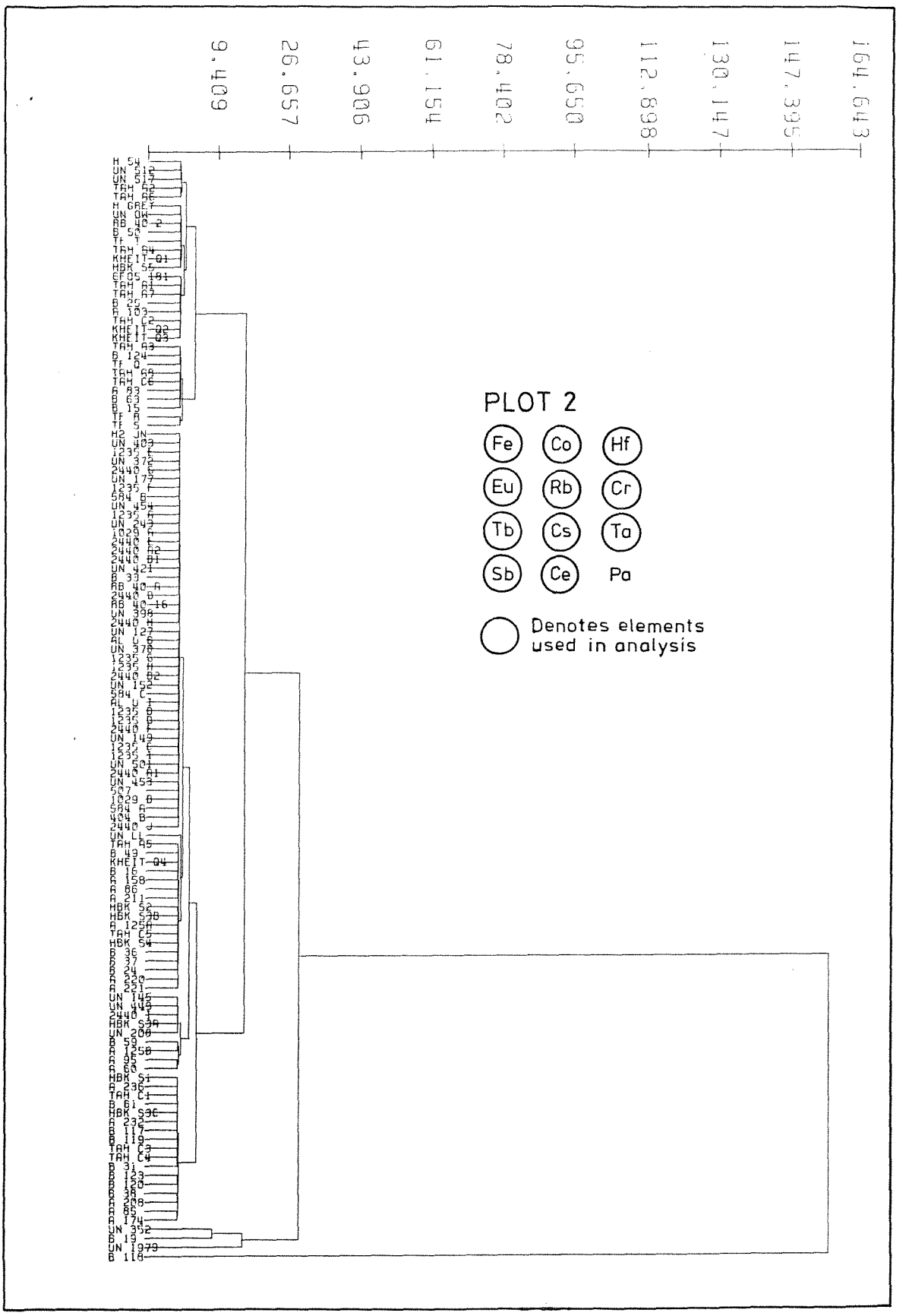


Fig. 8.96 NAA cluster analysis, Plot 2: late fourth and third millennium pottery from Syria (Habūba Kabira); Iraq (Ur, Abu Salabikh, Kish, Jamdat Nasr, Kheit Qasim, Tell al Rubeidheh, Tell Ahmed al Hattū and Tell al Usiyeh); Iran (Tepe Farukhabad) and the Gulf (Umm an Nar and Hili)

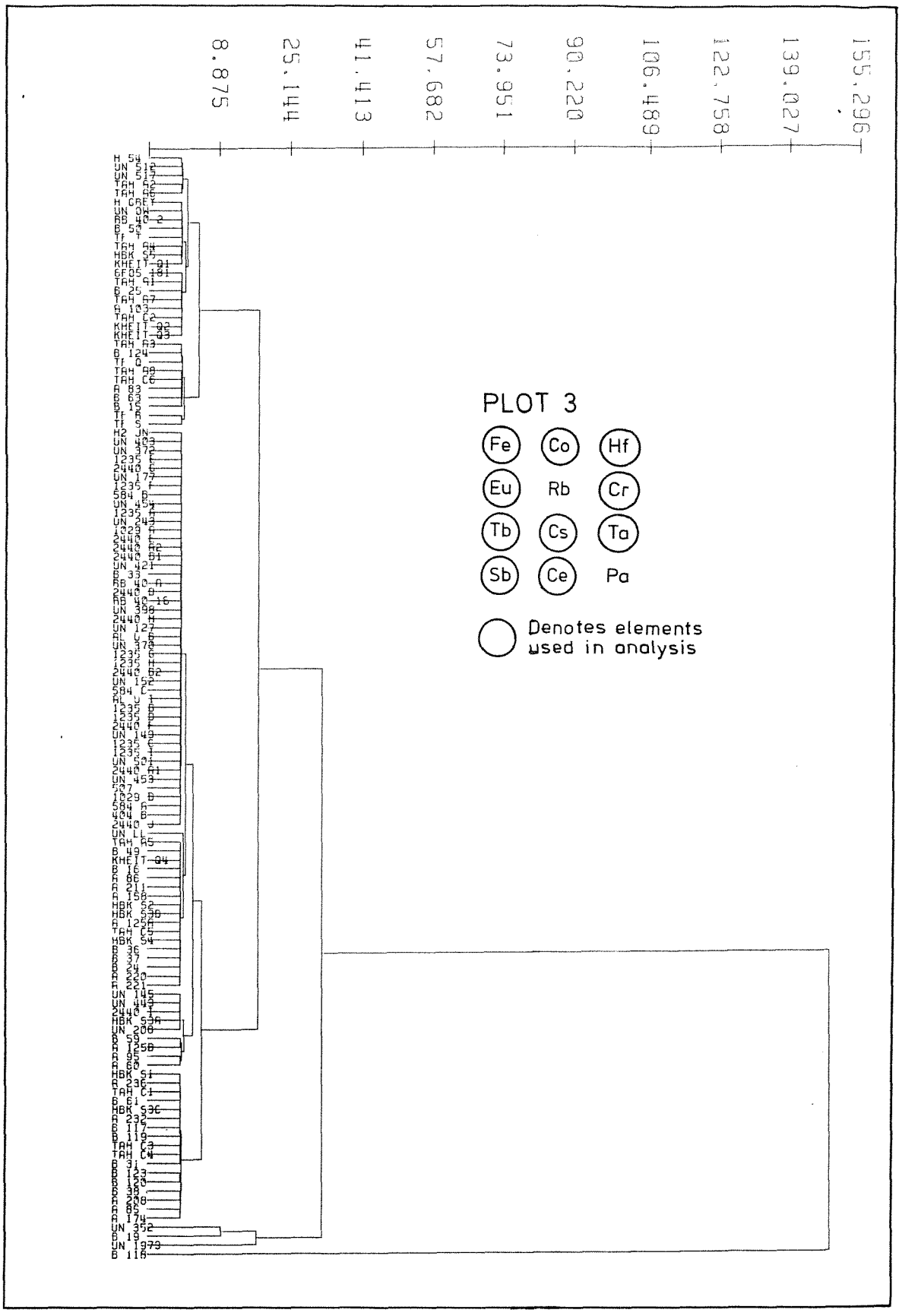


Fig. 8.97 NAA cluster analysis, Plot 3: late fourth and third millennium pottery from Syria (Habūba Kabira); Iraq (Ur, Abu Salabikh, Kish, Jamdat Nasr, Kheit Qasim, Tell al Rubeidheh, Tell Ahmed al Hattū and Tell al 'Usiyeh); Iran (Tepe Farukhabad) and the Gulf (Umm an Nar and Hili)

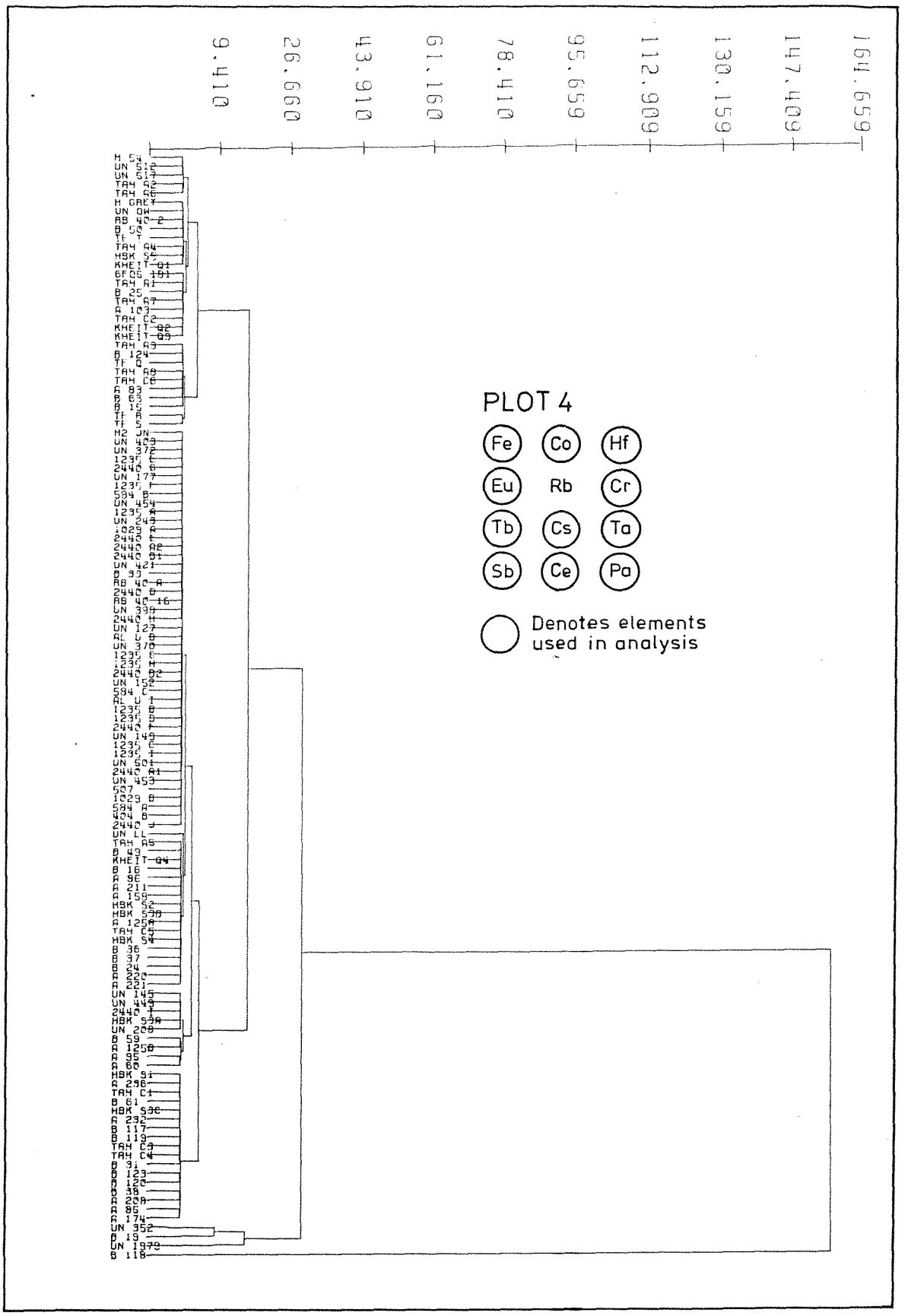


Fig. 8.98 NAA cluster analysis, Plot 4: late fourth and third millennium pottery from Syria (Habūba Kabira); Iraq (Ur, Abu Salabikh, Kish, Jamdat Nasr, Kheit Qasim, Tell al Rubeidheh, Tell Ahmed al Hattū and Tell al 'Usiyeh); Iran (Tepe Farukhabad) and the Gulf (Umm an Nar and Hili)

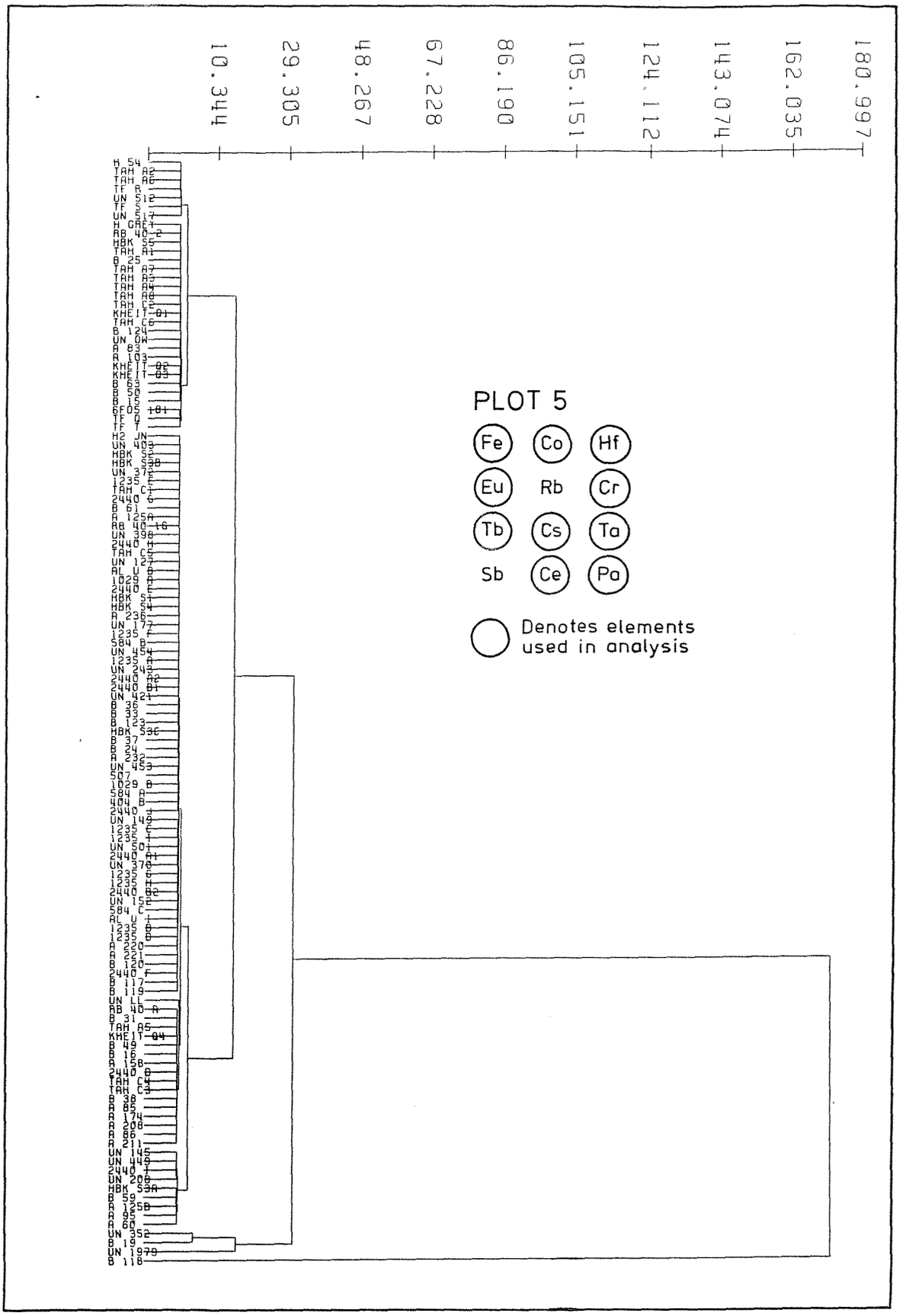


Fig. 8.99 NAA cluster analysis, Plot 5: late fourth and third millennium pottery from Syria (Habūba Kabira); Iraq (Ur, Abu Salabikh, Kish, Jamdat Nasr, Kheit Qasim, Tell al Rubeidheh, Tell Ahmed al Hattū and Tell al 'Usiyeh); Iran (Tepe Farukhabad) and the Gulf (Umm an Nar and Hili)

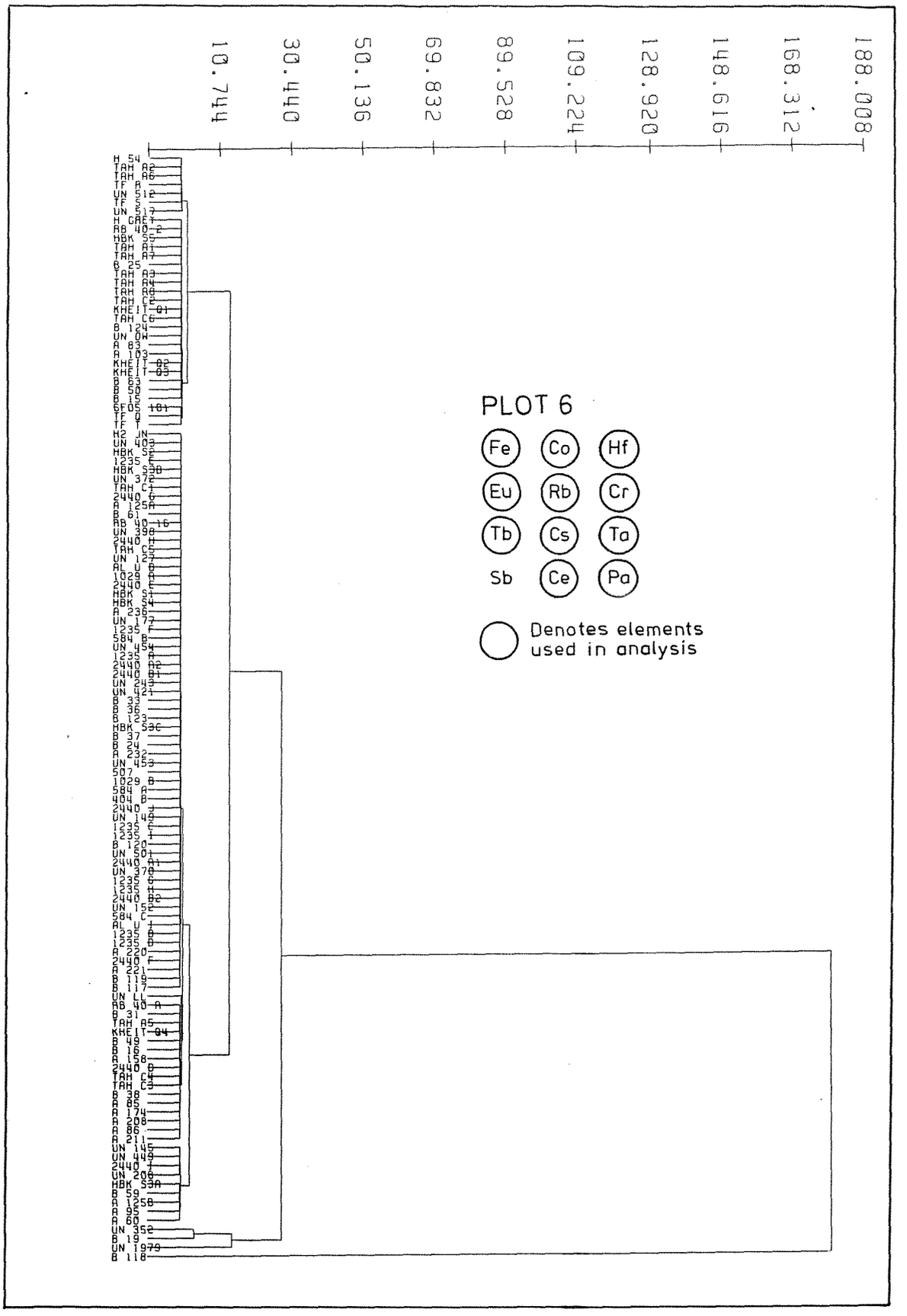


Fig. 8.100 NAA cluster analysis, Plot 6: late fourth and third millennium pottery from Syria (Habūba Kabira); Iraq (Ur, Abu Salabikh, Kish, Jamdat Nasr, Kheit Qasim, Tell al Rubeidheh, Tell Ahmed al Hattū and Tell al 'Usiyeh); Iran (Tepe Farukhabad) and the Gulf (Umm an Nar and Hili)

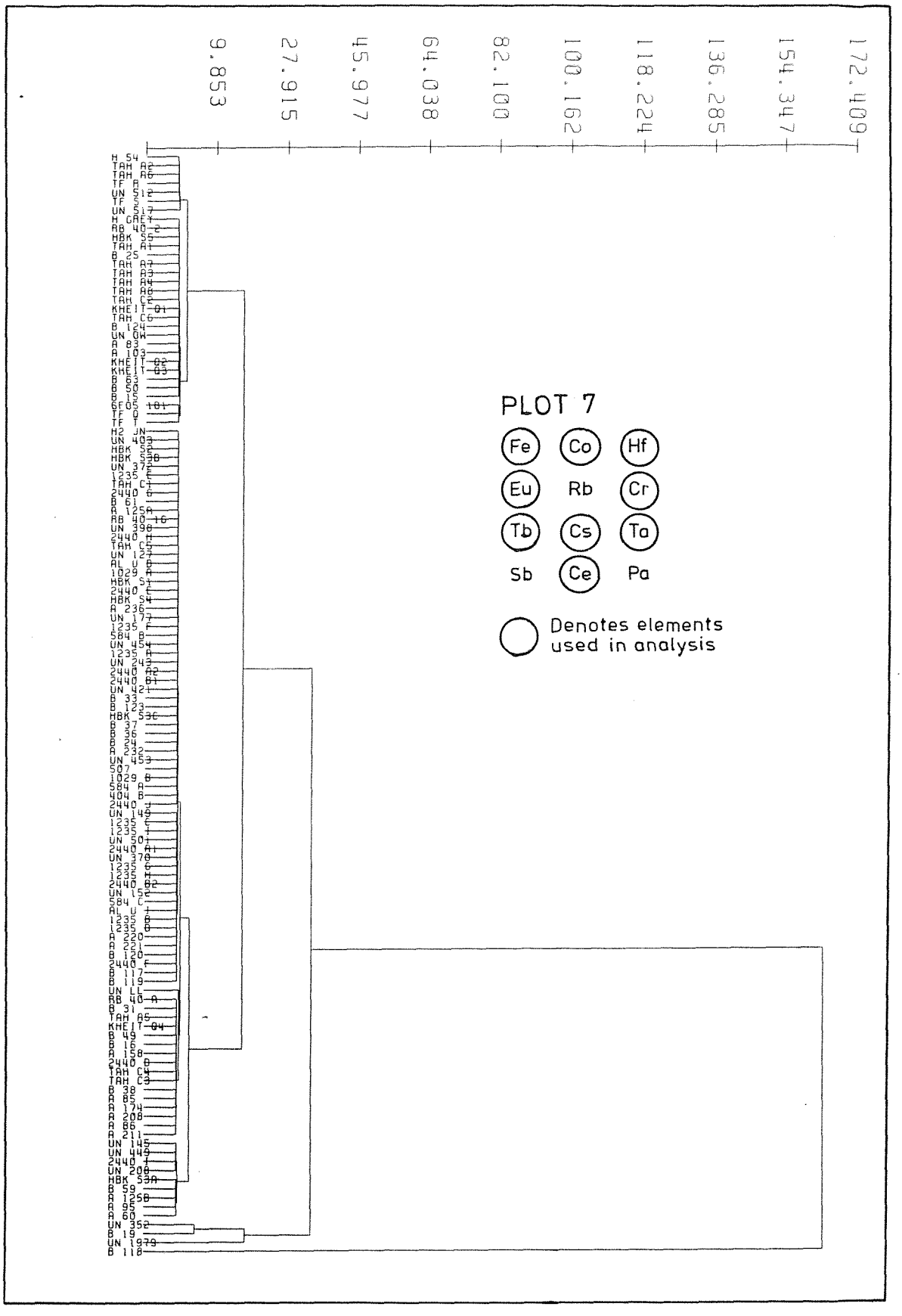


Fig. 8.101 NAA cluster analysis, Plot 7: late fourth and third millennium pottery from Syria (Habūba Kabira); Iraq (Ur, Abu Salabikh, Kish, Jamdat Nasr, Kheit Qasim, Tell al Rubeidheh, Tell Ahmed al Hattū and Tell al 'Usiyeh); Iran (Tepe Farukhabad) and the Gulf (Umm an Nar and Hili)

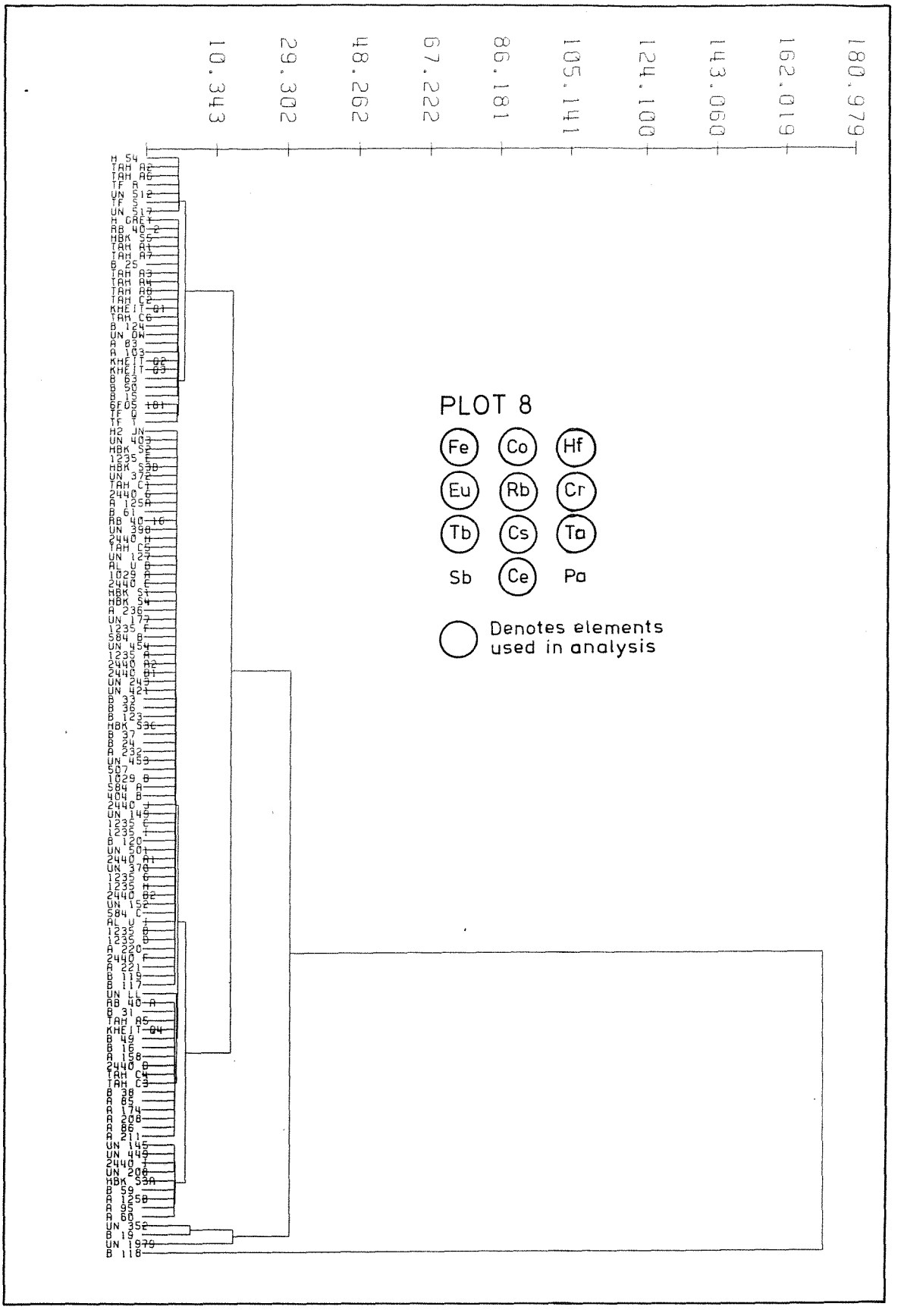


Fig. 8.102 NAA cluster analysis, Plot 8: late fourth and third millennium pottery from Syria (Habūba Kabira); Iraq (Ur, Abu Salabikh, Kish, Jamdat Nasr, Kheit Qasim, Tell al Rubeidheh, Tell Ahmed al Hattū and Tell al 'Usiyeh); Iran (Tepe Farukhabad) and the Gulf (Umm an Nar and Hili)

8.4.3. Cluster Analysis

A preliminary examination of the raw data prior to the implementation of multivariate statistical analyses shows considerable variation in iron (Fe), cobalt (Co) and chromium (Cr) concentrations even after normalisation. Very little variation is apparent for the rare earths such as europium (Eu), terbium (Tb) and hafnium (Hf) although there is an anomalously high value for cerium (Ce) in samples 1078 and 1081 (Table 8.6, Runs 745 and 776). The possibility of at least two groups based on distinctions between high and low chromium values is also evident from a visual examination of the data. The sample group as a whole, however, exhibits a degree of heterogenity which requires statistical sorting in order to identify and distinguish between potentially different pottery groups.

Multi-trace element analyses such as neutron activation analysis require elaborate data treatment to obtain maximum results. Early analytical studies of pottery relied upon visual comparisons of composition patterns from which preliminary groups were formed and to which samples were assigned by matching their patterns to group averages (Catling and Millett 1965, 18-32). The analysis of a greater range of trace elements, however, requires the use of more rigorous techniques derived from multivariate statistics.

Cluster analysis has become a widely used technique for the statistical processing of data (Benfer 1979, 241-242; Doran and Hodson 1975, 173-184; Hodson 1969; Orton 1980, 47-62; Wishart 1978, 2-3) and is particularly appropriate for the analysis of neutron activation data concerned with provenance studies requiring a visual representation of the data. The choice of clustering procedure, however, varies considerably. Davidson (1981) and Davidson and McKerrell (1976; 1980) employed Mahalinobis distance to relate pottery groups to clay sources while Hughes et al. (1982) have used Principal Components Analysis to identify small sub-groups within a single large group of data and Discriminant Analysis to test distinctions between pottery groups on the basis of trace element concentration. An alternative approach is the use of hierarchial agglomerative procedures. The results are generally produced in the form of a dendrogram. Ward's method is an example of such an hierarchical linkage and has been adopted in the present study using the CLUSTAN computer package (Wishart 1978).

Detailed descriptions of the various hierarchical

agglomerative procedures may be found in Bieber et al. (1976, 60-71); Sneath and Sokal (1973, 188-308) and Everitt (1974). Samples are grouped to form clusters and the clusters are joined to form larger groups. Quantification of compositional similarity is the most important step towards objective groupings. Given compositional data for two samples, some numerical value must be obtained which is a measure of their similarity or dissimilarity. In practice the measure is 'distance'. Thus the different concentration values of several elements in a comparison of two different samples may be combined to yield a total amount of dissimilarity. One way of achieving this summation is the use of Squared Mean Euclidian Distance. This technique is applied in Ward's method. It should be noted that a number of other methods, such as Single Linkage, Average Linkage (Hammond et al. 1976, 156) and Centroid (Pollard 1983, 56) are available in CLUSTAN. No single method however is suited to every research programme concerned with analytical data grouping (Pollard 1983, 59), although Ward's method is considered useful in processing large bodies of data (Pollard 1983,60) and produces clear compact clusters from which major groups are readily identifiable.

Ward's method

The data to be classified are arranged in an n x m raw data matrix where n rows represent the entities to be grouped on their similarity to one another;
and m columns represent the characteristics (variables) on the basis of which these groupings occur.
Thus: sherd samples = entities
component trace elements = (characteristics) the columns.

The standardisation of this raw data matrix is first carried out to ensure that each variable is equally weighted, thus eliminating the greater influence exerted by variables with the greatest magnitude.
Hence the matrix of standard scores is obtained from:

$$[\ X_{ik}\ ]_s = (X_{ik} - \bar{X}_k) / S_k)$$

Where $\bar{X}_k$ = mean for variable k

S_k = standard deviation for variable k

Each score $[\ X_{ik}\ ]_s$ is therefore expressed as deviation from the mean in standard deviation units.

A computation of the measure of resemblance between each pair of entites produces an n x m similarly matrix. The coefficient of resemblance between each pair of entities applied in Ward's method is the Squared Euclidean Distance where each entity is considered as a part in multi-dimensional space where the number of dimensions represents the number of variables determined.

The Squared Euclidean Distance d_{ij}^2 is calculated thus:

$$d_{ij}^2 = \int_{k=1}^{m} (X_{ik} - X_{jk})^2$$

where X_{ik} is the kth variable measured on entity i

X_{jk} is the kth variable measured on entity j

d_{ij}^2 is the distance between entity i and entity j

m variables are measured on each entity.

Once the similarity matrix is computed the cluster analysis is performed. In Ward's method this is accomplished by pairing the first of the two entities whose d^2 is a minimum, followed by the addition of subsequent entities so that the error sum of squares on d^2 is only increased by the minimum amount possible.

The computer program output comes in the form of a dendrogram illustrating the various groupings and their hierarchical relationship to one another.

Relocation

It has been noted that outlying members of groups may cluster in the 'wrong' group since sherds added to a group at an early stage remain in that group despite the fact that the overall character of the group may change during subsequent additions. Few studies using multivariate data attempt to regroup sherds although Hammond et al. (1976, 158-160) introduced the LIKEPART programme in order to improve their data clustering. A relocation procedure where a sherd is reallocated when it does not occur in its closest group is available in the CLUSTAN package (Wishart 1978, 43-50) and has been used in conjunction with Ward's method in the present study. Unfortunately the results from RELOCATE cannot be presented in

dendogram form. In the two cases examined (Figs. 8.95 and 8.104), however, only three samples had been regrouped, each within the principal clusters. Hence the composition of the clusters remained the same despite reallocation of individual samples.

8.4.4. Discussion of the dendrograms

Initially the neutron activation results for all samples were included in the statistical grouping and a dendrogram produced which divided the vessels into three main groups (Fig. 8.95). Group A consists of pottery from sites in the Hamrin Basin, from Tepe Farukhabad, and from jars found at Ur and Kish. Several sherds from Umm an Nar and Hili are also included in this group.

The majority of the samples in the second and largest group (Group B) are from Ur, Abu Salabkih, Kish and Jamdat Nasr together with Early Dynastic jar types (Fig. 8.91) from Umm an Nar. The remainder of the group contains several sherds of painted ware from the Hamrin and from northern Syria (Habuba Kabira) and a further four samples of Early Dynastic wares from the Haditha area (Tell al Usiyeh). A similar selection of sites is represented in the much smaller cluster formed by Group C and it is not immediately apparent why the cluster analysis separates these two groups. Four vessels remain outside the three main groups and judging by the coefficient of similarity are not associated with one another. Two of the samples are from Ur, B19 (a spouted jar, Sample 0276) and B118 (a solid footed goblet, Sample 0095). The remaining two samples are from Umm an Nar and had been designated as local wares from the site. The degree of disimilarity between these two vessels, however, suggests that neither is local to Umm an Nar, nor is it likely that they originated from a Mesopotamian workshop. Petrographic analysis of the two samples also refutes the possibility of a Mesopotamian origin.

It has not been possible using cluster analysis for all 124 samples to distinguish adequately between the pottery produced from different geographical regions. Group B however does seem to contain pottery predominantly from the Hamrin Basin. A series of cluster analyses using different combinations of samples has been undertaken in order to distinguish between ceramic products from different regions. Others deemed to be imported wares may subsequently be identified by clustering these vessels with pottery samples from other regions.

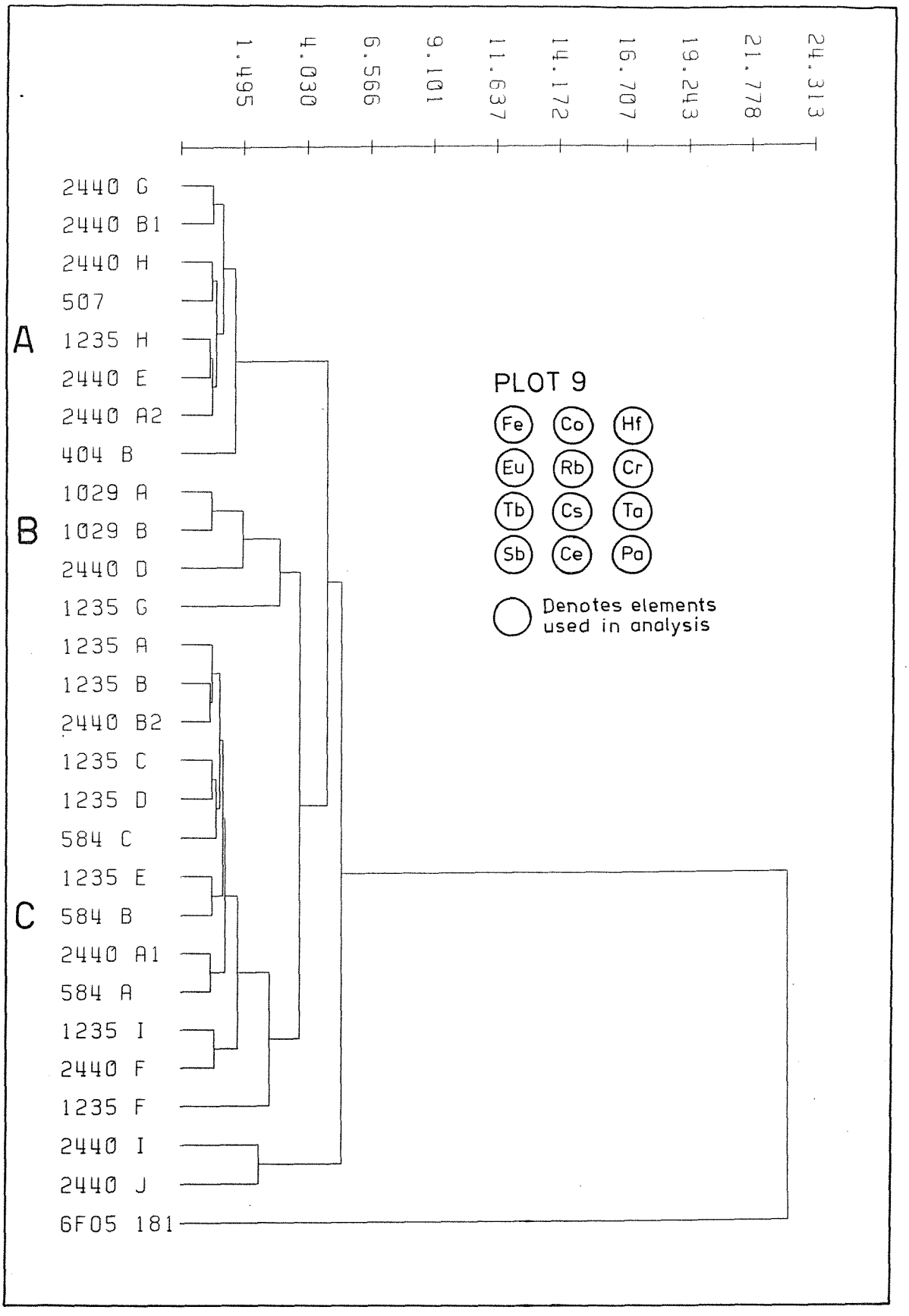


Fig. 8.103 NAA cluster analysis, Plot 9: Early Dynastic pottery from Abu Salabikh

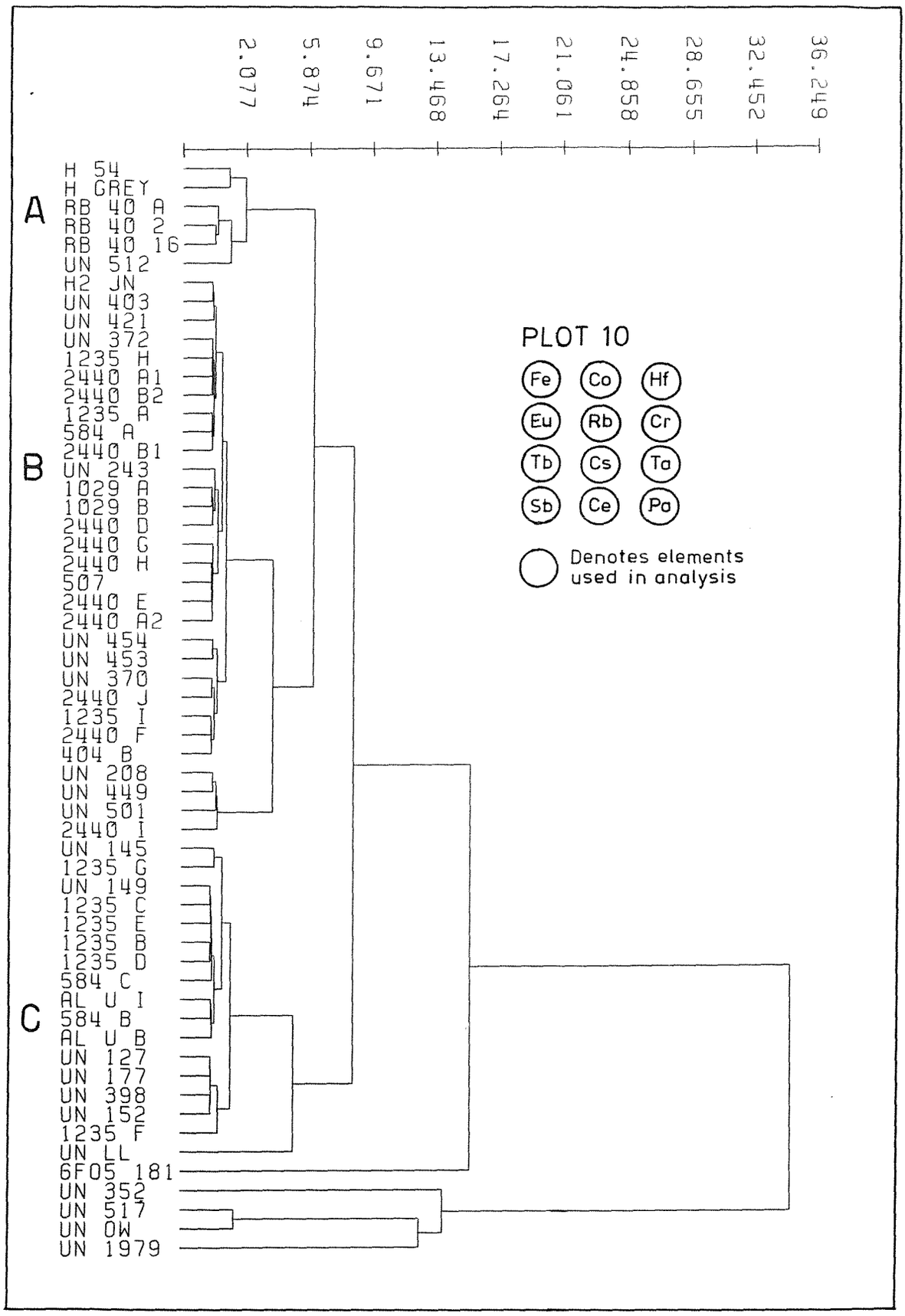


Fig. 8.104 NAA cluster analysis, Plot 10: Late fourth and third millennium pottery from Iraq (Abu Salabikh, Tell al Rubeidheh and Tell al 'Usiyeh), and the Gulf (Umm an Nar and Hili)

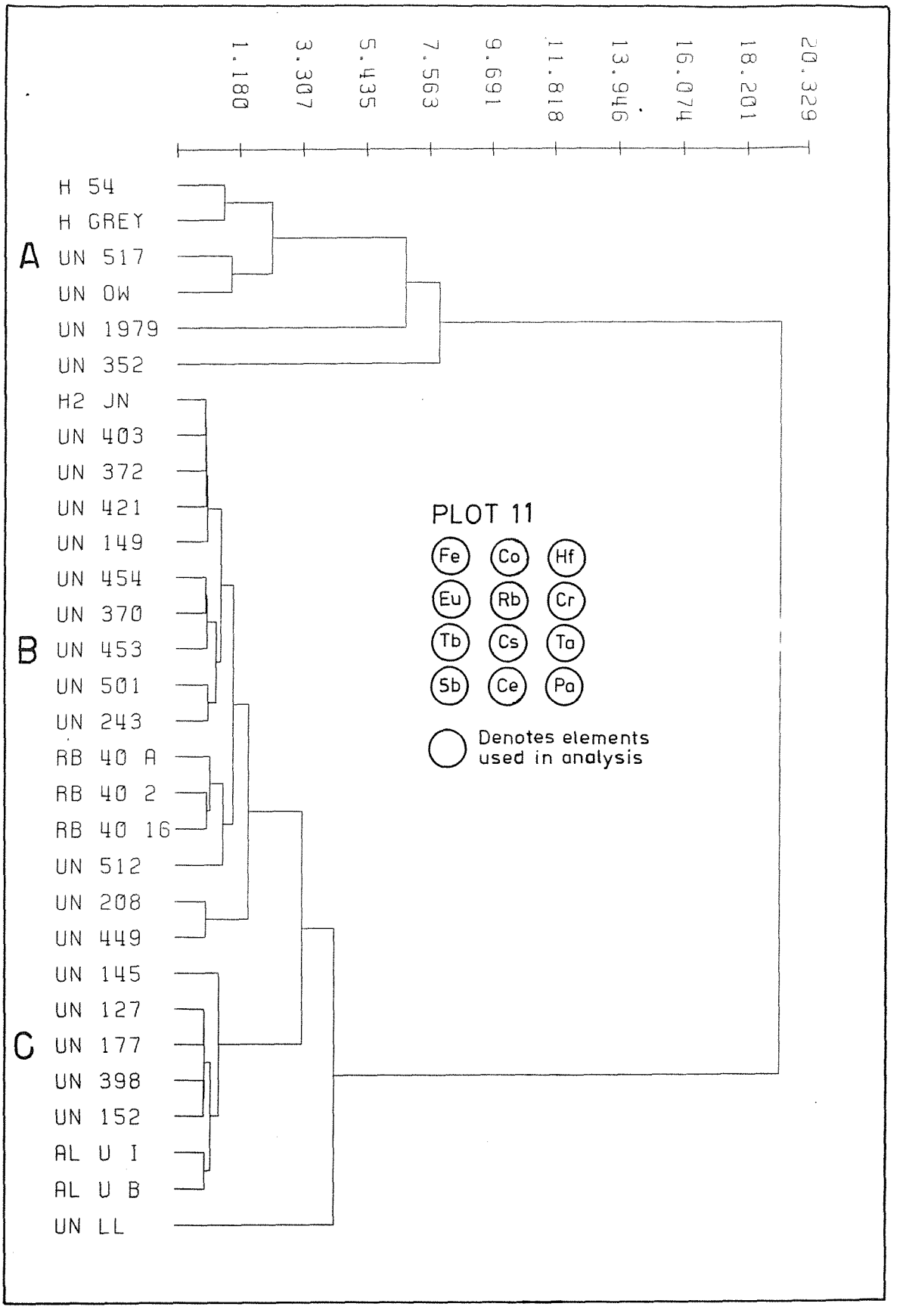


Fig. 8.105 NAA cluster analysis, Plot 11: Third millennium pottery from the Gulf (Umm an Nar and Hili), Tell al Rubeidheh and Tell al 'Usiyeh

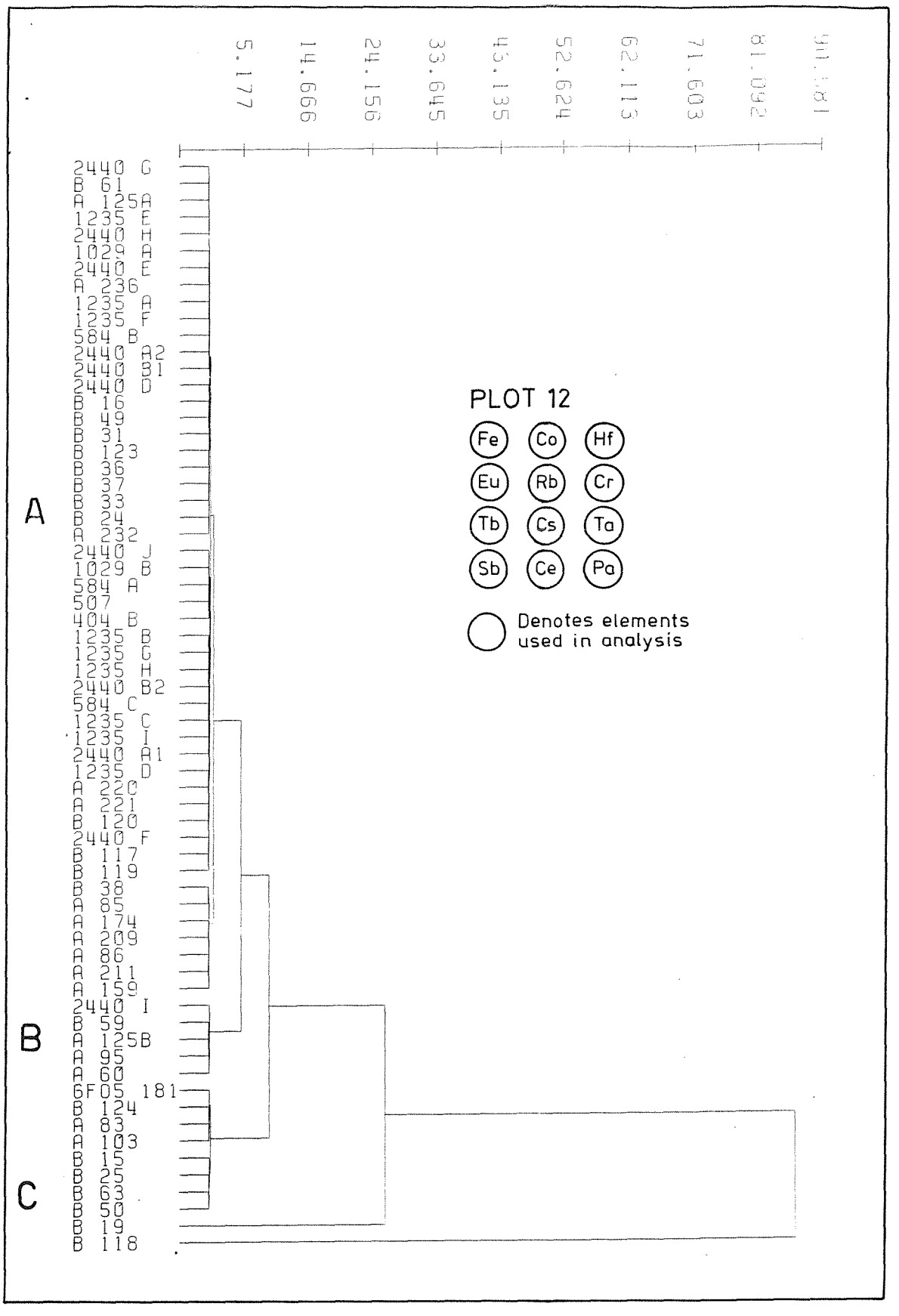


Fig. 8.106 NAA cluster analysis, Plot 12: Third millennium pottery from Ur, Abu Salabikh, Kish and Jamdat Nasr

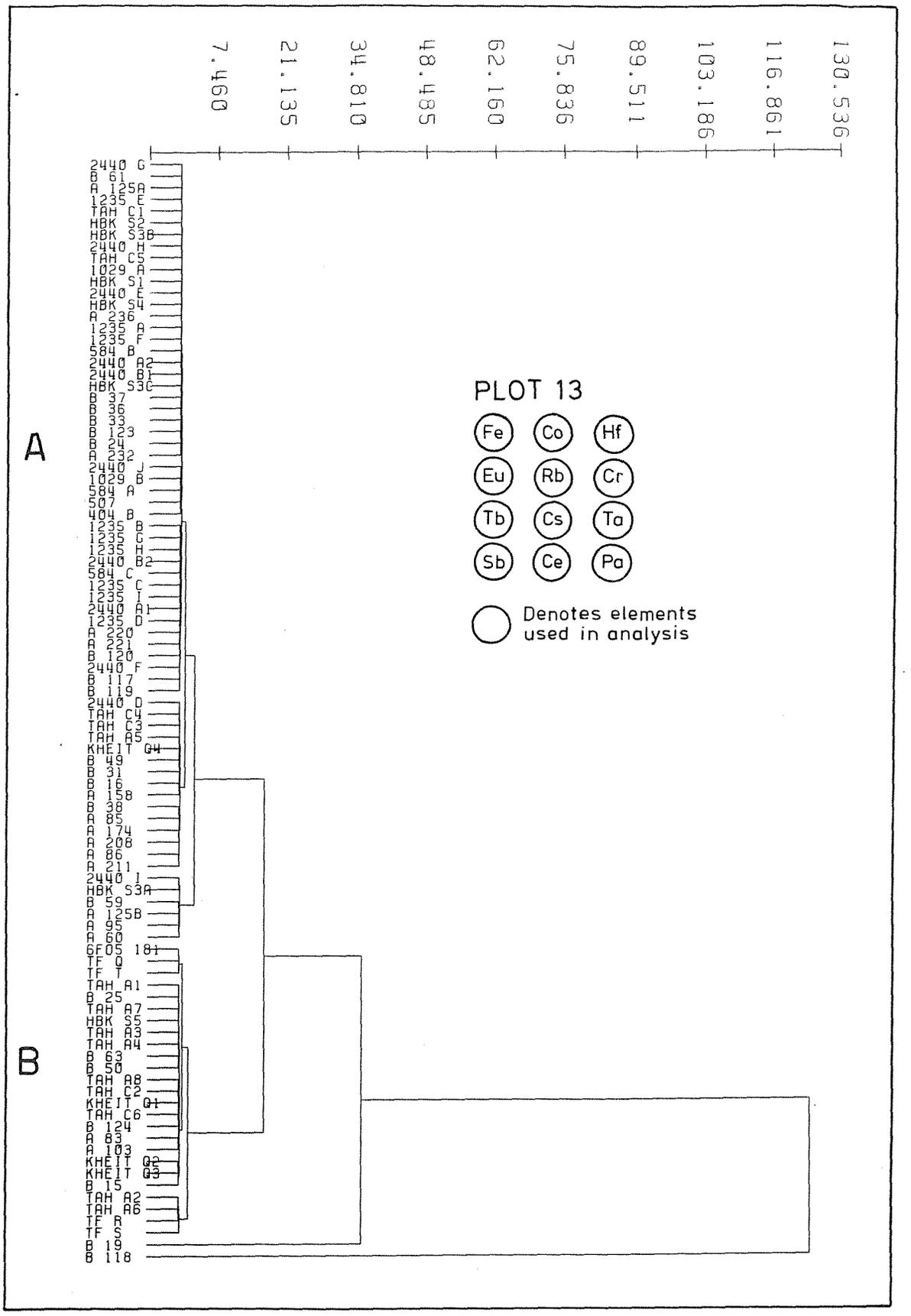


Fig. 8.107 NAA cluster analysis, Plot 13: Late fourth and third millennium pottery from Syria (Habūba Kabira); Iraq (Ur, Abu Salabikh, Kish, Jamdat Nasr, Kheit Qasim, Tell al Rubeidheh, Tell al 'Usiyeh, Tell Ahmed al Hattū) and Iran (Tepe Farukhabad)

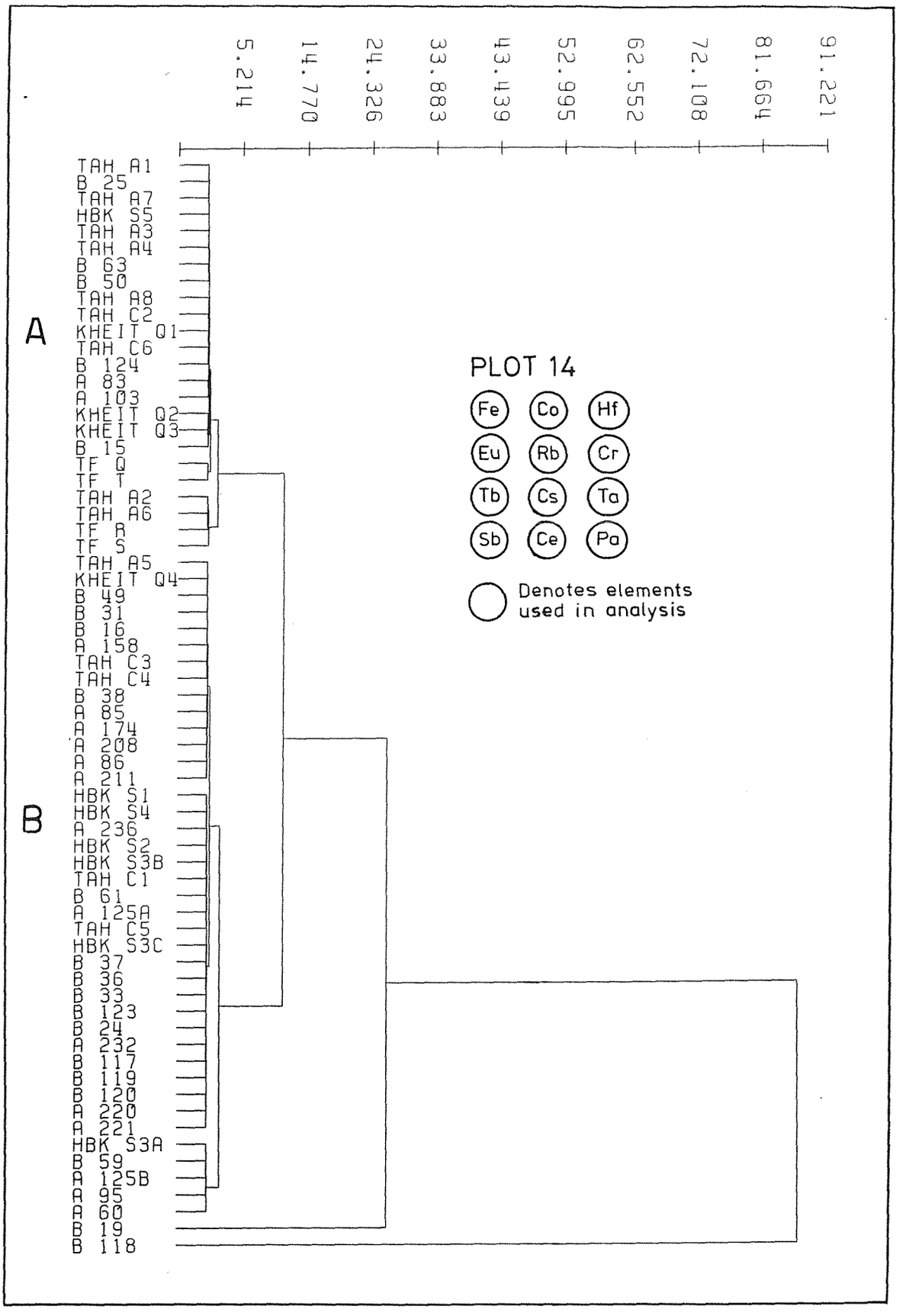


Fig. 8.108 NAA cluster analysis, Plot 14: Late fourth and third millennium pottery from Syria, Iraq and Iran. Similar to Plot 13, but excluding samples from Abu Salabikh

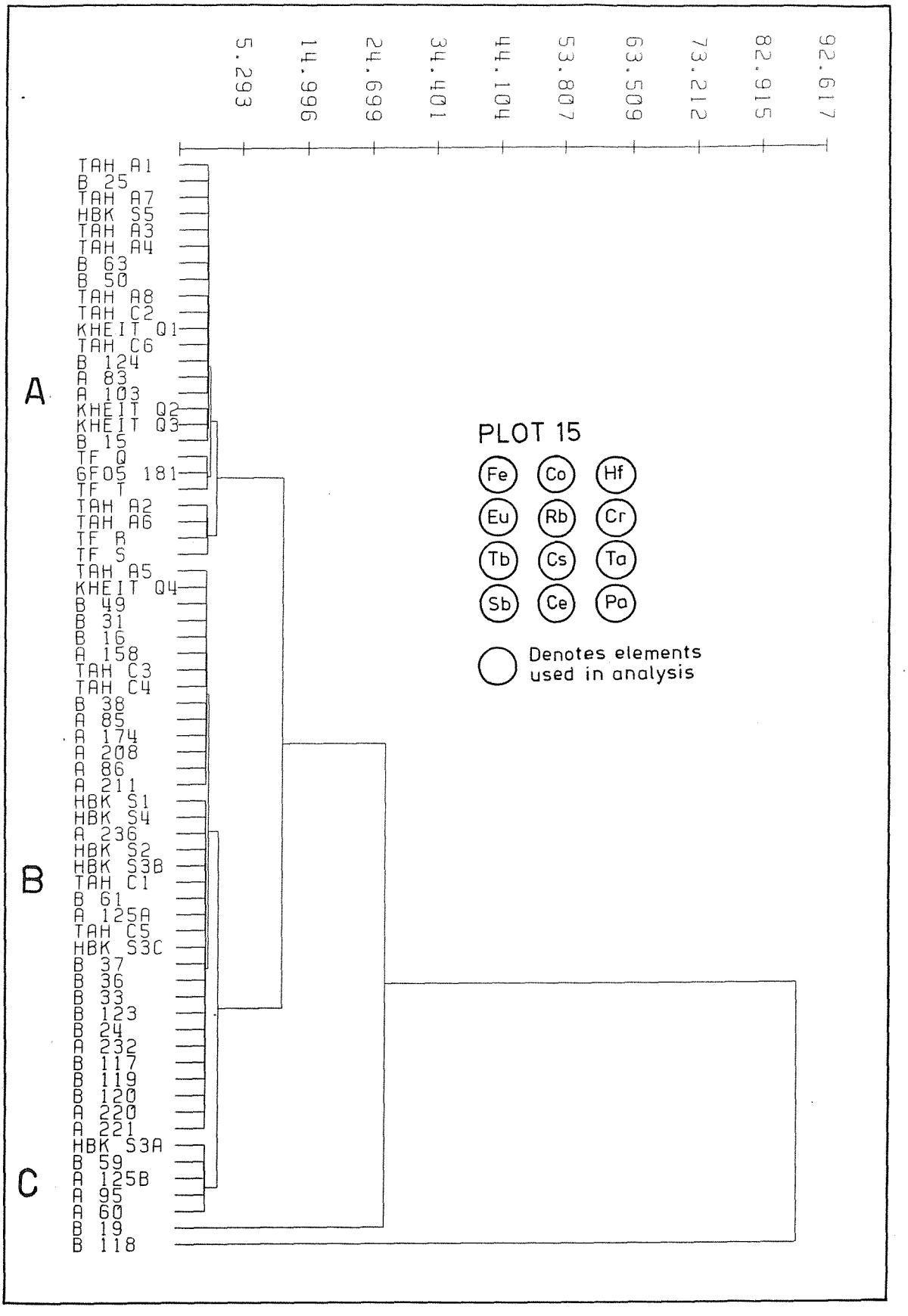


Fig. 8.109 NAA cluster analysis, Plot 15: Late fourth and third millennium pottery from Syria, Iraq and Iran. Similar to Plot 14, but including painted ware (6 F05. 181) from Abu Salabikh

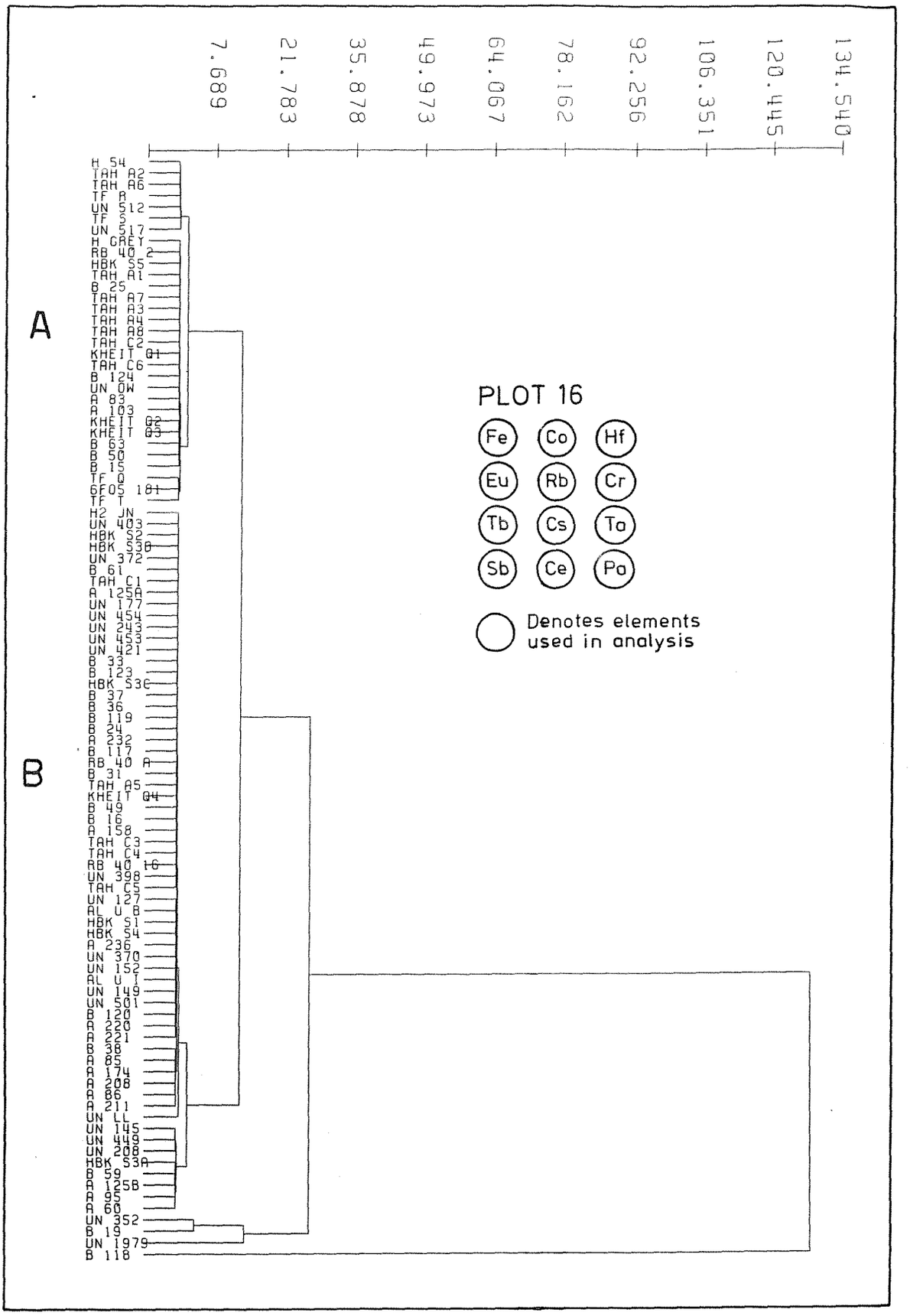


Fig. 8.110 NAA cluster analysis, Plot 16: Late fourth and third millennium pottery from Iraq (Ur, Kish, Jamdat Nasr, Kheit Qasim, Tell al Rubeidheh, Tell al 'Usiyeh, Tell Ahmed al Hattū) and the Gulf (Umm an Nar and Hili)

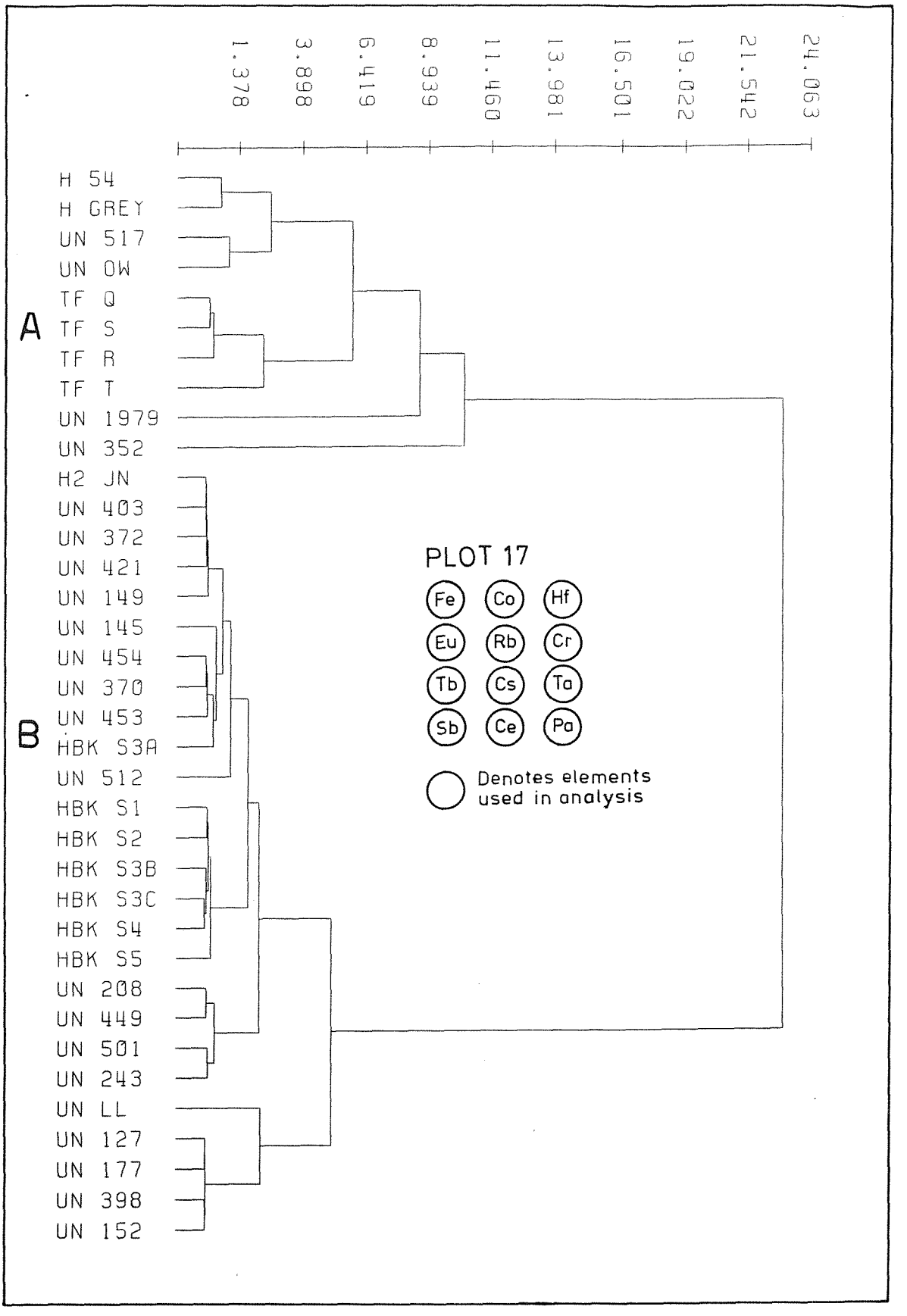


Fig. 8.111 NAA cluster analysis, Plot 17: Late fourth and third millennium pottery from Syria (Habūba Kabira); Iran (Tepe Farukhabad) and the Gulf (Umm an Nar and Hili)

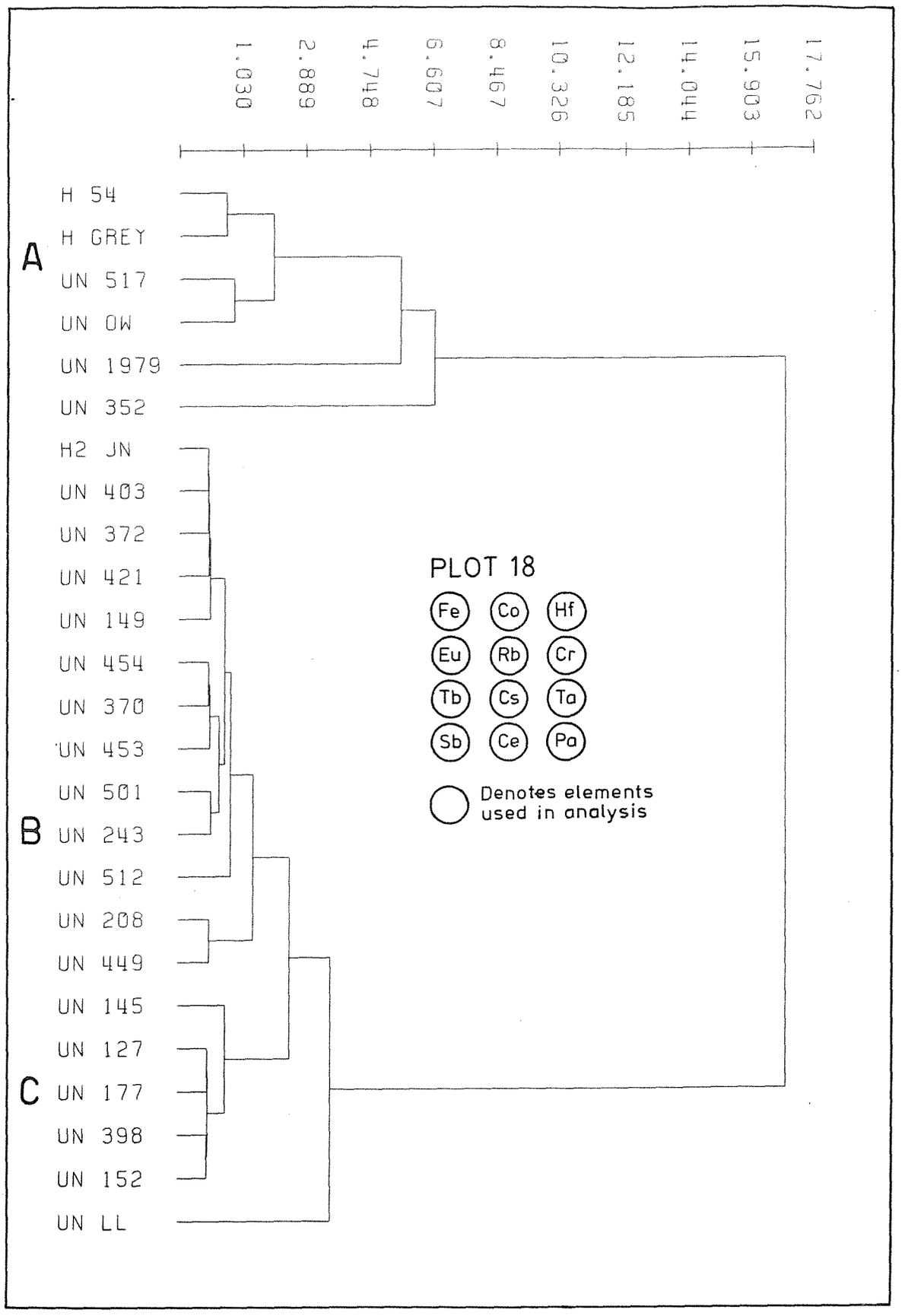


Fig. 8.112 NAA cluster analysis, Plot 18: Late fourth and third millennium pottery from Umm an Nar and Hili

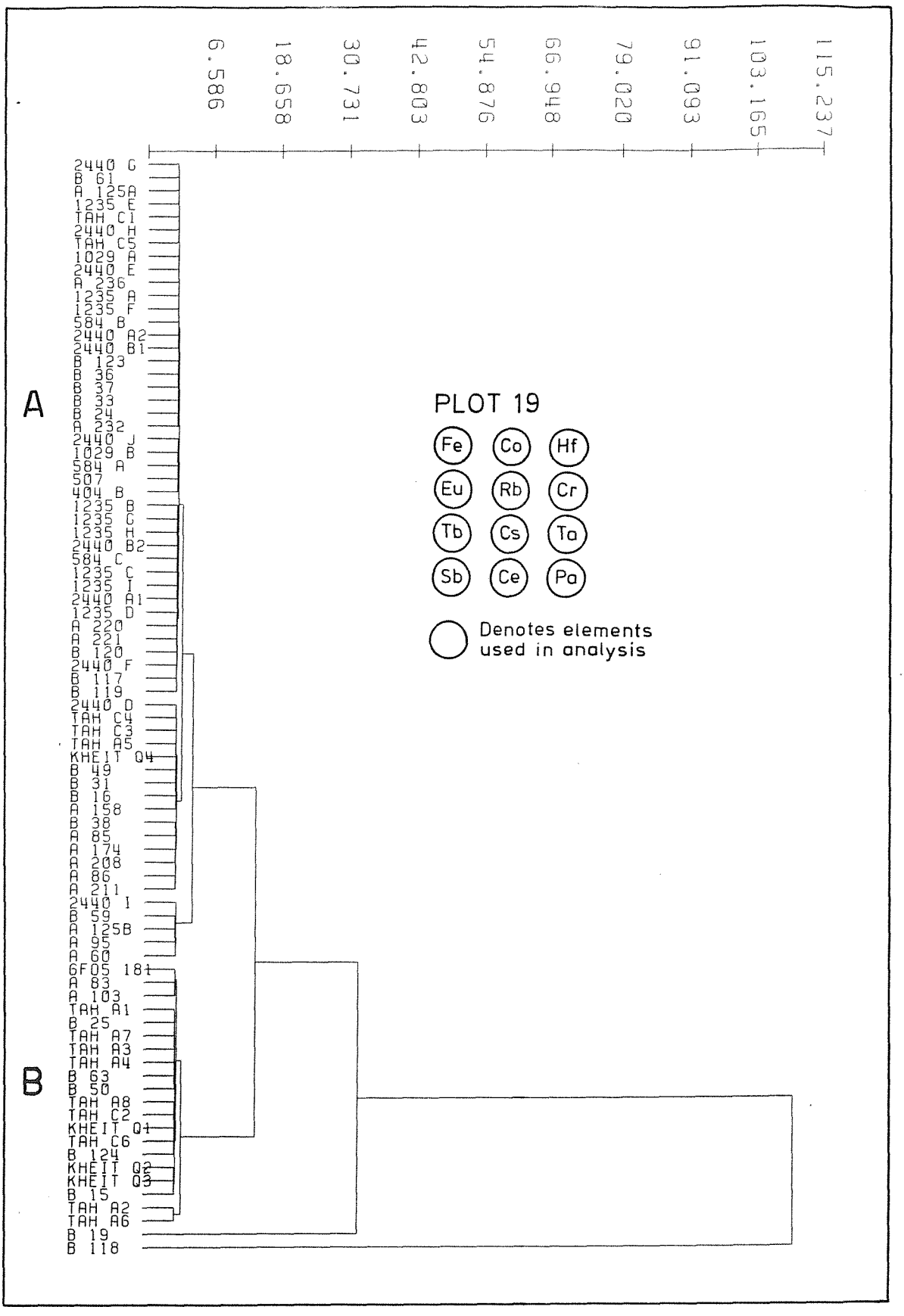


Fig. 8.113 NAA cluster analysis, Plot 19: Late fourth and third millennium pottery from Iraq only: Ur, Abu Salabikh, Kish, Jamdat Nasr, Kheit Qasim and Tell Ahmed al Hattū

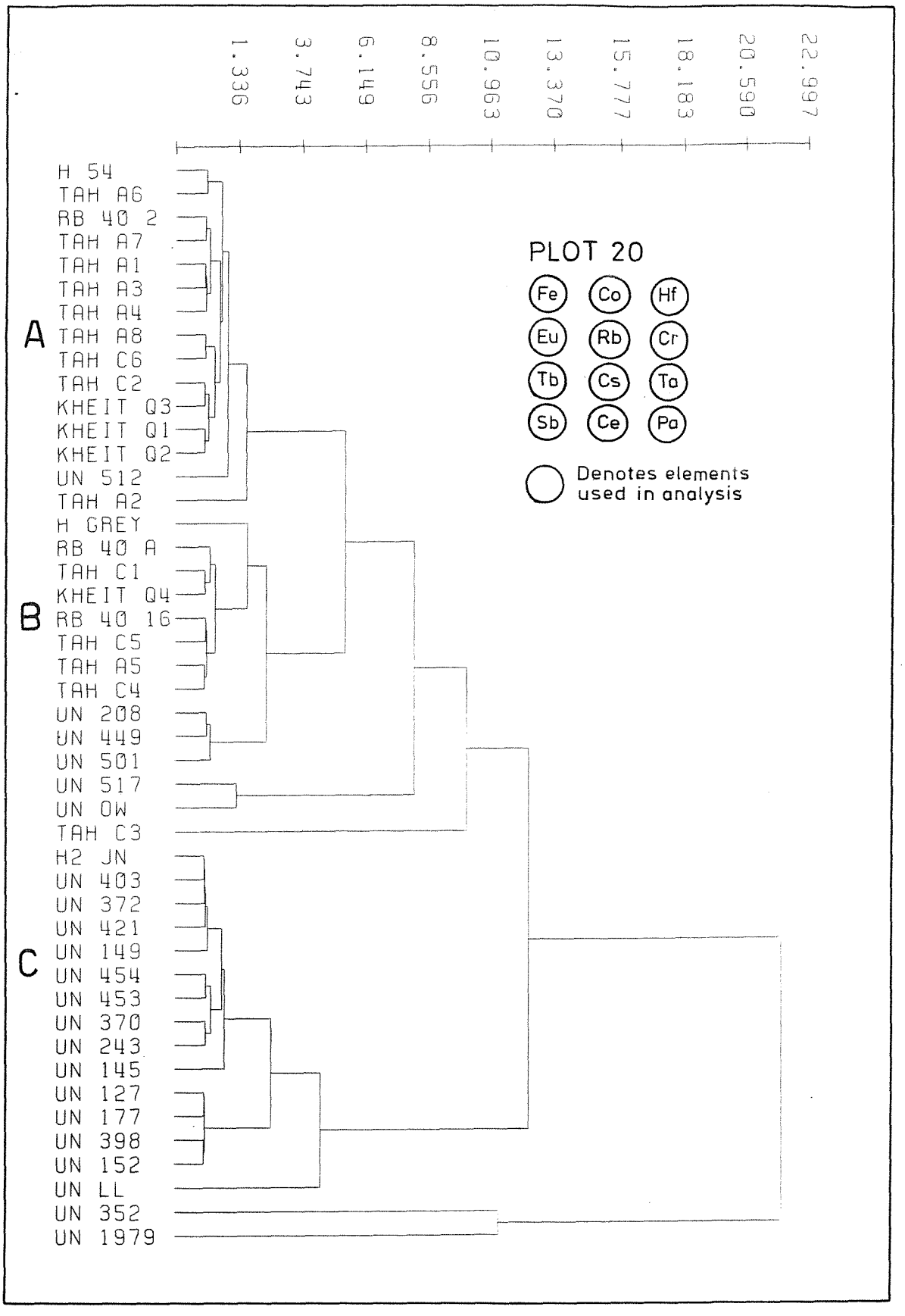


Fig. 8.114 NAA cluster analysis, Plot 20: Late fourth and third millennium pottery from the Hamrin Basin (Tell al Rubeidheh, Kheit Qasim and Tell Ahmed al Hattū) and the Gulf (Umm an Nar and Hili)

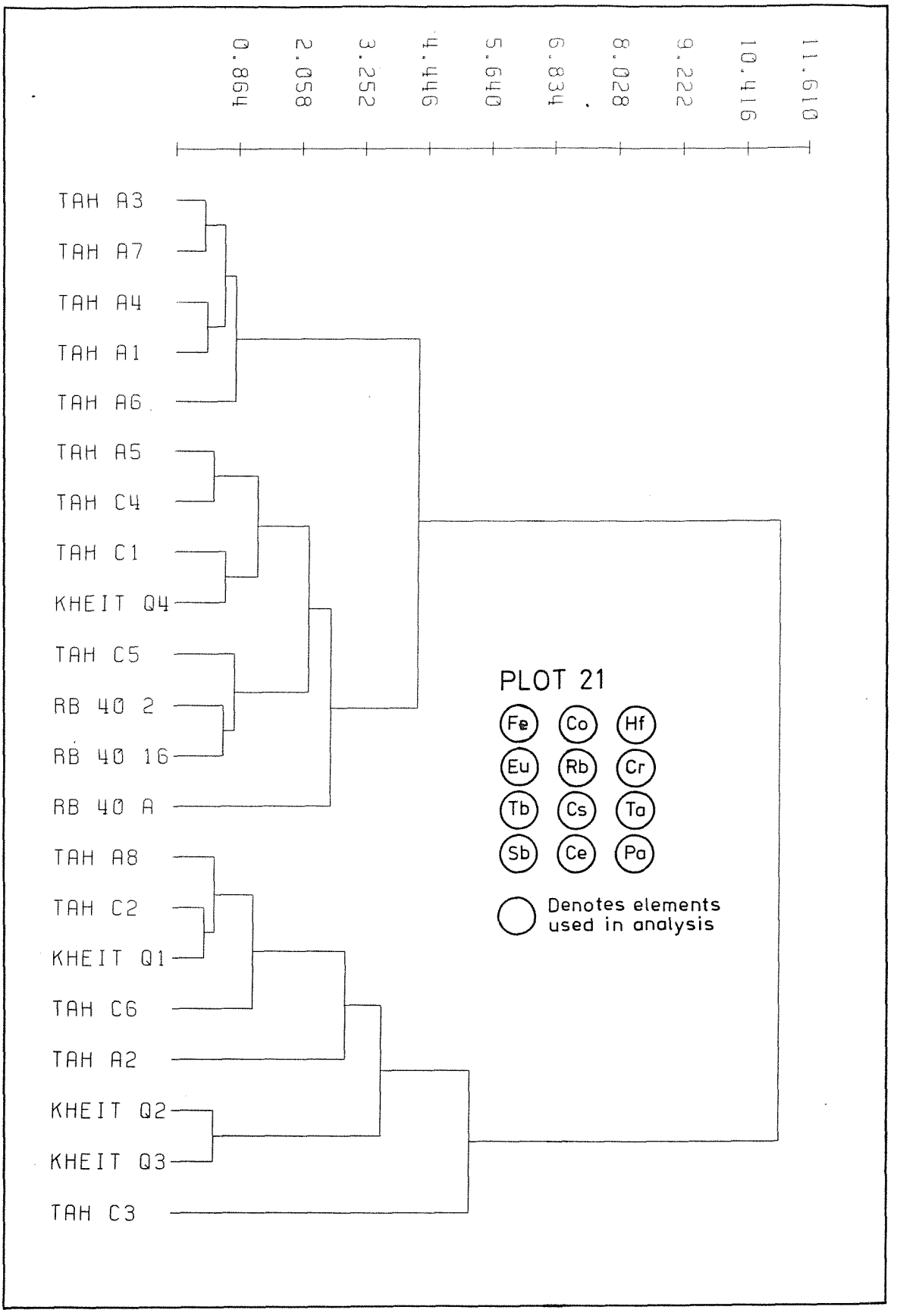


Fig. 8.115 NAA cluster analysis, Plot 21: Late fourth and third millennium pottery from the Hamrin Basin only. Tell al Rubeidheh, Kheit Qasim and Tell Ahmed al Hattū

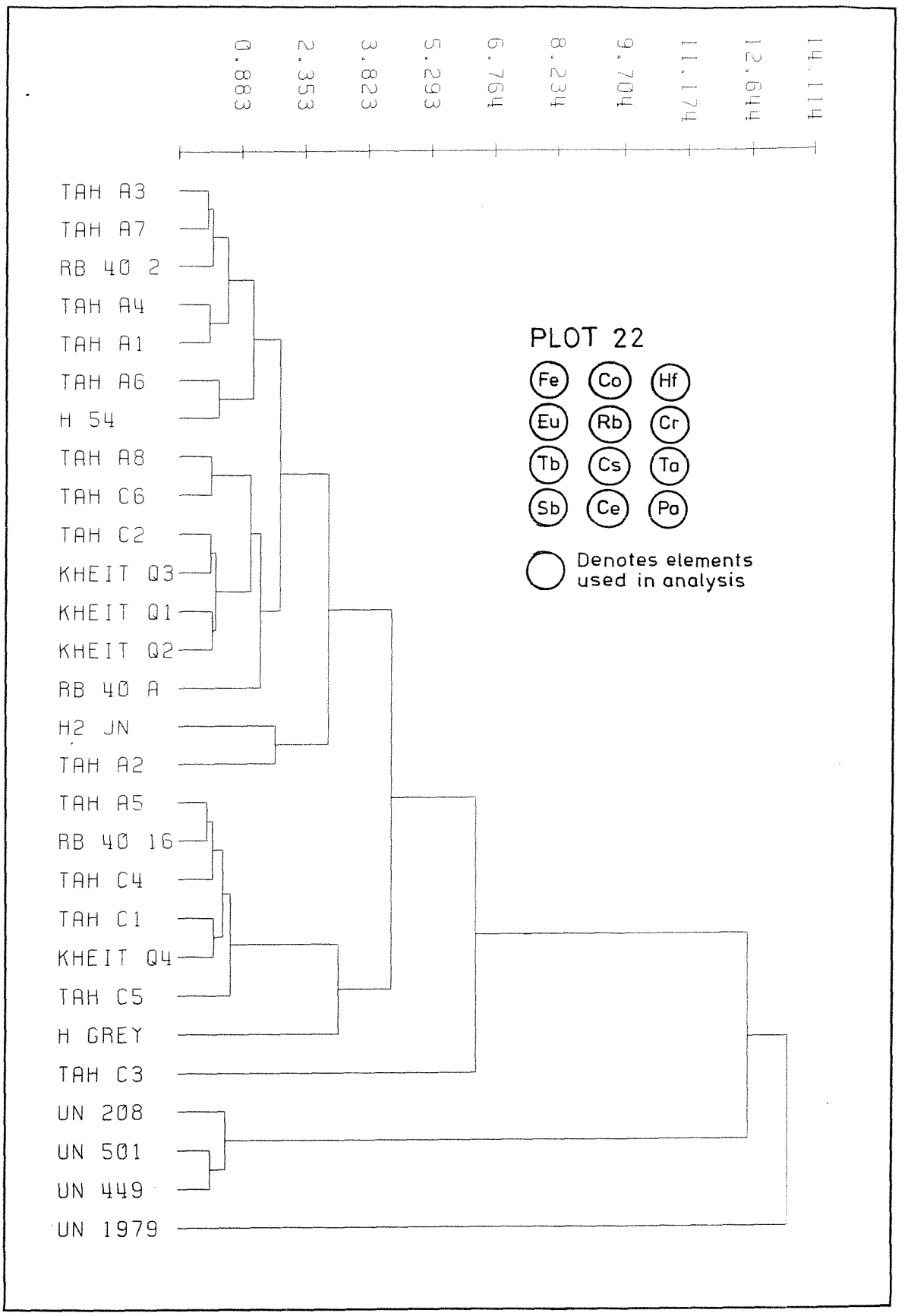


Fig. 8.116 NAA cluster analysis, Plot 22: Late fourth and third millennium pottery from the Hamrin Basin (Tell al Rubeidheh, Kheit Qasim and Tell Ahmed al Hattū) and painted wares from Umm an Nar and Hili

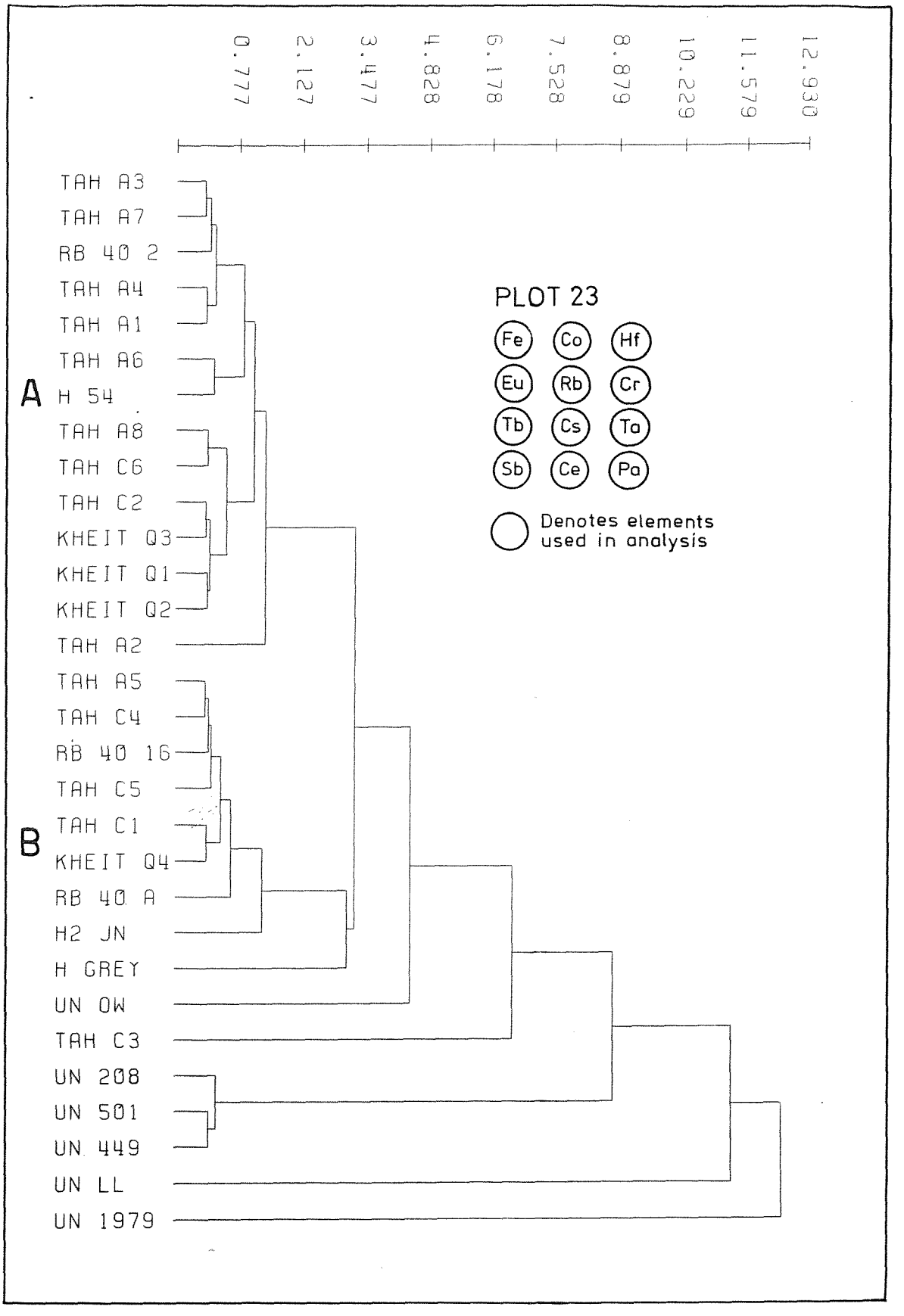


Fig. 8.117 NAA cluster analysis, Plot 23: Late fourth and third millennium pottery from the Hamrin Basin (Tell al Rubeidheh, Kheit Qasim and Tell Ahmed al Hattū) and the Gulf (Umm an Nar and Hili), excluding Sumerian imports

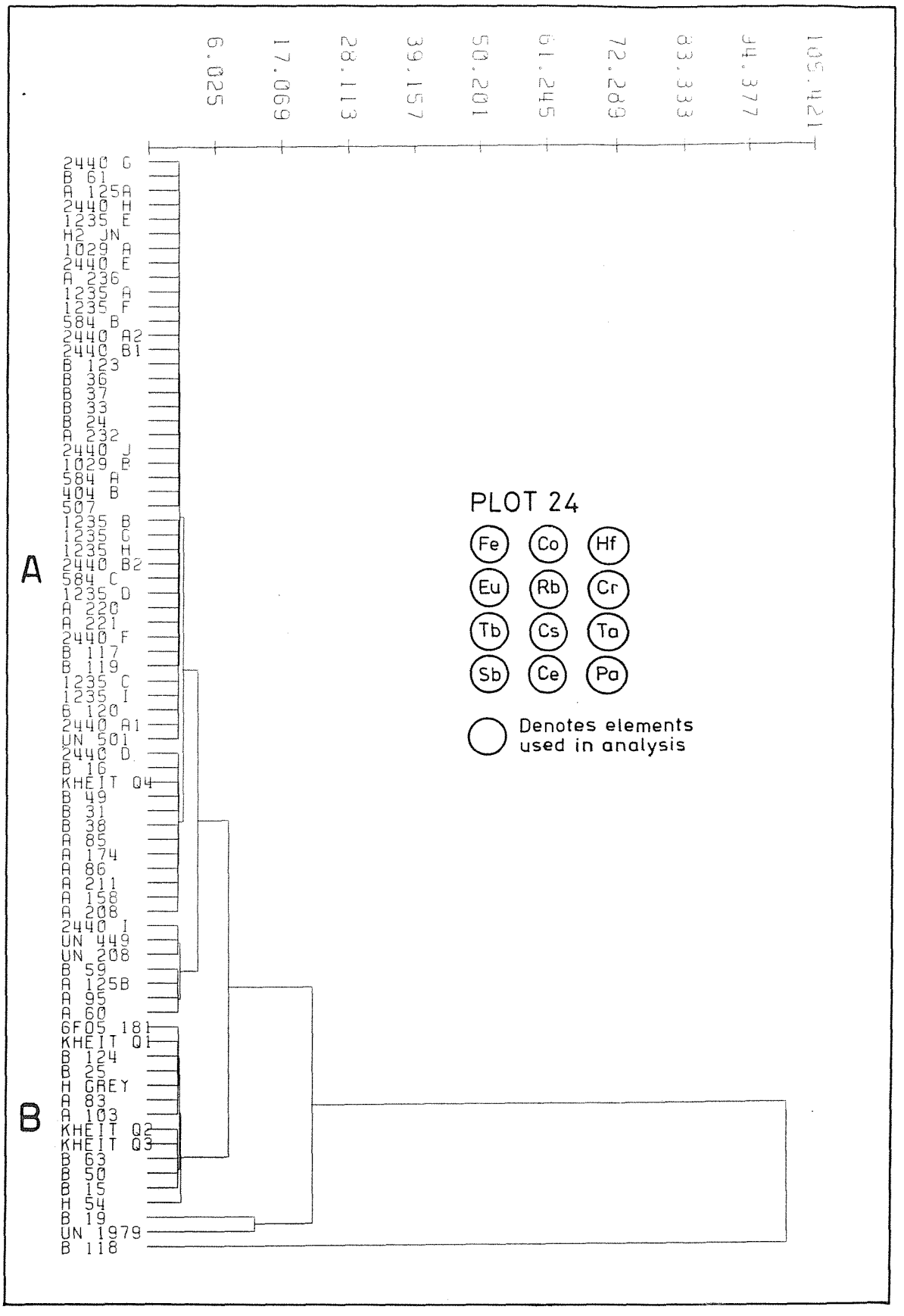


Fig. 8.118 NAA cluster analysis, Plot 24: Early Dynastic pottery from Ur, Abu Salabikh, Kish, Jamdat Nasr, Kheit Qasim and third millennium painted wares from Umm an Nar and Hili

Regional Diversity

Cluster analysis of pottery from two distinct regions in Iraq, the southern Mesopotamian plain and the Hamrin Basin (Fig. 8.113) produces two principal groups. A preliminary evaluation of these groups might imply that differences between the two regions can be distinguished on the basis of trace element concentrations. The two major clusters do not appear to represent a division between ceramic assemblages from these two geographical areas since vessels from sites in both regions are represented throughout the major clusters.

Closer scrutiny of these two groups, however, reveals that with the exception of a single painted sherd (6F05.181, Sample 1251) the pottery from Abu Salabikh is confined to Group A. This forms the basis for an assumption that Group A samples probably represent pottery from the Mesopotamian plain (Babylonia). The majority of vessels in Group B, however, are from sites in the Hamrin Basin, whilst the remainder of this group consists of early ED I (or possibly late Uruk) container vessels and painted wares from Ur and Kish and the single example from Abu Salabikh. It may be assumed, therefore, that pottery manufactured from Hamrin clays is represented by Group B in Fig 8.113.

Painted wares from Kheit Qasim and Tell Ahmed al Hattu occur in both clusters in Fig. 8.113 although most samples are confined to the Hamrin Group (Group B) (Figs. 8.107 and 8.113). These wares were all thought to be local copies of Jamdat Nasr painted wares (J.D. Forest and D. Sürenhagen, pers. comm). A number of these painted wares, however, group with pottery from the Mesopotamian plain and may therefore represent southern imports in the Hamrin Basin region. By repeating the cluster analysis of these samples without pottery from Abu Salabikh (which may produce anomalous results owing to post-deposition conditions) two groups (Figs. 8.108 and 8.109) again adhere to the divisions established in Fig. 8.113.

An attempt to isolate divisions between sites on the Mesopotamian plain (i.e. Ur, Abu Salabikh, Kish and Jamdat Nasr) by confining the cluster analysis to samples from these sites only (Fig. 8.106) produced three principal groups. The distinction between the groups, however is not based upon individual sites. Group A contains samples from all four sites, while Group C is essentially the same as Group B (Fig. 8.113) with the exception of the Hamrin sites.

It is apparent therefore, that the compositional variation of pottery manufactured from clays derived from the alluvial plain is broadly homogeneous. The differences between the trace element concentrations of different ceramic assemblages from this region are consequently overshadowed by pottery groups from different geological contexts, such as the Hamrin Basin.

The possibility of identifying differences between the products of Tigris and Euphrates clays is explored in Fig. 8.104. Group A (Fig. 8.104) consists of vessels manufactured in the Hamrin region and includes the Hamrin wares from Umm an Nar and Hili identified in Fig. 8.95. Group B contains pottery from Abu Salabikh together with Early Dynastic jar types from Umm an Nar. The vessels in Group C, however, are from Tell al 'Usiyeh (situated in the Haditha region of the Euphrates), Abu Salabikh and the group includes several Early Dynastic jar types from Umm an Nar. It is possible, therefore, that these two groups represent different river sediments. Group C, with pottery from Tell al 'Usiyeh probably contains vessels manufactured from Euphrates clays whilst pottery in Group B may represent Tigris river sediments. Petrographic analysis has established the possibility of both Tigris and Euphrates river sediments being used in the manufacture of pottery from sites on the alluvial plain (Section 8.3.4.) Furthermore, evidence for successive floodings of the rivers coupled with changes in the river courses suggests that some deposits may represent a mixture of both Tigris and Euphrates sediments (Adams 1958; Nützel 1978, 17).

Long distance trade

Comparisons between the minerological assemblages of fabrics from several Early Dynastic jar-rim types from Umm an Nar (Fig. 8.91 nos. 2883-2909) and the mineral inclusions known to be typical of Early Dynastic pottery from the Hamrin Basin and southern Mesopotamia suggest that both of these regions exported container vessels to Umm an Nar.

Neutron activation analysis has proved to be equally successful in isolating this group of imported wares within the Umm an Nar assemblage itself. The majority of the Early Dynastic vessel types from the Gulf have clustered with pottery from the southern Mesopotamian plain, including a sherd of Jamdat Nasr painted polychrome from Hili (Fig. 8.91, no. 2913). Plot 1B (Fig. 8.95)

illustrates the clustering of pottery from Umm an Nar and Hili with the majority of samples from southern Mesopotamian sites. Vessels clustering on Plot 1A (Fig. 8.95) are identified as local wares from the Hamrin Basin. The presence of two of the Early Dynastic jar-types from Umm an Nar (Table 8.4, Sample nos. 2880 and 2899) indicates that these vessels together with two fine ware jars (Fig. 8.91, Sample nos. 2912 and 2915) were probably exported from the Hamrin Basin. Further statistical analysis reinforces this distinction between vessels manufactured in the Hamrin Basin and pottery from sites in Sumer (Figs. 8.110 and 8.114). The same Hamrin vessels cluster together when the Mesopotamian imports from Umm an Nar are excluded, with the exception of the painted wares and imitation steatite wares (Plot 24A, Fig. 8.118).

Having established, therefore, that a number of sherds found at Umm an Nar may be traced to the Hamrin area, a final dendrogram (Fig. 8.104) examines pottery from Umm an Nar thought to derive from sites further south on the Mesopotamian plain (Fig. 8.104). Three clusters are produced. Plot 10A with pottery from Tell al Rubeidheh acts as a control group for the Hamrin fabrics. The pottery on Plots 10B and 10C highlights a division in the group of Early Dynastic jar types from Umm an Nar. Vessels on Plot 10C are probably manufactured at sites where potters were restricted to clays derived from Euphrates river sediments. The majority of imported Mesopotamian wares, however, group with vessels from sites which had access either to Tigris clays or to a mixture of Tigris and Euphrates alluvia (Plot 10B, Fig. 8.104; Plot 11B, Fig. 8.105).

Further statistical analyses including samples from Iran (Tepe Farukhabad (TF)) and Syria (Habūba Kabira (HBK)) indicate that there are no close links between the Early Dynastic fabrics from Umm an Nar and pottery fabrics from these two sites (Fig. 8.111). The inference is therefore that Mesopotamian imports found at Umm an Nar came principally from Sumer. Examples of pottery imported from north of the middle Euphrates region are confined to a small amount of pottery from the Hamrin Basin.

Several outliers have been detected from the cluster analysis of pottery from the Gulf region (Table 8.4, Sample nos. 2902 and 2906; Fig. 8.95, UN 352 and UN 1979). In the absence of comparative material from local fabrics it is impossible to speculate on the probable origin of either of these vessels. The pottery cannot be related to Early Dynastic vessel types and the incompatibility of

these samples with any of the Mesopotamian wares, both on the basis of neutron activation and petrographic analyses, confirms that they are not imported from Mesopotamia.

Amongst the pottery from Umm an Nar identified as Mesopotamian wares is Sample 2905 (Table 8.4). Petrographic analysis has established that the clay is derived from a basaltic dolerite (Table 8.5, thin section 572) with a possible Syrian origin. This sample is less easily distinguished from other Mesopotamian wares by neutron activation analysis. It clusters with samples on Plot 1B (Fig. 8.95, UNLL). This group has been identified as containing fabrics which most closely reflect a mineral assemblage akin to Euphrates clays. It may include pottery from Syria, and the degree of resolution for provenancing Sample 2905 is therefore inadequate using trace element analysis. The sample is more easily identified from other imported Mesopotamian wares in the Umm an Nar assemblage (Figs. 8.104 and 8.112). It is evident from Fig. 8.114 that this sample does not group with pottery from the Hamrin Basin but without petrographic analysis it would not be possible to identify the vessel as a northern (Syrian) product.

Intra-site variability

A major theme of third millennium Mesopotamian ceramic analyses has been to consider pottery production within a single site. Abu Salabikh has been selected as the principal site for this research. From the results of petrographic analysis (Section 8.3.4) it has been concluded that the majority of the pottery at Abu Salabikh is locally produced. It has also been possible, however, to detect considerable variations in clay preparation and firing reflected in the diversity of fabric types. Neutron activation analysis, however, is less suited to an intra-site study where there is the possibility of several workshops producing pottery from clay sources which are broadly similar in composition.

Statistical grouping based on 28 samples selected from different batches (levels) on the Main Mound (Area E) has produced three principal groups (Fig. 8.103). The vessels on Plot 9A are all from calcereous clays and the fabrics contain abundant fine limestone inclusions with a sandy texture. They are frequently tempered with abundant vegetable material (see Table 8.5 nos. 343 (2440E0; 348 (2440A1 and 2440A2) and Table 8.4, Sample nos. 0812, 0857, 0937, 1357,

1410, 1411, 0706 and 1081. Plot 9B contains a disparate group of four samples of which two are from orange-painted wares thought to be Syrian in origin (Postgate and Moon 1982, 131). These wares group with other samples from Habuba Kabira on Plot 13A (Fig. 8.107), but, since this group represents all samples from sites south of the middle Euphrates, the provenance of these painted wares is difficult to establish. Clusters produced with samples included from several other sites tend to obscure any potential distinction between the vessels on Plot 9A (Fig. 8.103) and other samples from Abu Salabikh (Figs. 8.95; 8.104 and 8.106).

The third and largest group of wares from Abu Salabikh contains several different fabrics and includes a wide range of vessel types from stemmed dishes (Type 10) to plain, bevelled and band-rim jars (Type 2.4) and a conical bowl (Type 1.1). Furthermore, there appear to be no chronological distinctions between these samples on Plot 9C and the pottery on Plot 9A. The probable division into Euphrates clays and Tigris or Tigris/Euphrates sediments postulated from Fig. 8.104 (Plots 10B and 10C), is not reflected in the cluster analysis confined to pottery from Abu Salabikh (Fig. 8.103). Since the coefficient of similarity indicates that there is very little difference between the three main pottery groups from Abu Salabikh alone (Fig 8.103), the distinction between the groups might be interpreted as representative of several local clay sources suitable for pottery production (Adan-Bayewitz and Perlman 1985, 203). Petrographic analysis of these samples has shown that the pottery on Plot 9A is predominantly calcareous and that fabrics containing abundant limestone inclusions are almost wholly restricted to that group. Were it not for a mineralogical examination of the pottery, however, such a grouping could not be interpreted on the basis of trace element analysis alone. An additional characteristic of all fabrics included on Plot 9A lies in the more porous nature of these vessels compared with samples on Plots 9B and 9C. The pottery on Plot 9A contains coarser inclusions either in the form of sparse medium sand or abundant medium vegetable material (Table 8.5 thin sections 343 (2440 E); 348 (2440 A2); 351 (2440H) and 325 (404B)). Moreover, included in this group is a sample of Fabric Li (Table 8.5, thin section 348 (2440 A2), identified by petrographic analysis as a possible import (see Section 8.3.4).

A probable explanation for this apparently anomalous grouping of pottery within a single site lies in the problem of post-

deposition conditions. Artefacts from sites situated on the alluvial plain are seriously affected by post-burial conditions. Prolonged dry periods accompanied by high temperatures and interspersed with the rainy seasons combine to produce extreme salinity of the soil. It has been observed that changes in elemental composition are associated with the retention of phosphate (Freestone et al. 1985, 161-177). Although the pottery from Abu Salabikh has not been analysed for content, the saline conditions on the site are likely to have the same effect particularly on fabrics of a more porous nature. Furthermore, the cation exchange noted by Hedges and McLellan (1976, 206-207) when pottery is rehydrated is a source of error peculiarly applicable to the combination of climate and soil conditions found on the Mesopotamian alluvial plain.

The only imported ware to be detected by both petrographic (Table 8.5, thin section 560) and neutron activation analysis (Figs. 8.95, 8.103 and 8.104, 6F05.181) is a fragment of painted ware (Table 8.4, Sample no. 1251). In this instance neutron activation analysis has been more successful in tracing the probable origin of this vessel to the Hamrin Basin region (Plots 1A and 15A, Figs. 8.95 and 8.109).

Summary

The emphasis of the present research has been an examination of third millennium ceramic technology in the context of chronological changes in fabric types reflected in the transition from late Uruk/ED I through to ED III.

Neutron activation analysis is particularly suited to studies concerned with the distribution of pottery between distinct geographical regions. Whilst it is less applicable to analysis concerned with pottery production, trace element analysis has proved successful in determining trading connections between Sumer and the Gulf, together with the regional exchange of pottery between Sumer and the Hamrin Basin.

Visual identification of pottery fabrics, coupled with petrographic analyses, has produced fabric groups which can be used as chronological indicators. Trace element analysis, however, is subject to considerable variability in clay sources available to potters from sites on the Mesopotamian plain. Furthermore, intra-site studies based on trace element analyses of local pottery from such sites may be seriously affected by post-deposition conditions. Studies

involving regional exchange between sites within this region could be equally at risk.

It has been established, however, that an examination of long-distance exchange in pottery between Mesopotamia and the Gulf is enhanced by employing both petrographic and neutron activation analysis. The conclusions reached independently by each method are in general agreement and serve to strengthen subsequent archaeological interpretation. Neutron activation analysis is therefore best employed in studies concerned with pottery exchange between distinct geographical areas.

8.5 ANALYSIS OF PIGMENTS IN SURFACE DECORATION

8.5.1 Introduction

Painted ware forms only a small percentage of the pottery included in the corpus. The exceptions are some twenty-five painted sherds from Abu Salabikh, the Jamdat Nasr painted polychrome wares from both Kish and Jamdat Nasr, the Jamdat Nasr painted wares from Umm an Nar and Hili, and a number of sherds of ED I scarlet ware from the Hamrin Basin. It is of interest, therefore, to compare the results of analyses conducted on the range of pigments represented amongst the painted wares.

It is not the intention to present a detailed analysis of the elemental composition of pigments. Instead, a qualitative analysis of the general composition of painted decoration on third millennium pottery has been undertaken to compare, for example, the composition of red paint on scarlet ware with red paint applied to Jamdat Nasr painted wares. For the purposes of further comparison similar pigments have been analysed on Jamdat Nasr pottery from a number of different sites.

The principal method of analysis is X-Ray fluorescence, a non-destructive technique which has been widely used in the analysis of surface decoration (Courtois 1978; Gillies and Urch 1983; Kamilli 1977; Maggetti et al. 1981; Noll 1981; Stos-Gale et al. 1981). Pigments of a limited sample of scarlet ware have been analysed by a second technique: laser emission microspectral analysis (LMSA). The LMSA equipment, available in the Iraq museum research laboratories, was used on sherds which could not be exported for analysis using X-Ray fluorescence techniques.

8.5.2 Laser emission microsprectral analysis

LMSA has been used primarily to examine pigments in wall paintings and in the analysis of metals (Ashok 1979; Moenke and Moenke-Blankenburg 1973, 173-178; Petriakiev et al. 1971). It has recently been employed, however, as a method of ceramic analysis (Al-Kaissi and Mynors forthcoming). The technique is essentially non-destructive and is therefore appropriate for use in the analysis of painted decoration on pottery.

Method

The theoretical principles and a detailed account of the method of LMSA is described by Moenke and Moenke-Blankenberg (1973). As the use of this method consitutes a new approach to the characterisation of pigments in ceramic studies, however, it is appropriate to summarise the technique.

Laser radiation is focussed in a very fine beam resulting in a high intensity sufficient to vaporise a microscopically small sample of the material and to excite the 'atom vapour cloud' thus generated. The resultant radiation dispersion permits samples to be analysed by a microspectral technique where spectral lines emitted by the excited atoms of the elements within the pottery are recorded using a PG2 Plane-grating-spectrograph. The spectra are detected on astrographic plates (ORWU ZU1 and ZU2) with RF-69 ORWO-Technic film. A pure iron spectrum is used as the standard comparision for a qualitative assessment of the data.

Four sherds of scarlet ware have been examined using LMSA (Table 8.7) and, in the case of the two sherds from Abu Qasim, both red and black pigments were analysed.

Results

Laser spectrography has proved to be particularly worthwhile in an analysis of the red pigments. Spectral analysis of red paint on the sherd from Khafajah indicates the presence of mercury (Table 8.7). This, combined with the absence of iron from the spectra suggests that the red pigment may be derived from cinnabar (mercuric sulphide) and not from the more common source of haematite as might have been supposed. Further credance is given to this suggestion by

microchemical analysis of red paint from the same sherd (al Kaissi and Mynors forthcoming, table 3) which indicated that mercury was present as mercuric sulphide. Microspectral analyses of red paint from the remaining three samples are less conclusive. Whilst mercury (Hg) has been identified in the pigments of all three sherds, the presence of iron (Fe) is also indicated. Results of a microchemical analysis of the pigments suggest that in this case the red colour is a product of haematite (Fe_2O_3) rather than cinnabar (Al-Kaissi and Mynors forthcoming, table 3).

QUALITATIVE LASER MICROSPECTRAL ANALYSIS

	Si	Sb	Cr	Mg	Fe	Ca	Al	Cu	Ti	Na	Ni	Pl	Sr	K	Sn	Mn	Hg	Rb
Khafajah scarlet ware red	-	-	-	●	-	●	-	-	-	-	-	-	●	●	-	-	●	-
Abu Qasim scarlet ware red	-	-	-	●	●	●	-	-	-	-	-	-	●	●	-	-	●	-
Abu Qasim scarlet ware black	-	-	-	-	●	●	-	-	-	-	-	-	●	●	-	-	-	-
Abu Qasim scarlet ware red	-	-	-	●	●	●	-	-	-	-	-	-	●	●	-	-	●	-
Abu Qasim scarlet ware black	-	-	-	-	●	●	-	-	-	-	-	-	●	●	-	-	-	-
Halawa red	-	-	-	●	●	●	-	-	-	-	-	-	●	●	-	-	●	-

● trace element present in the sample
\- trace element absent from the sample

Table 8.7 Laser microspectral analysis: elemental composition of 'scarlet ware' pigments

Discussion

The application of laser spectrography to an analysis of painted decoration on pottery has provided evidence for the presence of mercuric sulphide in the red pigments of some ED I scarlet ware from the Diyala region. It could be argued that mercuric sulphide is present in these pigments as an impurity and that the colour may be derived from haematite. In the case of the sherd from Khafajah, however, such a conclusion is inadmissible since no iron has been detected in the pigment. In this instance the results suggest the interesting possibility that pottery may owe its red-painted decoration to the use of cinnabar (vermillion) rather than haematite.

8.5.3 X-Ray Fluorescence analysis

Introduction

For a detailed discussion of the methodology and applications of X-Ray fluorescence analysis reference should be made to the publications of Cesareo et al. (1972); Hall (1960) and Hall et al. (1973). Qualitative X-Ray fluorescence analysis has been applied to third millennium Mesopotamian pottery using equipment at the Research Laboratory for Archaeology, Oxford. The technique involves the use of a miniature X-Ray tube combined with an isotope source (Hall 1973, 55-57). This method has the advantage of improved flexibility by permitting the detection of a greater range of elements. Furthermore, it is possible to examine very small areas using an X-Ray tube thus facilitating the analysis of specific areas on a sample. By directing the beam onto several different areas of the same sample it has been possible to select and analyse a number of different pigments used in the decoration of a single vessel.

Several different colour categories have been identified from amongst the pigments applied to Jamdat Nasr painted wares: red (scarlet), red (crimson), orange, plum (purple), red/brown, brown and black, and representative samples of each colour have been analysed.

Painted wares have been selected from the site of Jamdat Nasr itself (Figs. 8.119 - 8.123); from the Diyala region (Figs. 8.124 and 8.126); from Syria (Fig. 8.125) and from the Gulf sites of Umm an Nar and Hili (Fig. 8.127). Examples of all seven identified colour categories have been included in the analysis. In addition, analyses have been conducted on several samples from different vessels which appear to have been decorated with similar pigments.

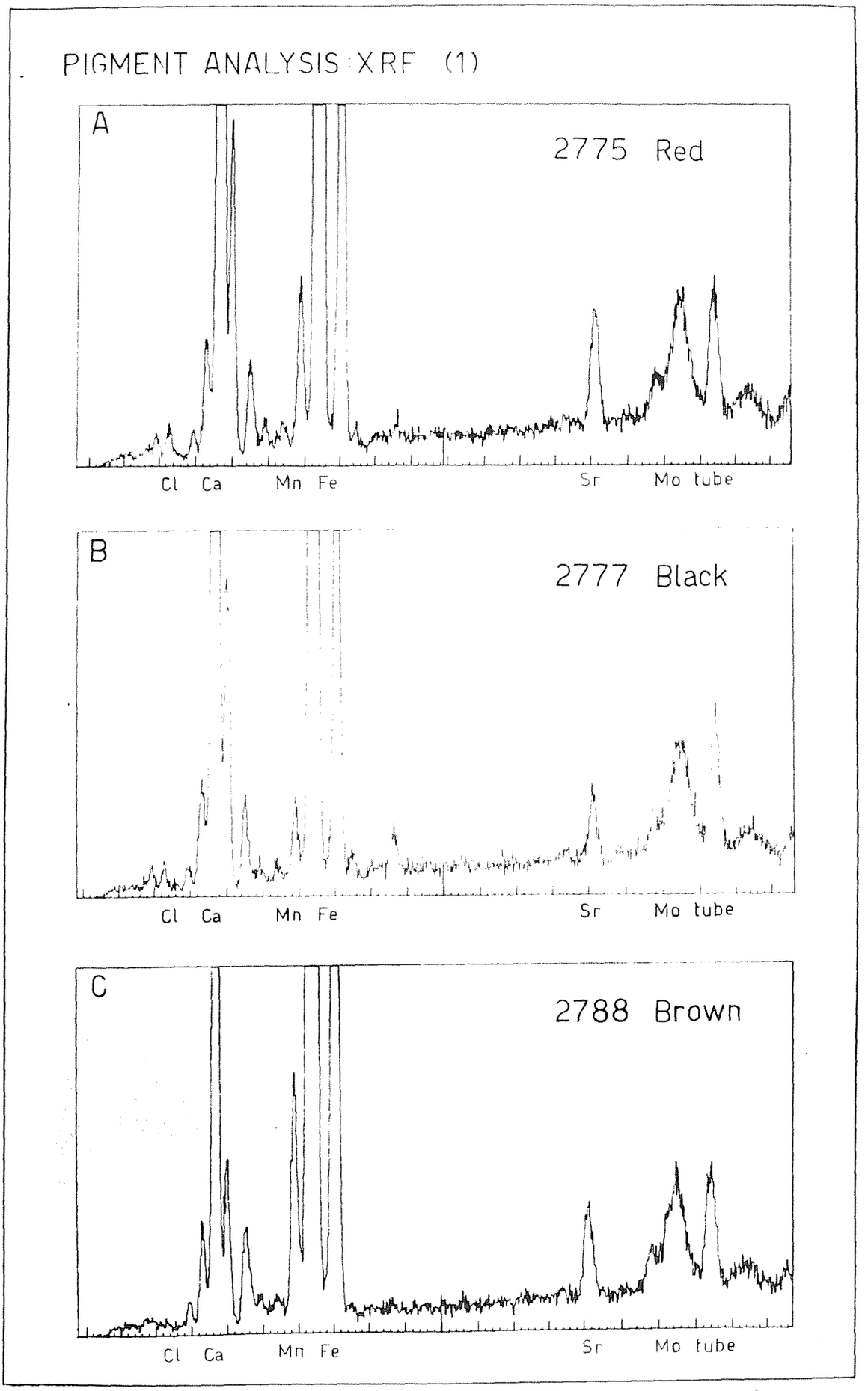


Fig. 8.119 Pigment analysis: XRF (1) Jamdat Nasr: Pottery samples 2775, 2777 and 2788

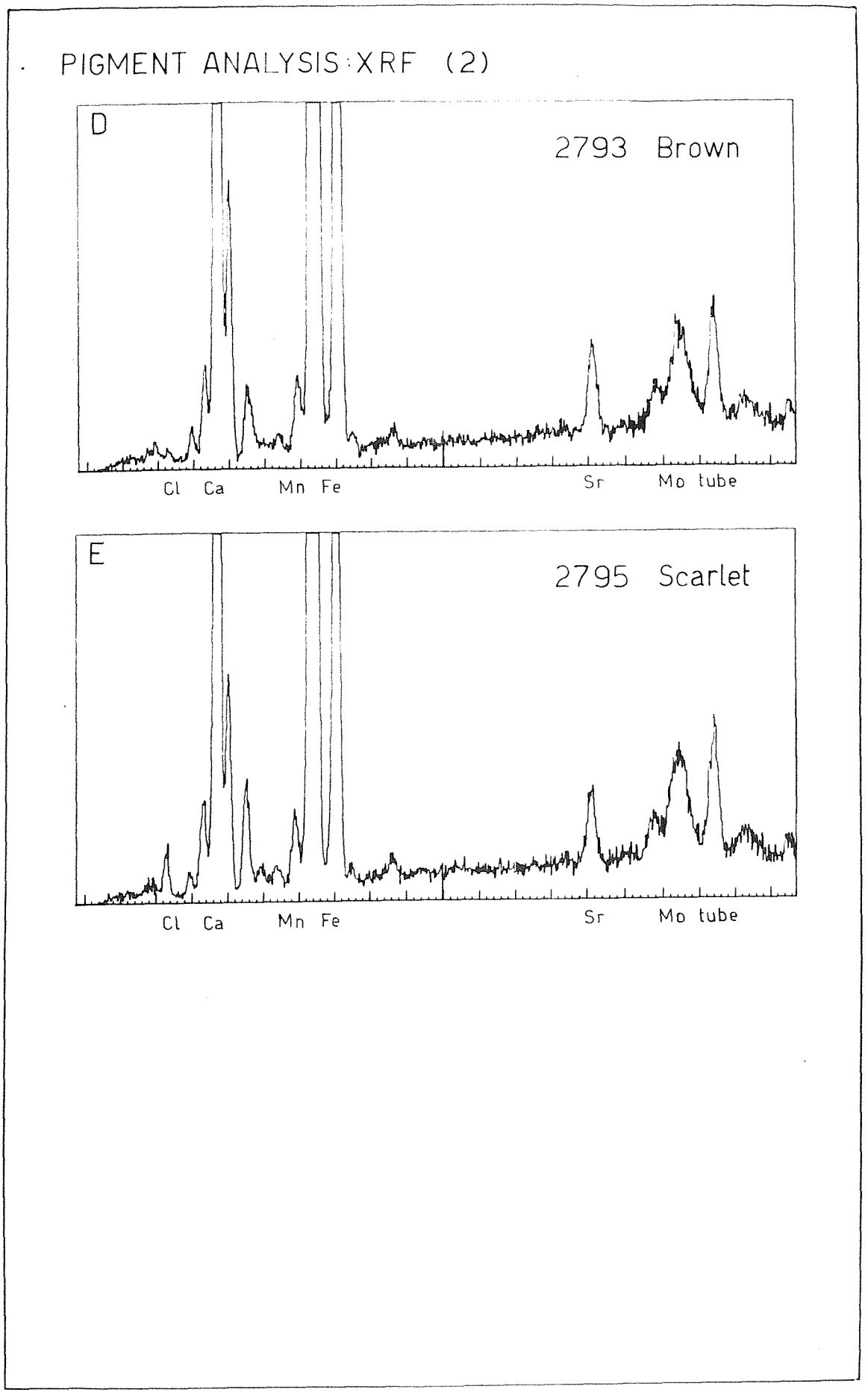


Fig. 8.120 Pigment analysis: XRF (2) Jamdat Nasr: Pottery samples 2793 and 2795

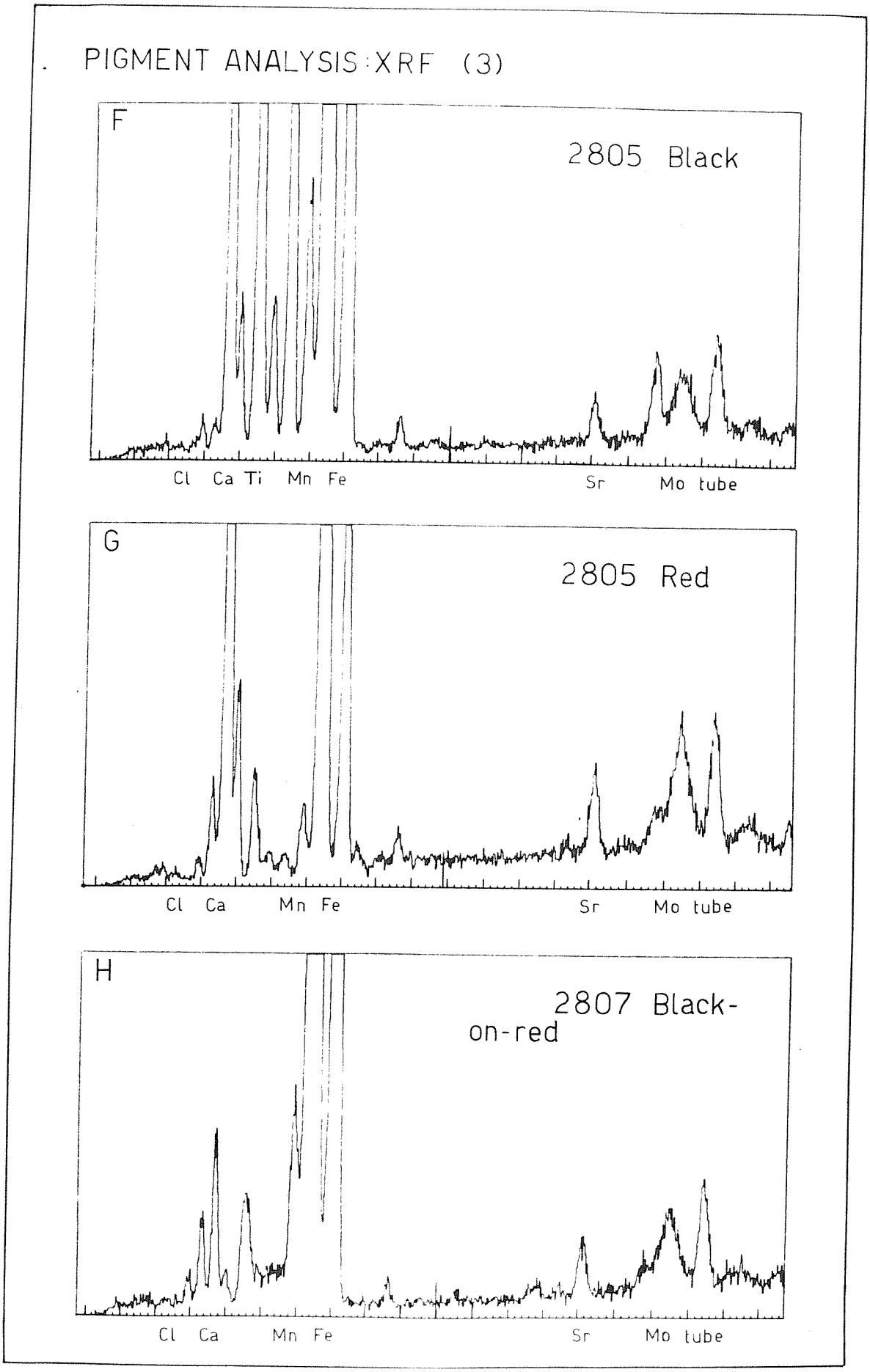


Fig. 8.121 Pigment analysis: XRF (3) Jamdat Nasr: Pottery samples 2805 and 2807

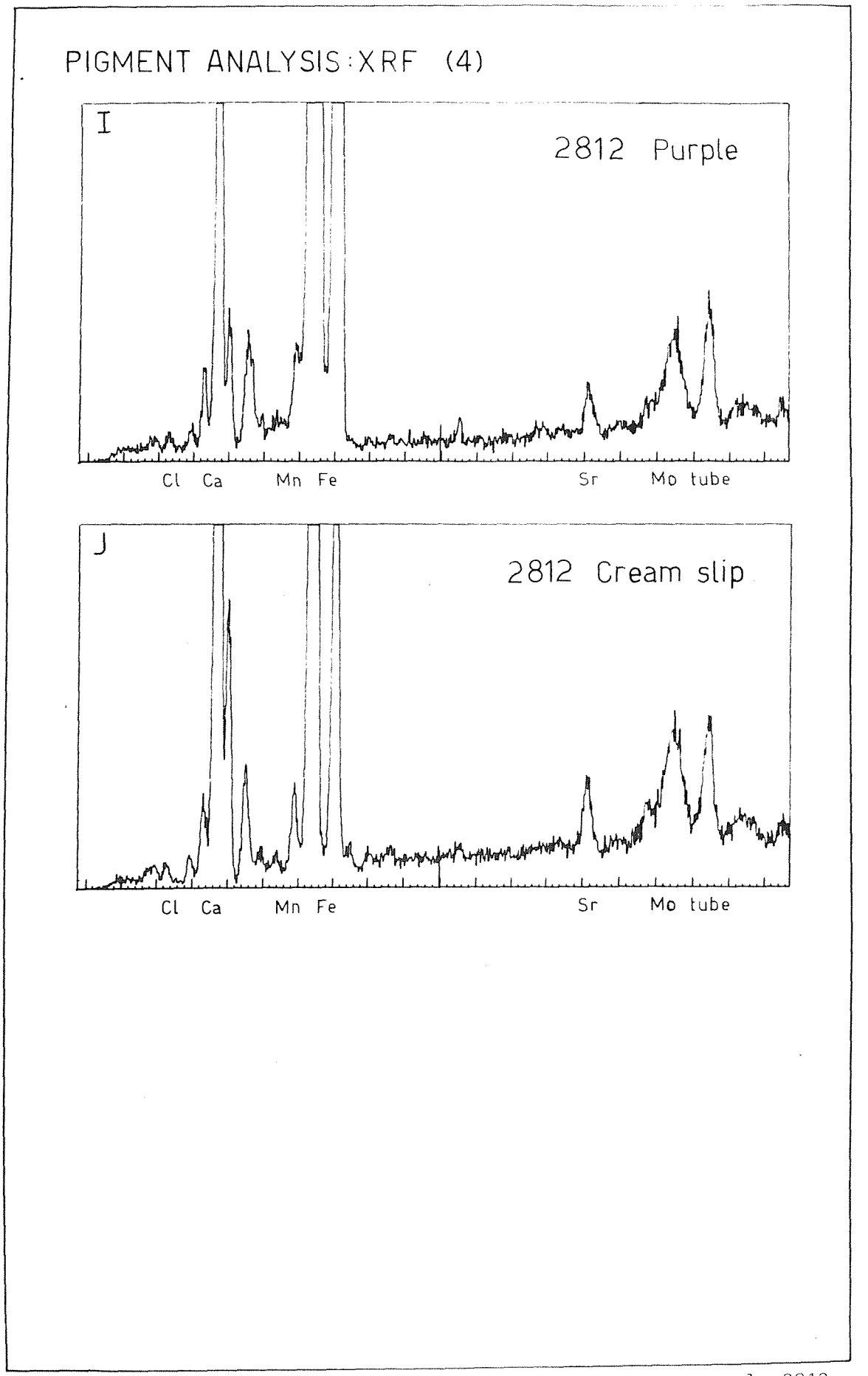


Fig. 8.122 Pigment analysis: XRF (4) Jamdat Nasr: Pottery sample 2812

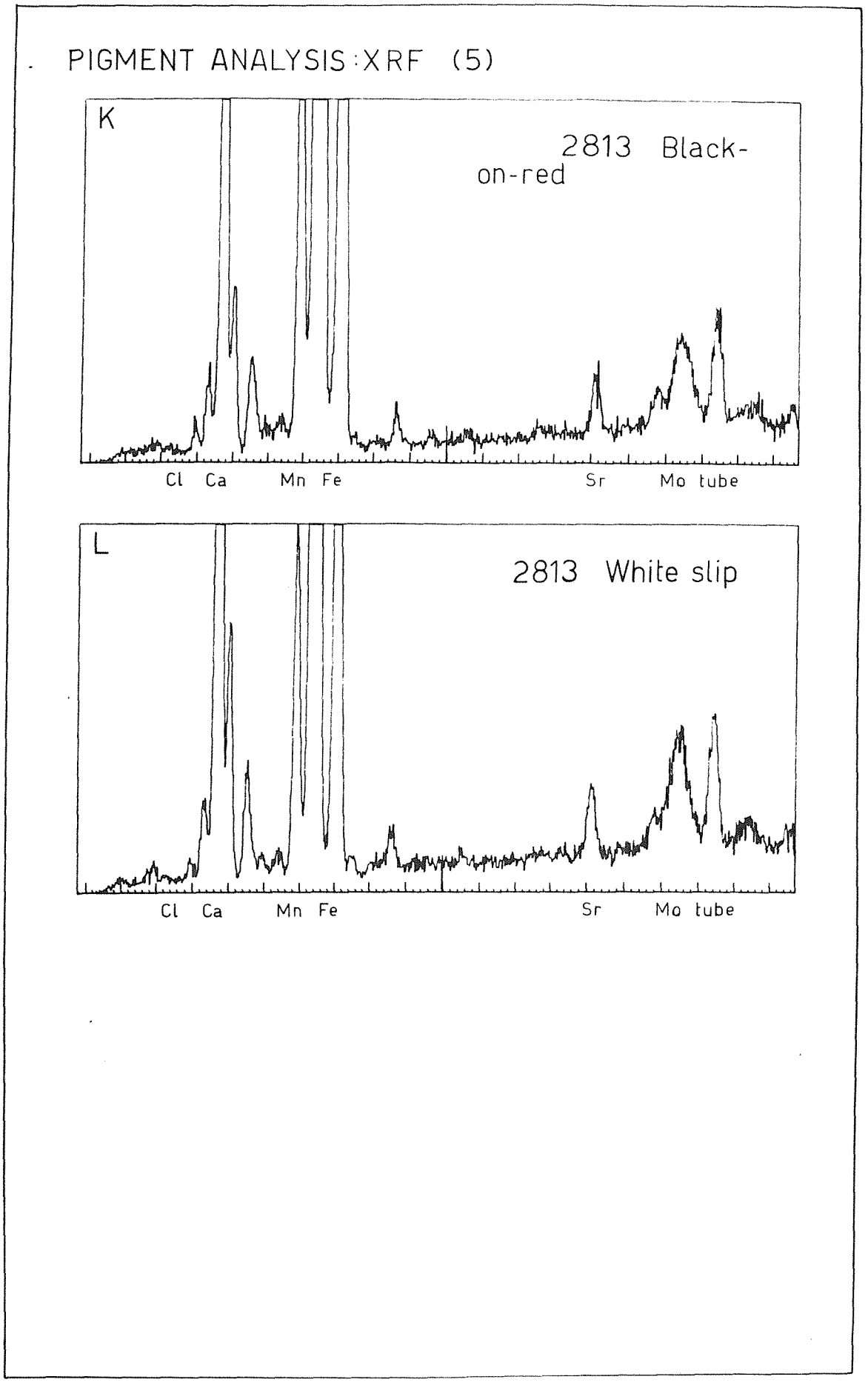


Fig. 8.123 Pigment analysis: XRF (5) Jamdat Nasr: Pottery sample 2813

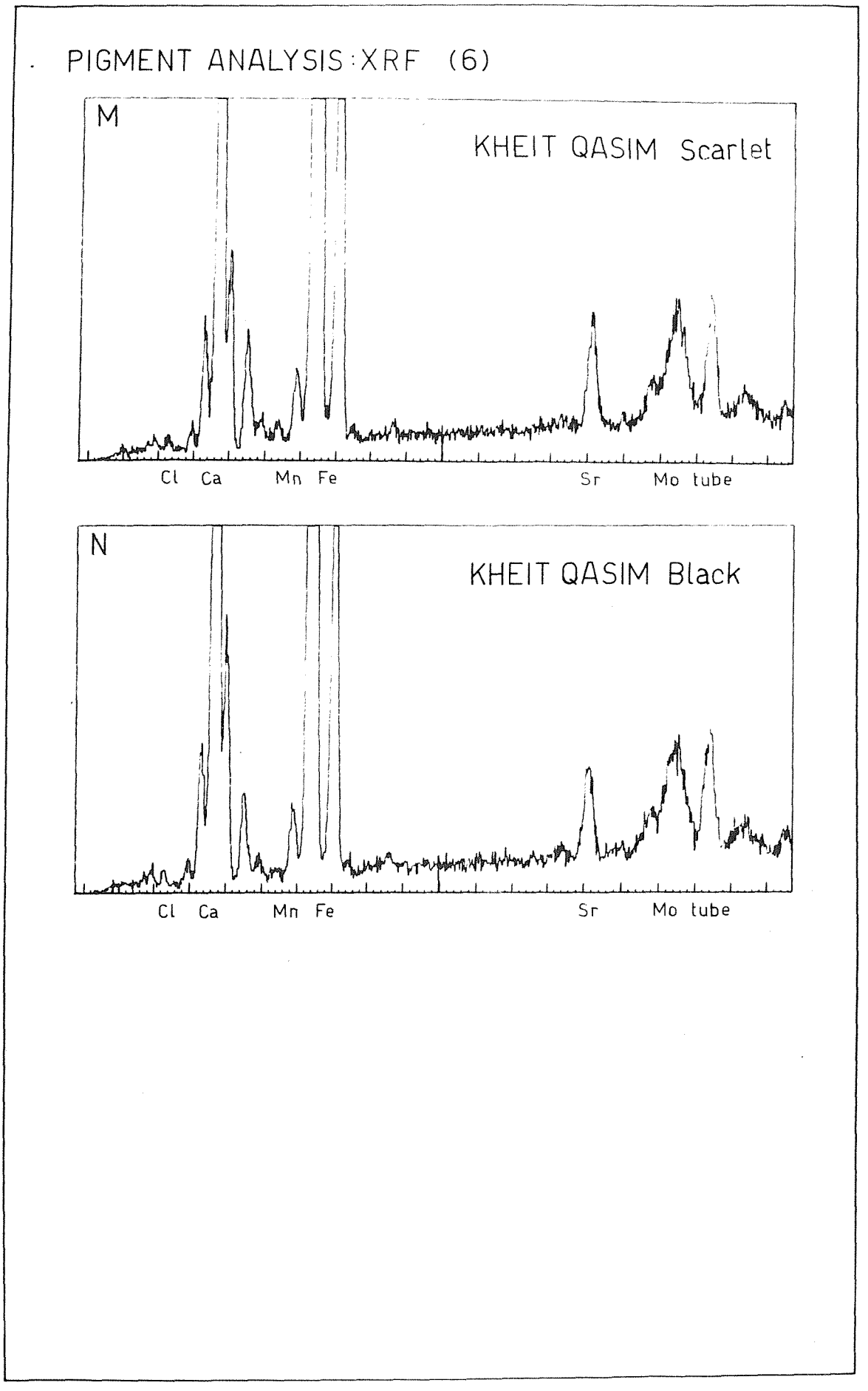


Fig. 8.124 Pigment analysis: XRF (6) Kheit Qasim

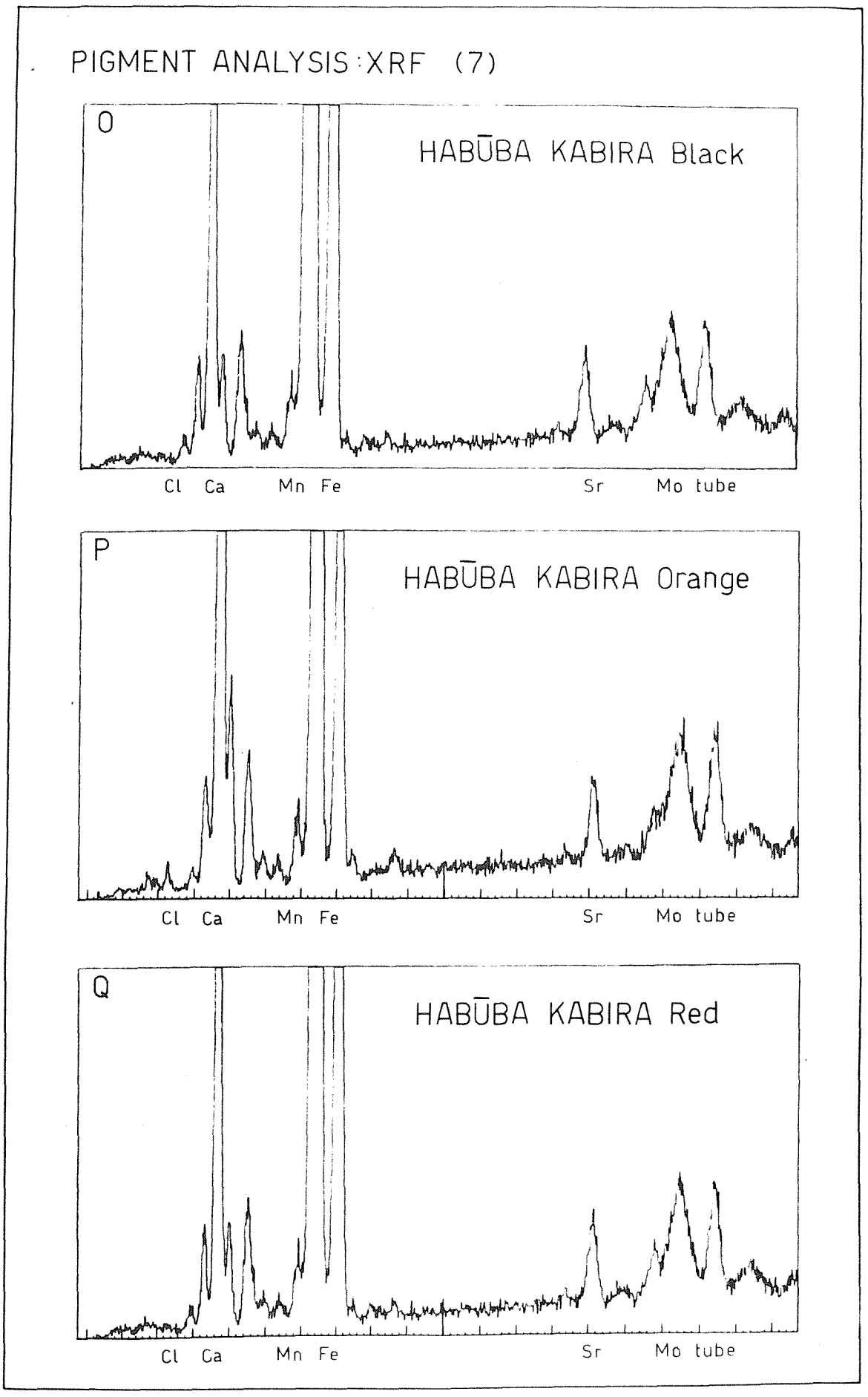


Fig. 8.125 Pigment analysis: XRF (7) Habūba Kabira

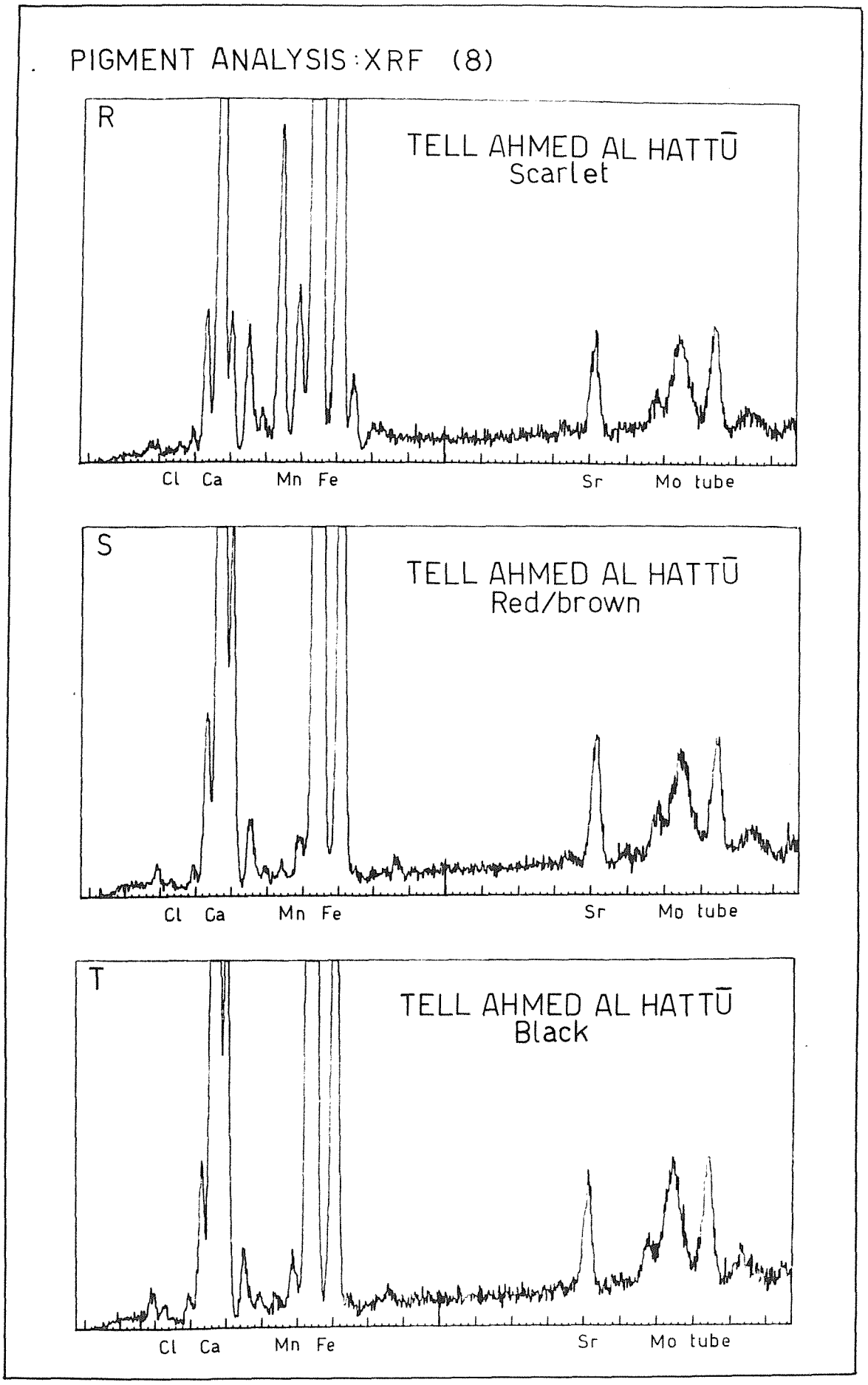


Fig. 8.126 Pigment analysis: XRF (8) Tell Ahmed al Hattū

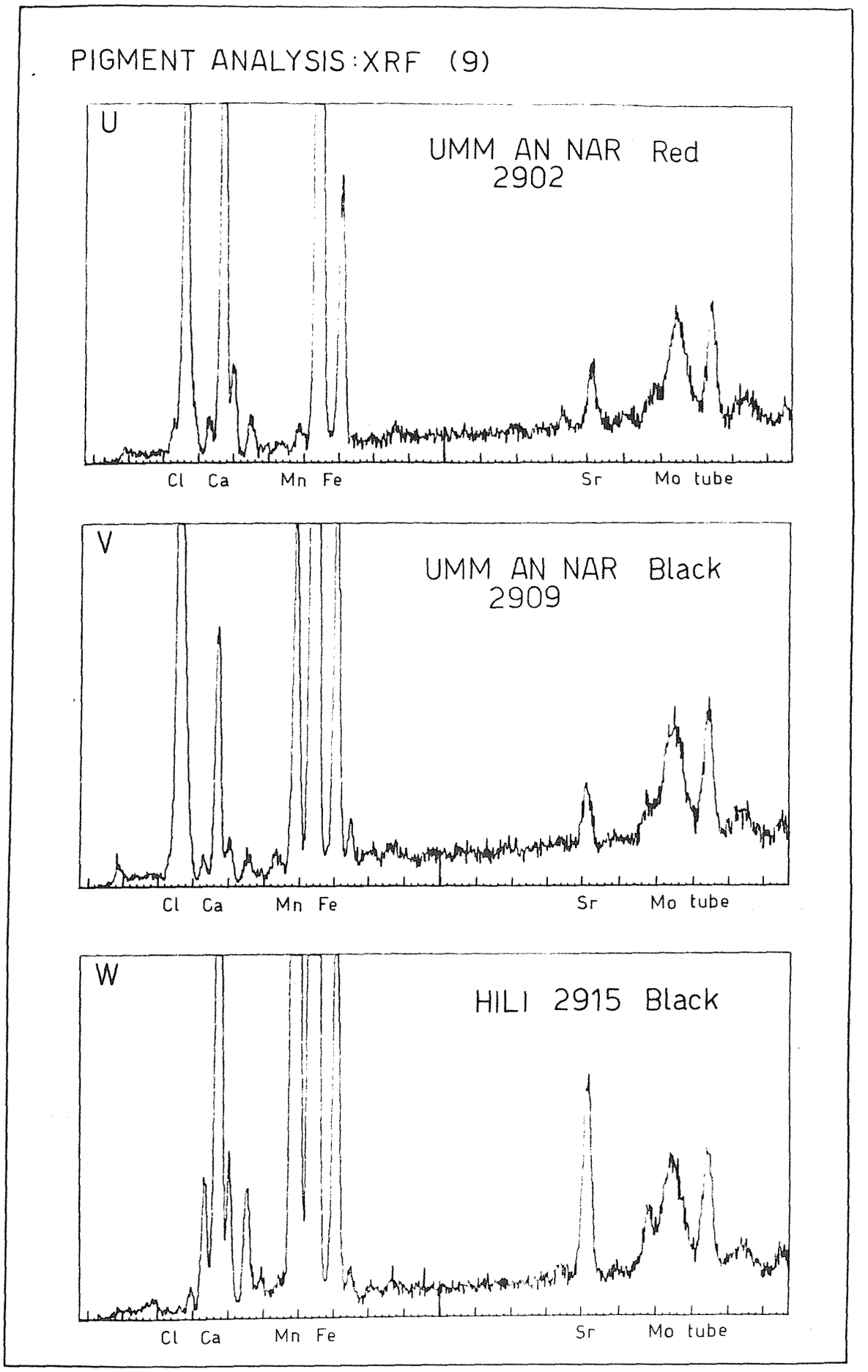


Fig. 8.127 Pigment analysis: XRF (9) Umm an Nar and Hili

Red Pigments

Whilst a considerable degree of variation may be observed amongst the colours present in red painted decoration it is possible that these colour differences may be partly attributable to the degree of preservation of the applied pigments. To some extent the possibility of altered colours can be resolved by an examination of polychrome decoration. Where vessels are painted with both red and plum (purple) paint, both colours were obviously applied with the intention of achieving a polychrome effect (Table 8.4, Samples nos. 2812 & 2813; Fig. 8.122).

X-Ray fluorescence analysis of purple paint (Fig 8.122, I) indicates a strong iron (Fe) peak in comparison with the cream slip over which it is applied (Fig. 8.122, J). Compared with crimson-red (Fig. 8.119, A) and scarlet (Fig. 8.120, E), which show smaller peaks, the purple colour appears to contain more iron. It is probable that all red pigments owe their colouring to the presence of iron in the form of haematite (Courtois 1978, 212; Noll 1981, 149; Stos-Gale & Rook 1981, 155). Variations in colour may have occurred either in the application of the paint (Courtois 1978, 213 and Kamilli 1977) or in differences between pigments applied before firing and those colours achieved by post-firing painted decoration (Noll 1981, 149).

Amongst the examples of red pigments included in the analysis two spectra stand out as being different. The spectrum produced from analysis of scarlet paint on the vessel analysed from Tell Ahmed al Hattū (Fig 8.126, R) shows that, in addition to iron (Fe), manganese (Mn) is also present. This is unusual since manganese is rarely detected in red pigments, the presence of manganese being predominantly a feature of black pigments. In this case, however, the black pigment on the same sherd (Fig. 8.126, T) is not manganese-black since only a minor manganese peak has shown up on the spectrum. The red paint is not therefore contaminated by the presence of black pigment and it is possible that manganese occurs in a manganese-containing haematite deposit.

An unusual spectrum is also produced from the analysis of red paint on a vessel from Umm an Nar. This also appears to derive its colour from haematite but the spectrum produced differs from the analyses of other red pigments in one respect. The presence of chlorine (Cl) is indicated on the spectrum (Fig. 8.127, U). Analysis of black paint on the same vessel also registers a definite chlorine

peak (Fig. 8.127, V). Since this spectrum is otherwise typical of a manganese-black pigment the presence of chlorine in both pigments is probably the result of contamination by salts leaching out onto the surface of the vessel.

Analysis of a sample of orange paint (Fig. 8.125, P) indicates that this pigment is also haematite based and there is no evidence to suggest that the orange colour is the product of a different pigment.

In the majority of cases brown and red/brown pigments also appear to owe their colouring to the presence of iron (Figs. 8.119, C; 8.120, D and 8.126, S) with only faint traces of manganese in one example (Fig. 8.119, C).

Black pigments

It has been established that black paint on pottery is usually derived from on of three sources: manganese (Courtois 1978, 212-213; Noll 1981, 149; Stos-gale et al. 1981, 161); iron (Gilles and Urch 1983, 29; Kamilli, 1977, 24-25; Maggetti et al. 1981, 200) or carbon (Gilles and Urch 1983, 29; see also Section 8.5.2).

X-Ray fluorescence analysis has shown that amongst the painted wares from Jamdat Nasr black pigments are derived from both iron (Fig. 8.119, B) and manganese (Fig. 8.121, F). In the latter sample the presence of titanium (Ti) is also indicated on the spectrum. As this element is not present in the spectrum obtained from a red pigment in the same vessel (Fig. 8.121, G) it must be assumed that titanium is confined to the black pigment. Small titanium peaks are present in almost all the spectra produced, but the strong peak produced by black paint applied to Sample 2805 appears to be an exception.

Black paint on vessels from Umm an Nar and Hili owe their origin to manganese-black (Fig. 8.127, V & W). By contrast, however, only iron is present in black pigments on pottery from the Diyala region (Figs, 8.124, N and 8.126, T) and from Syria (Fig. 8.125, O).

Mixtures of iron and manganese may have been produced from ochres containing the black iron manganese oxide and these would probably have been applied before firing (Noll 1982, 149; Stos-Gale and Rook 1982, 161).

The presence of carbon as a black pigment, however, is usually attributed to the use of soot deposited on the surfaces of

wares by firing in a smokey atmosphere (Gilles and Urch 1983, 29). From the analysis carried out on black paints it would appear that carbon-based pigments were less widely used than manganese black. Since black paint with an organic base usually occurs as a vestigial layer on the surface of vessels such examples were not selected for X-Ray fluorescence analysis. However, analyses have shown that carbon is sometimes used as a black pigment on third millennium pottery (Al-Kassi and Mynors forthcoming, Table 3).

Summary

It is probable that the various shades identified from amongst the group of red pigments have been obtained by mixing different sources of colours. Traces of manganese together with iron present in a sample of brown paint (Fig. 8.119, C) suggest that the pigment used to produce this colour was prepared from a slip using a manganese-based ochre mixed with haematite from a ferruginous clay.

High peaks are observed for calcite (Ca) in almost every sample examined. This may reflect absorption in post-burial conditions or alternatively the calcite may have been part of a pigment applied after firing (Slos-Gale and Rook 1982, 161).

Finally, it is noticeable that iron peaks are also present in cream slips analysed by X-Ray fluorescence (Figs. 8.122, J and 8.123, K). It is possible that these peaks are due to very high concentrations of haematite, known to be present in pottery fabrics (Table 8.5) which may have also been used in the preparation of the slip.

9: VESSELS ON NEAR EASTERN SEAL IMPRESSIONS

9 VESSELS ON NEAR EASTERN SEAL IMPRESSIONS

9.1 INTRODUCTION

Carved designs on cylinder seals which appear prolifically for the first time during the late fourth millennium B.C. (Lloyd 1961, 44) reflect subjects ranging from banquets and contests (Table 9.1, F and G) to pastoral and hunting scenes (Table 9.1, C and E). In common with other forms of Sumerian art such as shell carving and inlay (e.g. Woolley 1935, pl. 43) and stone plaques (e.g. Frankfort 1939a, 185-192 and Woolley 1935, pl. 45 and pl. 49), seal impressions depict elaborate groups of human or animal figures in which both religious and secular objects seem to portray Sumerian religious ritual and symbolism.

Some of the richest and most varied designs are to be found on seal impressions of the archaic period although amongst such a wealth and variety of subject matter, little attention has been paid to the repeated appearance of vessels. Examples of seven different vessel forms have been identified on Mesopotamian archaic seal impressions (Baudot 1979, 55). The distinction between vessels manufactured from stone, wood, or metal compared with pottery (fired clay), however, is rarely apparent from the vessel shapes represented on sealings. Traces on the hollow reverse of seal impressions suggest that containers such as baskets, sacks and leather bottles were tied and sealed in the same way as jars (Legrain 1936, 1). Cups, bowls and jars are known to occur amongst ceramic, stone and metal assemblages (Delougaz et al. 1967, 134-142, Table 1; Mackay 1925, pl. 20; 1929 pl. 45-47; Martin et al. 1985, fig. 141; Moorey 1985, 24-27, 77; Woolley 1934, pl. 41b; pl. 176; pl. 180a and c; pl.184). Containers in the form of baskets are an exception and may be identified in carved designs, such as the limestone relief from Tello which depicts a figure balancing a large basket on his head (Woolley 1935, pl. 49a).

In examining the vessels depicted on sealings this study is confined to material from Mesopotamia and in particular to finds from the excavations at Ur and to the extensive collections of ancient Near Eastern seals in the Ashmolean Museum (Buchanan 1966; Moorey and Gurney 1978) and in the Department of Western Asiatic Antiquities, British Museum (Collon 1982b; Moorey 1979; Wiseman 1962).

A select catalogue (Table 9.1) includes all the examples of seal impressions published by Legrain (1936) where vessel forms are represented. By confining this catalogue almost exclusively to archaic seal impressions from Ur it has been possible to produce a systematic evaluation of the occurrence of vessel forms in the early periods of glyptic art. Occasionally, however, the catalogue is supplemented by additional information. Thus Uruk seals illustrating carrying devices for transporting pottery have been included from Jebel Aruda [Table 9.1, J (Van Driel 1983)]. Seal impressions from the Uruk, Jamdat Nasr, Early Dynastic and Akkadian periods (Collon 1982b) are represented to illustrate aspects of both change and continuity in vessel form and function.

The sealings have been grouped together on the basis of ten different categories:

A: Sealings with jar stopper or lid impressions.

B: Schematic representations of pots.

C: Representations of pots in Pastoral/Dairy scenes

D: Representations of pots in Offering scenes

E: Representations of pots in Hunting scenes

F: Representations of pots in Banquet scenes

G: Representations of pots in Contest scenes

H: Representations of pots in Drinking scenes

I: Representations of pots: miscellaneous

J: Sealings representing carriage of pottery

The first group (Table 9.1, A) comprises seal impressions on the reverse of which marks from jar stoppers or lids are visible, frequently in the form of cloth or string marks. The remaining nine categories incorporate principal themes represented on sealings in which vessels are depicted. The recording of these examples is confined to quotations from the published sealing descriptions where vessels have been noted.

Table 9.1

SELECT CATALOGUE OF MESOPOTAMIAN SEALINGS

A. SEALINGS WITH JAR STOPPER OR LID IMPRESSIONS

Jamdat Nasr/Early dynastic

U. 14646 (Legrain 1936, 18, no. 21)
"The clay covering and closing the mouth of the jar has been in this case incised with a network of lines or scratchings made with a stylus, sometimes along with a seal-impression. A few of these appear to become real pictographs (i.e. apparently intentional) as used on the inscribed tablets of Jamdat Nasr and Fara."

U. 14636 (Legrain 1936, 19, no. 47)
"Impressions left by the cloth obstructing the mouth of the jar, on the lower part of the clay stopper"

U. 14733 and U.18403 (Legrain 1936, 22, no. 120; pl.43)
"Impression of cloth on the reverse of the clay stopper"

U. 14166 (Legrain 1936, 22, no. 121)
"Dotted lines and string marks"

B. SCHEMATIC REPRESENTATION OF POTS

Jamdat Nasr/Early Dynastic

U. 14796 (Legrain 1936, 17, no. 3; pl.1)
"lines of jars with ring foot, spout rising from a flat shoulder and mouth covered by a conical overturned cup"

U. 14759 (Legrain 1936, 17, no. 4; pl.1 and pl.43)
"Lines of pointed jars with spout, narrow neck and angular shoulders

U. 13072 (Legrain 1936, 17, no. 6; pl.1)
"2 lines of pointed jars, one with a spout, the other (a leather bottle?) with a loop handle"

U. 14752 (Legrain 1936, 17, no. 9; pl.1)
"Construction, panelled door, conical top, leaf or jar, framed in vertical lines, fragment of pictographic inscription ?"

U. 14755 (Legrain 1936, 17, no. 10; pl.1)
"Panelled construction, conical hut (rather than man walking?) and jars). Small human (or animal?) figure"

U. 14732 (Legrain 1936, 17, no. 14; pl.1)
"Jar and construction (?) (c.f. fishing net no.44) Frag. of pictographic inscription?"

U. 14743 (Legrain 1936, 17, no. 17; pl.1)
"Archaic human figure; jar with handles and lid branches"

U. 14764 (Legrain 1936, 17, no. 5; pl.1)
"Round bottles (leather bottles?) with loop handle"

U. 8804 Royal Cemetery area (Legrain 1936,18, no.19;pl.2)
"Bow like pattern made by a vertical tang between 2 spiral horns. Handled jar in a wicker basket, placed on a base or shelf like a ladder with hands" (Footed jar) "Same jars in Elam and in Warka, Level V".

U. 15016 (Legrain 1926, 32, no. 336)
"Reed hut with characteristic side buckles, which are probably the thin ends of bundles forming the ribs of the hut, bent over and attached to the sides. Panelled door made of the same material. A nude man is seated outside probably holding a jar"

U. 14622; U. 14774 (Legrain 1936, 32, no. 37)
"Reed hut with side buckles and panelled door. A bull is half way out of the byre. The farmer seated on a low stool holds a jar. The line running around the shoulder of the vase may be a rope"

U. 14666 (Legrain 1936, 32, no. 338; pl.49)
"Same scene, reed hut, side buckles, seated man, jar also leaf and star flowers"

U. 14832 (Legrain 1936, 33, no. 339)
"Same scene. The man seated on the ground holds the pointed jar" before the calf half way out of the byre"

U. 14588 (Legrain 1936, 33, no. 340)
"Same scene, A branch over the calf"

U. 13962 (Legrain 1936, 33, no. 341)
"Same scene. A leaf in the field"

U. 14821 (Legrain 1936, 33, no. 342)
"Same scene. In this case the farmer is not seated but steps forward holding a vase to the mount of the bull. A plant in the field"

U. 13997 (Legrain 1936, 33, no. 343)
"Same scene. The calf leaves the byre and the seated farmer holds a jar. Plant and star flower"

U. 14570 (Legrain 1936, 33, no. 344)
"Same scene. The farmer seated on a low stool, holds a jar decorated with incised lines or tied with a rope The bull leaves the byre. Long reeds projecting horn-like on either side of the hut replace the usual buckles. The snake on the top is a magic emblem"

U. 18401 (Legrain 1936, 33, no. 345)
"Same scene. Here again the reed horns replace the buckles"

U. 18404 (Legrain 1936, 33, no. 346; pl.49)
"Same scene. Reed horns on either side of the byre. Plant, star flowers, crescent"

U. 14700 (Legrain 1936, 33, no. 347)
"Same scene. Large hut. High panelled door with side buckles. The farmer is standing"

U. 14554 (Legrain 1936, 33, no. 348; pl.49)
"Same scene, same door with side buckles. The seated farmer holds the jar half reclined"

U. 18404 (Legrain 1936, 33, no. 349; pl.49)
"Above scene but more elaborate. Farmer sits on elegant stool with rungs between. Two bulls leaving the byre on either side. His two hands rest on the jar, which he apparently holds by a loop of rope tied about the neck. The spread eagle above the hut, which siezes in its claws the two buckled posts planted sideways, is a remarkable feature, and almost certainly a religious emblem. Jar animal legs, a quiver (or torch?) sign from probably a pictographic inscription"

C. REPRESENTATIONS OF POTS IN PASTORAL/DAIRY SCENES

Jamdat Nasr/Early Dynastic

U. 18550 (Legrain 1936, 19, no. 45; pl.3)
"Cattle coming out of the "byre" and facing a seated man a jar between them suggests the dairy" (flat based amphura)

U. 14191 (Legrain 1936, 19, no. 46; pl.3)
"Dairy scene in 2 registers. A large jar is placed between a man seated on an elegant stool with rungs and a kneeling (?) servant" (jar possibly represents a churn)

U. 14595, U.14679, U.14792, U.14860 and U.18399 (Legrain 1936, 24, no. 167; pl.8)
"Chain of double axes between lines of notchings. In the upper register a pastoral scene: nude men, cattle, spouted jar, and tree (or reeds)"

U. 14613, U. 14560 (Legrain 1936, 25, no. 189; pl.9)
"Crouching bulls, branch, pointed jar with spout"

U. 13989 (Legrain 1936, 25, no. 190; pl.9)
"Crouching antelopes, a jar with double handles (or reed?)"

U. 14521 (Legrain 1936, 26, no. 205; pl.10)
"Two registers. Reed hut with side buckles. Cattle, jar, branches," (spouted jar beneath cow)

U. 13881 (Legrain 1936, 26, no. 209; pl.10 and pl.45)
"Two or three registers. Spread eagle between crouching calves. Leaf, jar or sign or rising sun"

U. 14520 (Legrain 1936, 31, no. 310)
"Man driving a bull (?) (the DUN species?) among the reeds. Jars"

U. 14817 (Legrain 1936, 31, no. 311)
"Man and cattle. Jar. Border of chevrons"

U. 14158 (Legrain 1936, 43, no. 484; pl.27 and pl.56)
"The farmer seated on a low stool holds a round jar to the muzzle of the bull coming out of the byre. A bird is perched on the bull's back"

U. 14795 (Legrain 1936, 33, no. 354; pl.49)
"Same scene. Two pointed jars, one of which is as tall as the man"

U. 14692 (Legrain 1936, 33, no. 355)
"Same scene. Panelled door, standing man, jar and grove. There are side buckles at the top of the rectangular doorway"

U. 14130 (Legrain 1936, 33, no. 356)
"Same scene. Man, jar, grove, panelled door"

U. 14734 (Legrain 1936, 33, no. 357)
"Same Scene"

U. 13956 (Legrain 1936, 34, no. 358)
"Same Scene"

U. 14672 (Legrain 1936, 34, no. 359)
"Same Scene"

U. 14189 (Legrain 1936, 34, no. 360)
"The rectangular panelled door with side buckles at the top and a spread eagle above the shrine. A big jar with handles is placed on a stand before it"

U. 14802 (Legrain 1936, 34, no. 361)
"Store, panelled door with side buckles. Two nude men, one holding a jar, the other rampant. A spread eagle in the field between"

D. REPRESENTATIONS OF POTS IN OFFERING SCENES

Jamdat Nasr/Early Dynastic

U. 18397 and U. 18400 (Legrain 1936, 24, no.169; pl.8), also U. 18413 (Legrain 1936, 23, no.135; pl.44) which has a second seal.
"A scene of offering occupies the lower register. A lady drinks out of a tumbler"

U. 13974; U. 14672 (Legrain 1936, 33, no. 353; pl.49)
"Panelled door between straight jambs, man and jar. The door is not arched over, and the absence of animals shows that the reed byre is no longer intended. This may be another type of shrine near a grove. The man steps forward, one hand extended, and seems to deposit a full jar as an offering"

U. 14790 (Legrain 1936, 35-6, no. 387; pl.20); U. 15019; U. 18404 (Legrain 1936, no. 387; pl.20 and pl.51)
"Ritual offering at the shrine of the spread eagle. The panelled door with side buckles is surmounted by the emblematic bird.....Outside the gate.....stands the main person, king or god to whom are brought the offerings.....a priest entirely nude performs the libation, holding by neck and foot the ritual jar with a long spout. He is followed by two women who bring liquid offerings in jars of different types and sizes containing probably milk, oil and beer....."

U. 14138 (Legrain 1936, 31, no. 323)
"Scene of offering. A large spread eagle between a scorpion and an ass is the centre of the picture. A man approaches carrying a jar in both hands. The jar resembles the stone vase (with lids) of later times. There are more offerings and a two handled jar in the field, and above the ass a curious figure (a lion?)"

U. 18169B (Legrain 1936, 45, no. 533; pl.30 and pl. 58)
"Ritual scene in two registers. An enthroned person is approached by two male servants, the first pouring a libation over a stand or jar. Behind the throne stand four female assistants..... The same libation scene is repeated in the lower register in front of the enthroned king or god (?) who holds a cup"

U. 15061 (Legrain 1936, 45, no. 534; pl.31)
"Libation scene. A woman worshipper pours out a tumbler of water over a small stand before the enthroned goddess (?). Both have long hair and garments and raise one hand in token of adoration and welcome..."

U. 14822 (Legrain 1936, 45, no. 535; pl.31)
"Ritual scene. A servant brings a tumbler to an enthroned person. Between them a small stand"

U. 15056 (Legrain 1936, 45, no. 536; pl.31)
"Ritual scene. Two divine assistants approach an enthroned god. Between them a small stand.....The first extends one hand over the small table, apparently performing the libation. The second holds the overflowing vase from which streams of water escape. Fishes are swimming along the streams"

U. 18553 (Legrain 1936, 46, no. 547; pl.31)
"Ritual scene. Throne, shrine, door, altar on which are placed offerings. A nude priest is apparently pouring a libation. A second nude servant - a woman - prays with both hands up"

Akkadian

BM.103329 (Collon 1982b, 104, no. 225)
"Presentation Scene. Goddess with female worshipper who pours a libation on an altar."

BM.122563 (Collon 1982b, 105, no. 226)
"Presentation Scene. Goddess with bearded worshipper... who pours a libation on an altar before a seated goddess"

BM.129479 (Collon 1982b, 101, no. 213)
"Vegetation Deities. A war goddess stands full face.... a worshipper in a fringed robe stands facing her on the other side of the altar.... behind her, also facing left, stands a goddess in a striped robe who holds a flowing vase. A bearded god stands facing right with his back to her"

BM.125793 (Collon 1982b, 77, no. 149)
"Two figures each holding a cup a third figure holds out a small vessel with a basket handle.... They approach a seated god.... who holds a cup in his right hand. Between the figures and the god is a large cooking pot(?) on a stand beneath which is a double shape, probably a flame. Next to this stands an offering table"

BM.125793 (Collon 1982b, 77, no. 149)
"A figure wearing a flaring cap and a belt holds up a cup in his left hand. A figure similarly attired with his hair in a double bun, also holds up a cup (? chipped). A third figure holds out a small vessel with a basket handle....approach a seated god..... who holds a cup in his right hand. Between the figures and the god is a large cooking pot(?) on a stand beneath which is a double shape probably a flame"

BM.105159 (Collon 1982b, 101, no. 214)
"A seated bearded god, who wears a flounced robe and holds a cup in his left hand is approached by a god.....who.....looks back at a worshipper he is leading by the hand....Behind him comes an attendant in a striped skirt who raises his left arm and carries a footed cup which has a stirring rod or spoon in it"

BM.123571 (Collon 1982b, 102, no. 217)
"Two figures with hands clasped and one with his left hand raised approach a seated god(?) who holds a cup in his right hand. In the field a mace, a crescent moon and a feather-like branch of vegetation. Terminal, a vertical snake"

Presentation Scenes

BM.120544 (Collon 1982b, 104, no. 223)
"A bearded god, who wears a robe and has his hair in a curl down his back. Three worshippers approach him. The first is clean shaven and carries a tall vessel with a flaring lip and foot. The second is a female worshipper who.....raises a small cup in her right hand and a rectangular object in her left"

BM.122555 (Collon 1982b, 105, no.228)
"Two figures raise their left hands and approach a seated figure who raises a flat dish in his right hand. Behind him stands a figure facing left with his right hand raised....."

BM.125793 (Collon 1982b, 77, no.149)
"A figure wearing a flaring cap and a belt holds up a cup in his left hand. A figure similarly attired also holds a cup. A third figure holds out a small vessel with a basket handle. They approach a seated god... who holds a cup in his right hand. Between the figures and the god is a large cooking pot(?) on a stand beneath which is a double shape which is probably a flame. Next to this stands an offering table"

E. REPRESENTATIONS OF POTS IN HUNTING SCENES

Jamdat Nasr/Early Dynastic

U. 11688 (Legrain 1936, 26, no. 211; pl.10 and pl.45)
"Spread eagle, bull calf, goats or antelopes, jar, leaves, (footed-based jar)"

U. 18402 (Legrain 1936, 2, no. 223; pl.11)
"Spread eagle, bull, spouted jar, byre(?)"

U. 18394, U.18407 (Legrain 1936, 27, no. 238; pl.12 and pl.46)
"Three lions attacking a bull, running antelope. Fishes, bird, spouted jars, two separate legs" (spouted jars similar to Sample no. 0285, Fig. 8.25)

U. 18413 (Legrain 1936, 28, no. 251; pl.13)
"Nude man carrying a spear (?) on his shoulder and driving an animal (a lion ?). Leaves, spouted jar"

U. 18413 (Legrain 1936, 28, no. 252; pl.13)
"A nude hunter spears from behind a lion attacking an antelope (ibex?). Crescent, leaves, branches, spouted jar and birds"

U.14770, U.14808, U.18407, U.18413 (Legrain 1936, 28, no. 254; pl.13 & pl.44)
"A lion attacks an antelope (?) and is speared from behind by a nude hunter who has caught him by the tail. Shrub, star flowers, jar, bird, separate ass's head"

U. 13913 (Legrain 1936, 28, no. 258; pl.13)
"Scorpions, spouted jar, nude human figure"

U. 12547 (Legrain 1936, 29, no. 280; pl.14)
"Spread eagle, scorpions.... bull, spouted jar, and animal leg"

U. 14599 (Legrain 1936, 31, no. 302; pl.16 and pl.48)
"Nude fisherman bringing five fishes. A second man brings a jar (?) and a very indistinct object (perhaps a bird ?)"

U. 14163 (Legrain 1936, 31, no. 304; pl.16 and pl. 48)
"Nude man driving (or spearing ?)"

U. 13948, U. 13996, U. 14162 (Legrain 1936, 31, no.305; pl.16)
"Similar to above jars and spread eagle"

U. 14771 (Legrain 1936, 31, no. 309; pl.16)
"Man holding a bull by the tail. Jar, spread eagle"

U. 14153 (Legrain 1936, 31, no. 313)
"Man driving or spearing an animal. Jars, leaves"

U. 13980 (Legrain 1936, 31, no. 317)
"Man spearing an antelope. Reeds, leaves, star flower and spouted jar"

F. REPRESENTATIONS OF POTS IN BANQUET SCENES

Jamdat Nasr/Early Dynastic

U. 14766 (Legrain 1936, 34, no. 371; pl.50)
"Banquet with music. A seated man holds a tumbler apparently filled from an inclined pitcher above. Before him a nude servant holds a second pitcher. A musician plays on the harp. In the upper register are traces of a nude figure, a vase on a stand and a rosette"

U. 18413 (Legrain 1936, 34, no. 373)
"Banquet (?) with music. A woman is seated on a square stool with rungs. Opposite her a female musician also seated plays the harp. There are also a spread eagle above a high pointed jar and a border of dots"

U. 18413 (Legrain 1936, 35, no. 377; pl.50)
"Banquet scene. Two seated figures, hands up with a pointed jar between them. The only preserved seat is crescent shaped. There are more spouted jars, right way up and inverted, and a surplus base or divan below them. The figures are roughly cut and the arms and legs out of proportion"

U. 14000 (Legrain 1936, 35, no. 381; pl.50)
"Banquet scene. Two figures, a nude man and woman (?) are seated on low square stools, perhaps below a canopy and attended by nude servants. Each seems to hold a tumbler. In the field between are piled a number of offerings: fishes, loaves, round bread, a spouted jar with lid, and a second jar like a table of offerings set on the ground"

U. 18402 (Legrain 1936, 35, no. 382), U.18413 (Legrain 1936, pl.50)
"Banquet scene. A woman, tumbler in hand, is seated on an elegant stool and is attended by a nude servant. She has long hair and is fully dressed. The open stool has open lattic work side and bulls feet connected by a rung. There are also a second nude servant, bull, calf, scorpions and a spouted jar"

U. 14595, U. 14585, U. 18397, U. 18406, U. 18413 (Legrain 1936, 35, no. 384; pl.20), U. 18413 (Legrain 1936, pl.51)
"Banquet in fable land where animals play the parts of men. The lion is the King and he sits, tumbler in hand, on a stool with open work sides.... Animals too, are his servants: three assess (?) led by a goat, all standing on their hind legs. The two first bring a spouted vase and a sealed jar..... The offerings are piled before the King and on the shelf. Spouted and two-handled jars, loaves or cheeses of round, oval and triangular form..."

U. 15046 (Legrain 1936, 43, no. 491; pl.28)
"Banquet ? Servants bringing vase of offerings and a goat. Two registers"

Akkadian

BM.108782 (Collon 1982b, 107, no. 237)
"Divided into two registers by two panelled horizontal lines, with the two centre ones joined together by diagonal lines; the same motif forms a border round the top and bottom of the seal, with an extra hatched band round the bottom. Above, two figures in striped skirts sit facing each other; the right hand one seems to be holding a cup, Terminal, a feather-like tree"

BM.125794 (Collon 1982b, 108, no. 243)
"Two figures wearing striped skirts or robes, seated on box seats with central supports face each other and hold up cups in their left and right hands respectively. Between them and behind them are two feather like trees."

G. REPRESENTATIONS OF POTS IN CONTEST SCENES

Jamdat Nasr/Early Dynastic

U. 18410 (Legrain 1936, 30, no. 297; pl.15 and pl.48)
"The victorious hero triumphing over his enemy.... Animals form the couterpart of the human scene: spread eagle, lion and wild goat. Also net, jar, fishes (?), star flowers" (The jar is an amphora type)

Akkadian

BM.89221 (Collon 1982b, 46, no. 32)
"Bull man in conflict with a lion. In the field a tall spouted libation vessel"

BM.129471 (Collon 1982b, 65, no. 118)
"Contest scene. Terminal: "A tree with an Arabian onyx below it and a pot laid horizontally alongside it"

H. REPRESENTATIONS OF POTS IN DRINKING SCENES

Jamdat Nasr/Early Dynastic

U. 13653 (Legrain 1936, 45, no. 521; pl.30)
"Archaic figures of nude men seated and drinking in a boat of crescent shape"

U. 13651 (Legrain 1936, 45, no. 522; pl.30)
"Boat in reeds..... Two men seated with a jar between them"

U. 14810 (Legrain 1936, 45, no. 523; pl.30)
"Boat in reeds. Two men seated and drinking through a pipe from a jar between them"

Akkadian

BM.103338 (Collon 1982b, 108, no. 242)
"Two figures.....are seated facing each other on chairs..... Between them is a tall footed vessel from which they are drinking with the aid of long straws; above are the crescent moon, the sun and a star.....Behind the right hand figure is a male figure.....he seems to be threatening the seated figure with a dagger....."

I. REPRESENTATIONS OF POTS: MISCELLANEOUS

Jamdat Nasr/Early Dynastic

U. 15022 (Legrain 1936, 32, no. 331)
"Spread eagle, animal passant; and jars with long handles which seem to be part of the basket protecting them"

U. 13937 (Legrain 1936, 32, no. 332)
"Man holding a spouted jar by the handle in position on the ground. A goat is browsing the leaves of a shrub"

U. 14558 (Legrain 1936, 34, no. 363)
"Dubious figure, perhaps a woman, standing with clasped hands and wearing a short skirt. Jar and reed hut (?)"

U. 14597 (Legrain 1936, 34, no. 368; pl.49)
"Marital scene. A woman is bending over two pots which she apparently tries to lift from the ground. A second woman holds her head down by her tresses while an ithyphallic male siezes the first woman from behind by the shoulders..... A child is seated on a low stool behind him, holds up a round object, cup or bread. There is a second marital couple above and many smaller figures in the field: a scorpion, a spouted jar, round pieces of bread, a crescent, and again the curious checker board of nine squares inscribed in a circle"

U. 18412, U. 18413 (Legrain 1936, 35, no. 379; pl.50)
"A procession of nude men bringing offerings which look like a bundle of ears of corn and ripe fruit hanging from a long pole. There are some less distinct figures, jar, leaves, a leg, a small servant"

U. 14864 (Legrain 1936, 32, no. 325)
"Archaic figure of a man standing. A small bull and a jar in the field"

U. 12544 (Legrain 1936, 32, no. 328) U.14786 (Legrain 1936, pl.49)
"Chain of male dancers (?) with hands linked. Jars (or leaves?) in the field"

U. 14662 (Legrain 1936, 32, no. 330)
"Nude man in the centre of pointed jars of different types with or without a basket covering and a lid like an inverted cup. The man is walking with long strides like the dancers (?) above and seems to hold a large platter in both hands"

U. 20083C (Legrain 1936, 46, no. 553)
"Archaic freeze of pointed jars and dotted lines"

Akkadian

BM. 134762 (Collon 1982b, 76, no. 145)
"Miscellaneous scene. Procession led by a sphinx.....last in the procession is the boat-god.....below the boat and the sphinx is a round pot with a narrow neck. The god with rays, sphinx, plough, bucket, birdman and pot

BM.130693 (Collon 1982b, 77, no. 148)
"A bearded god is pulling a tree over...immediately to the right of it, a god with a multiple-horned head-dress...before him stands a female (?) worshipper...Her right hand is raised and she is carrying a situla"

J. SEALINGS REPRESENTATING CARRIAGE OF POTTERY

Uruk

Tablet JA 24 (Van Driel 1983, 38 and 39; fig. 6)
"Two large long - horned quadrupeds walking left, with above their backs narrow - mouthed jugs with two handles on their shoulder (possibly ring-based amphorae types)..with..."tasselled objects".....sprouting from a round vase (perhaps representing a liquid content), and a crescent-shaped object with two small vases in it. Between the two large animals is another small vase.....the crescent with pots can perhaps be interpreted as a boat"

Tablet JA 125 (c.f. Van Driel 1983, 41-42; fig. 13a)
"impressions of a seal showing long-horned, goat-like animals separated by a plant. Above one of the animals there is clearly a pot in a carrying device"

Tablet JA 367 (Van Driel 1983, 42-43; fig. 15)
"two registers, each of which seems to show an alternation of a jar in a carrying device and an unidentifiable quadruped moving left" (Two other possible jars or stands are visble (c.f. Baudot 1979, 54)

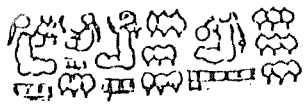
Tablets JA 170 and JA 171 (Van Driel 1983, 46, fig. 20)
"Recognisable are two fairly shapeless persons carrying with both arms a long stick above their heads. From this stick hangs a huge schematically represented jar in a carrying device" (c.f. Baudot 1979, 57, pl.4, no. 13)

Tablet JA 382 (Van Driel 1983, 47; fig. 22)
"a tiny seal...showing squatting persons on a pedestal with hands raised towards a very vague object represented by three big dots and a smaller one. A pot seems suggested in one instance"

Tablet JA 513 (Van Driel 1983, 47; fig. 23)
"impressions of a seal.....showing squatting women with raised hands. A bell-shaped object with two loops near the top" (c.f. Baudot 1979, 54; pl.1, no. 1.3/2) "seems to be present in both registers"

Tablet JA 134 (Van Driel 1983, 48; fig. 24)
"a seal of this type depicted only a row of vessels with tassels with a smaller pot without tassels as a fill element placed higher in the field"

Tablet JA 253 and Table JA 483 (Van Driel 1983, 48; fig. 25; 55-56; fig. 40)
"another repetitive design with pottery. A narrow-mouthed triangular vessel in a 'carrying device' is combined with a narrow-mouthed, oblong shape which is possibly a churn"



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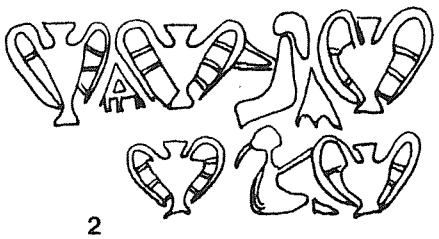

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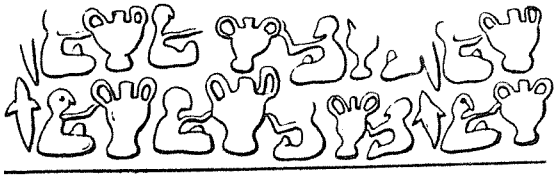

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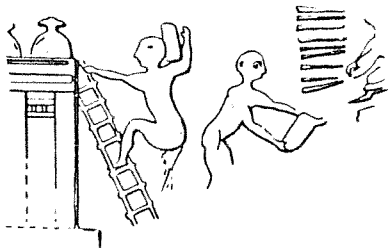

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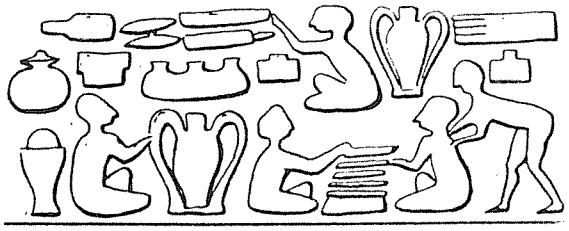

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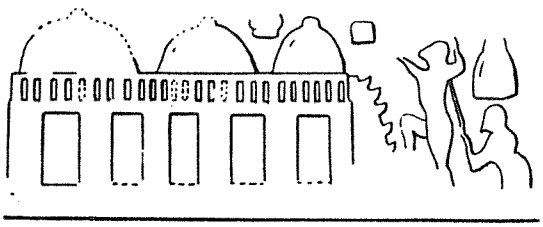

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Fig. 9.1 Vessels on archaic Mesopotamian sealings. Production: **1**, de Genouillac 1934, pl. 40, no. 2a; **2**, Buchanan 1966, pl. 46, no. 703; **3**, Amiet 1980, pl. 16, no. 262; **4**, ibid., no. 265; **5**, ibid., no. 267; **6**, ibid., no. 268; **7**, ibid., no. 269. (1:1).

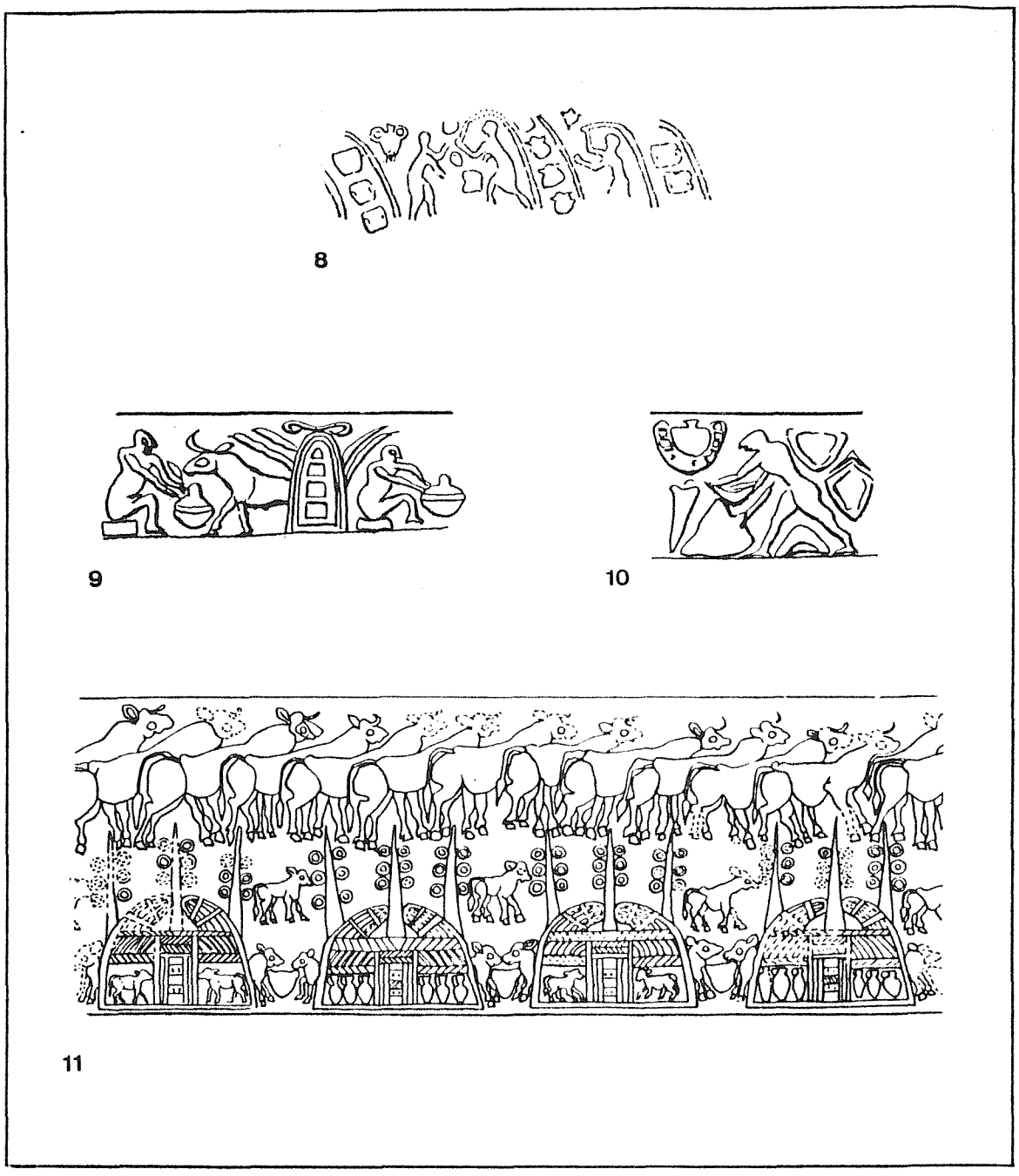

Fig. 9.2 Vessels on archaic Mesopotamian sealings. Production: **8**, Baudot 1979, pl. 57, no. 24. Pastoral scenes: **9**, Legrain 1936, pl. 17, no. 330; **10**, ibid., no. 344; **11**, Moorey and Gurney 1978, fig. 1, no. 9 (1:1).

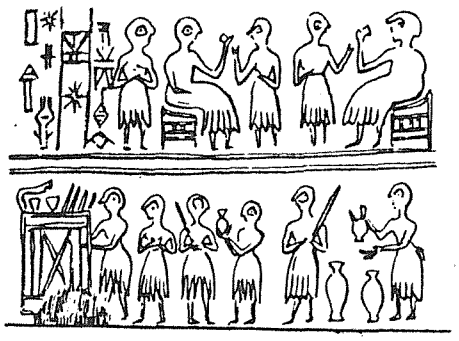

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Fig. 9.3 Vessels on archaic Mesopotamian sealings. Banquet/offering scenes: **12**, Amiet 1980, pl. 90, no. 1184; **13**, Legrain 1936, pl. 31, no. 533; **14**, ibid., no. 534; **15**, ibid., no. 535; **16**, Buchanan 1966, pl. 19 no. 228; **17**, Legrain 1936, pl. 20, no. 387. (1:1).

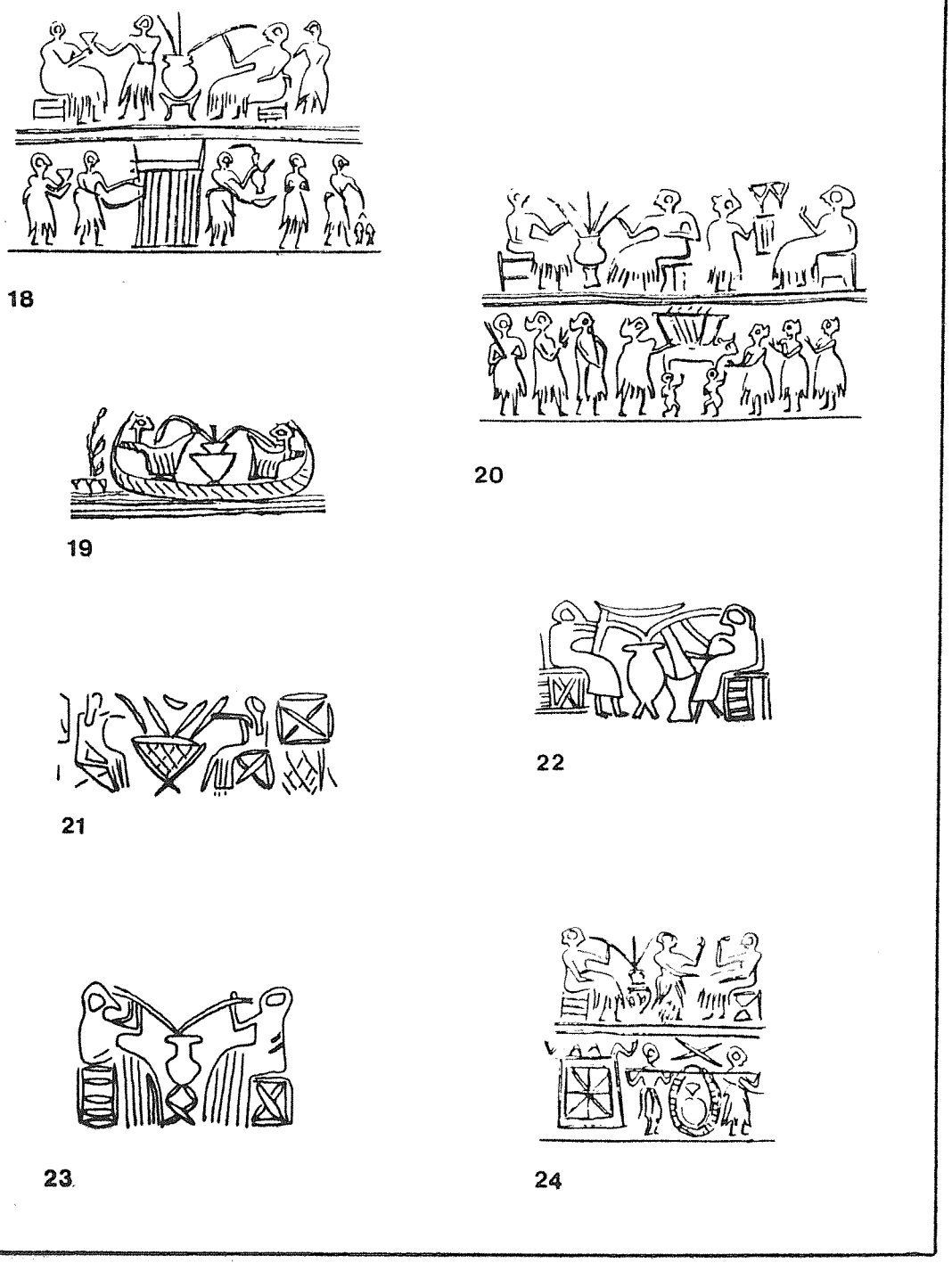

Fig. 9.4 Vessels on archaic Mesopotamian sealings. Drinking scenes: **18,** Amiet 1980, pl. 90, no. 1190; **19,** Legrain 1936, pl. 30, no. 524; **20,** Amiet 1980, pl. 90, no. 1194; **21,** Buchanan 1966, pl. 19, no. 230; **22,** ibid., no. 231; **23,** ibid., no. 232; **24,** Amiet 1980, pl. 90, no. 1191 (1:1).

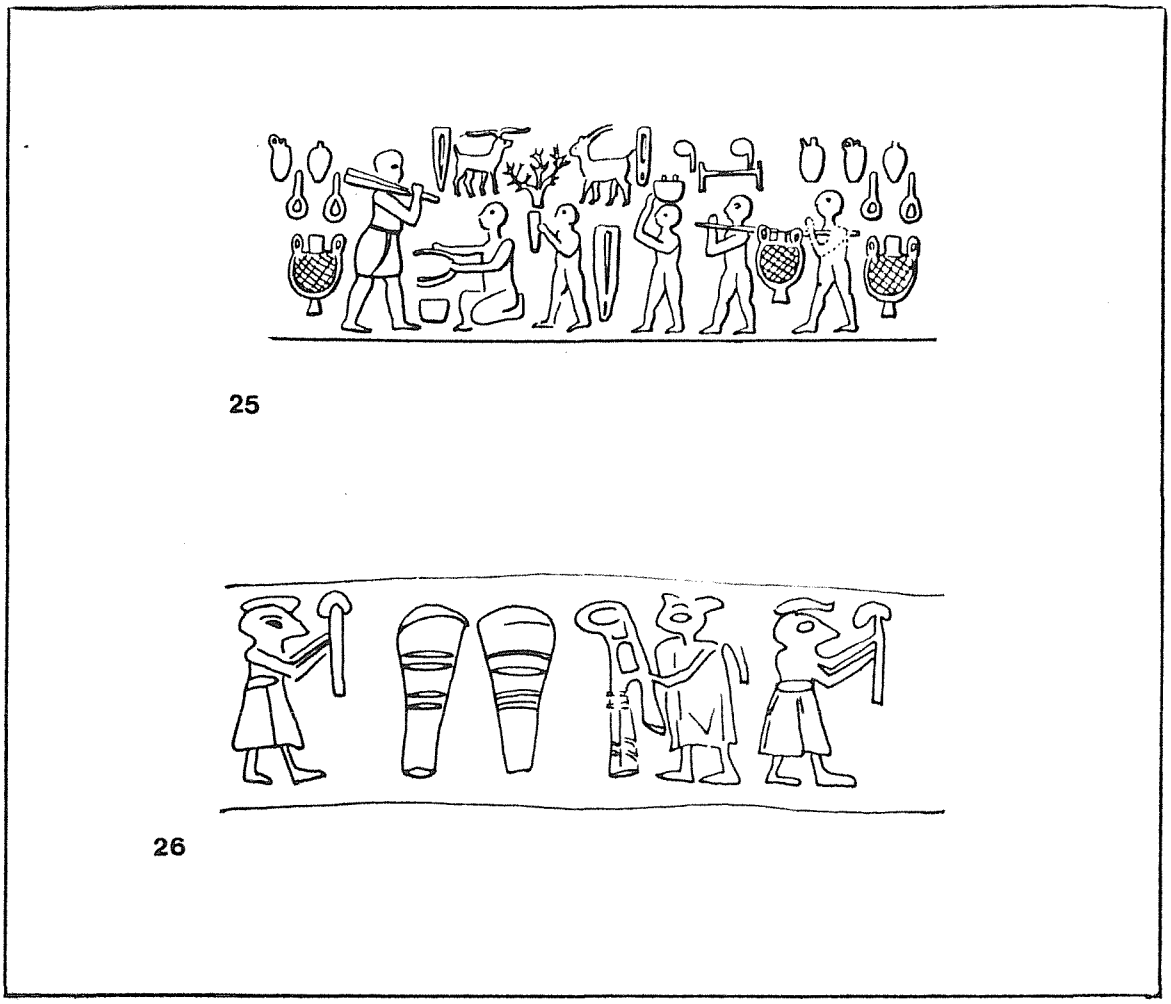

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Fig. 9.5 Vessels on archaic Mesopotamian sealings. Carriage of pottery: **25**, Amiet 1980, pl. 120, no. 1609. Storage jars: **26**, Woolley 1935, pl. 67b (1:1).

9.2 FUNCTION

9.2.1 Introduction

A degree of stylisation was practiced in the representation of vessels on seals (Table 9.1, B) which frequently precludes detailed analysis of vessel types. Few vessel forms identified from seal impressions can be equated with specific pottery types retrieved from excavations (Baudot 1979, 54-55; Legrain 1936 pl. 42) and it seems to be a peculiarity of glyptic art that function takes precedence over shape. It is surprising to note, however, that where a specific form may be related to function the sealcutters have attempted to illustrate pertinent differences between vessel types. Handles on jars, for example, may be positioned on the neck (Legrain 1936, pl. 1 no. 16) and at other times on the jar shoulder (Legrain 1936, pl. 20 no. 387). The latter perhaps indicates a jar used for strorage, whilst the former may represent a type of jug. Decoration is usually ignored with the occasional exception of two horizontal lines encircling jar shoulders and probably representing large ribs (Fig. 9.2, no.9: Legrain 1936, pl. 17 nos. 337 & 344). It is possible that the medium with which the seal engraver had to work dictated to some extent the degree of detail he could reasonably be expected to reproduce. A more persuasive argument for this simplistic representation of vessels, however, is the probability that the introduction of utilitarian items such as pottery, which are likely to have been regarded as accessories and therefore subordinate to the main scene, did not merit the same care and attention to detail as for example the Sumerian kilt (e.g. Woolley 1935, 69c) or the feathers of a falcon/eagle (e.g. Wiseman 1962, pl. 22).

Careful scrutiny of various types of scene, in particular pastoral/dairy scenes (Table 9.1, C); banqueting scenes (Table 9.1, F) and drinking scenes (Table 9.1, H) suggests that whilst attention to detail is frequently lacking in the illustration of specific forms, those vessels which are intended to represent different functions are in general carved so that they appear to scale with associated figures and other vessels included in the scene. Thus vessels depicted on a sealing from the Royal Cemetery at Ur (Amiet 1980, pl. 90 no. 1184) are in proportion to one another and to the figures depicted on the seal impression. In the lower register small cups (possibly conical

bowls: Table 8.1, Type 1.1), an ovoid jar, a spouted jar and two tall (ring-based?) jars are of appropriate proportions which may be compared directly with illustrated examples. This therefore facilitates comparisons between the postulated function of excavated pottery types and the function of broad categories of vessel type in the context of scenes depicted on seal impressions.

9.2.2 Bowls and dishes

Cups, bowls and dishes occur most frequently in offering (Table 9.1, D) and banquet (Table 9.1, F) scenes (e.g. Amiet 1980, pl. 90; Buchanan 1966, pl. 19 no. 228; Frankfort 1939a, pl. 185; 187-189; Woolley 1935, pl. 69e and g and pl. 70d.) Cups ranging from tall goblets (e.g. Legrain 1936, pl. 20 no. 384 and pl. 31 nos. 532 and 535) to wide shallow conical bowls (e.g. Legrain 1936, pl. 31 no. 533) are illustrated although distinctions between these two types are frequently hard to define and are not important in the context of their function as drinking cups.

The bevel-rim bowl is one of the most common bowl types occuring in the late Uruk period and various suggestions have been put forward for its possible function, the most durable of which is its use as a ration bowl (Johnson 1973, 129-139) used in the issuing of grain rations. In the Early Dynastic period conical bowls replace the bevel-rim bowl and may have also assumed the function of ration bowls (Ellison 1984, 64). The suggestion, however, that bevel-rim bowls and conical bowls were used as a form of measure is difficult to percieve from an examination of seal impressions. Apart from a single scene in which liquid is being ladled into a conical bowl shape (Amiet 1980, pl. 90 no. 1180) this form in glyptic art is confined to its function as a drinking cup (Porada 1948, pl. 18 no. 12). In one example from a dairy scene liquid is illustrated being poured from a jar into a bowl through which it is apparently decanted into a second bowl (Hall and Woolley 1927, pl. 13). The first bowl is perhaps intended to represent a strainer and may be equated with sieve bowls found in ceramic assemblages (Table 8.1, Type 1.9). It is possible that the liquid is milk which is being strained during the cheese making process.

Large bowls/basins are rarely represented in glyptic art. Neither Baudot (1979, 54-55) nor Legrain (1936, pl. 42) include this form amongst the vessel types identified from seal impressions and

dishes do not appear to occur on later seals of Akkadian date (Collon 1982b, 33). A large band-rim bowl/basin (Table 8.1, Type 1.6.2) however, is depicted in an offering scene on a fragment from a decorated gypsum vase (probably of Uruk date) found at Warka (Woolley 1935, pl. 18a). Detailed representations of this type are rare. The nearest approach to a large bowl represented on seal impressions is the shallow dish shape (Baudot 1979, 55 no. 7) which is again a rare form of vessel illustrated on clay sealings (Baudot 1979, 31). This contrasts with the archaeological evidence where large bowls are frequently found in graves associated with so called sets including a spouted jar, hollow perforated stand, conical bowl and a small cup/jar (Postgate 1982, 51, fig. 38; Martin et al. 1985, pl. 22a & c and fig. 123). It has been suggested that groups of such vessels constitute a form of washing-set (J.N. Postgate, pers. comm.) performing a similar function to modern islamic washing sets which are used for ritual cleansing before a meal (Moon 1982, 66). A large dish is depicted on a sealing from Ur (Amiet 1980, pl. 90, no. 1190) (See also Fig. 9.4, no. 18) in the lower register of what is probably a banquet scene. A figure holds a crescent-shaped dish in one hand whilst in the other he clasps the neck of a spouted jar. It is possible therefore, that in this instance the shallow dish together with the spouted jar may represent a washing set.

The crescent shape, however, occurs more frequently in the 'field' of scenes from seal impressions (e.g. Legrain 1936, pl. 18 no. 346; Wiseman 1962, pl. 17c and pl. 23b) where it resembles a crescent moon. This shape is also inscribed on large jars where it probably indicates a form of tally mark (Fig. 8.21, 244; 246 and 247). One final interpretation of the crescent shape is suggested by its occurrence in a pastoral context (Legrain 1936, pl. 17 no. 332) where it may have been intended to represent a clay sickle. It would be unwise, therefore, to interpret the appearance of a crescent shape on seals as a form of dish or bowl without due consideration of the context in which it occurs.

9.2.3 Jars

Among the archaic seal impressions from Ur almost 25% contain illustrations of vessels of which the most frequently occurring type is the jar depicted in a variety of different forms (Legrain 1936, pl. 42). Jars also constitute four out of the seven

principal categories of vessel type identified by Baudot (1977, 55 nos. 1-4) and are represented in all nine categories of seal impressions (Table 9.1, B-J), usually in some utilitarian capacity. Interpretation of the various jar forms often depends upon the type of scene depicted on a seal and the association of a particular vessel with the remaining elements including figures, animals, architecture and other vessels.

Schematic representations of pots (Table 9.1, B) usually depict rows of jars either on their own (e.g. Legrain 1936, pl. 1 nos. 3-6) or alternating with figures (Amiet 1980, pl. 16 no. 262). It is often the case that these large amphora-type jars are surrounded by a form of carrying device (Section 9.4). Large jars in such carrying devices are frequently illustrated suspended from poles between pairs of figures (Figs. 9.4, no. 24 and 9.5, no. 25; Van Driel 1983, 46; Fig. 20; Wiseman 1962, pl. 13c) and are often depicted in banquet scenes, carved on both seals and stone plaques, where they clearly perform a joint function as containers for the storage and transport of foodstuffs or liquor (Figs. 9.4 no. 24 and 9.5 no. 25; Frankfort 1939, pl. 185 and pl. 187; Woolley 1935, pl. 70).

Large jars, presumably also intended to represent containers for bulk storage, are illustrated with large looped appendages. These are apparently secured on either side of each jar giving the appearance of handles (Baudot 1979, 54; nos. 1.2/1 and 1.2/2). It is difficult to reconcile such large handled types with evidence from the archaeological record. Strap handles are a common feature on late fourth millennium jugs/jars and small handles placed high on jar shoulder are in evidence on seal impressions (Fig. 9.3, no. 17) but large amphora-type jars with handles extending from shoulder to base are not a feature of either late fourth millennium or third millennium pottery assemblages. Although Baudot (1979, 13) has suggested that these so-called 'ear-like' appendages may also represent carrying devices, no real explanation of the difference between the more obvious form of rope-harness and these handle-like appendages has been forthcoming. However, by examining both types of device depicted on seal impressions the distinction between the two forms appears to hinge on the shape of the jar itself. In the case of structures which extend below the base of the jar the base is always portrayed as either round or ovoid (Fig. 9.2, no. 10; Buchanan 1966, pl. 46 no. 705) whilst jars with handle-type appendages are invariably portrayed with foot or ring bases (Fig. 9.1, no. 2). In the latter

instance the shape of the jar base obviates any necessity for a carrying device which encloses the whole jar. Instead a rope harness could be securely attached to the tapering part of the foot or ring-base. Confirmation of this method of securing the carrying device may be seen on a seal impression from Ur (Legrain 1936, pl. 17 no. 331). Thus the large loops illustrated on either side of the shoulder may be interpreted as a means by which the carrying device could be hand-held or through which a pole could be threaded for ease of transport (Fig. 9.2, no. 9).

There is considerable variety in the range of medium-sized jars depicted on seal impressions and in some cases their function appears to be quite specific. Storage jars with handles are depicted placed in a reed byre (Moorey and Gurney 1978, Fig. 1, no. 9). Round-bodied jars with narrow bottle necks frequently appear in pastoral scenes (Table 9.1, C) and are probably intended to represent milk-churns (Fig. 9.2, no. 9; Baudot 1979, 37; Collon 1982b, pl. 22 nos. 151 and 153; Legrain 1936, pl. 17 nos. 337-338; Moorey 1967, fig. 122; Postgate 1977c, 48). Cooking pots are a rare feature on Akkadian seal impressions (e.g. Collon 1982b, pl. 21 no. 149) and these wide-mouthed vessels are even less common on archaic seal impressions from Ur where they occur in the form of a drinking vessel (Fig. 9.4, no. 18) rather than as cauldrons or cooking pots.

Medium sized jars with pointed bases are often illustrated in archaic seal impressions and a similar type of jar is known to occur in third millennium pottery assemblages (Hall and Woolley 1927, pl. 57 Type XXX). These jars may have contained produce such as grain or liquid. Pastoral scenes depict this type of jar where a cow approaches the jar held by a figure possibly indicating that the cow is drinking from the jar (Legrain 1936, pl. 17 no. 343). In what are presumed to be offering scenes at a shrine situated by a grove (Legrain 1936, 33-34 nos. 353-359) pointed jars appear, associated with a figure. Since spouted jars are more usually depicted as the vessel of the libation, the pointed jar may be intended to represent the harvested contents of a crop of grain or other produce signified by the 'grove'.

Spouted jars are a very common form of vessel-type represented in glyptic art and occur in all nine categories of seal impressions (Table 9.1, B-J). They appear to serve a joint function as libation vessels in offering scenes (Table 9.1, D; Fig. 9.3, no. 13); hunting scenes (Table 9.1, E); contest scenes (Table 9.1, G) and

as purveyors of liquid refreshment in banquet scenes and drinking scenes (Table 9.1, F and H; Fig. 9.3, no. 12; Amiet 1980, pl. 90 nos. 1184, 1186 and 1190). A squat form of spouted jar with an ovoid base also occurs occasionally in pastoral/dairy scenes (Legrain 1936, pl.17 no. 332). Its function in this case is difficult to interpret although the large round body implies a type of container vessel compared with the long narrow body of most libation vases. Spouted jars are occasionally included in scenes where they have no apparent relation to the principal theme. On some seal impressions spouted jars are included in the field (e.g. Legrain 1936, pl. 8 no. 167; pl. 9 no. 192; pl. 10 no. 205 and pl. 12 no. 238) and in hunting scenes the spouted jar is the predominant vessel type illustrated (Table 9.1, E). In such cases the sealcutters presumably used the spouted jar in an extension of its function as a libation vessel to symbolise the offering theme.

It is not possible to distinguish between ceramic vessels and those which are manufactured from stone or metals. Similar vessel types, however, occur in all three materials and probably perform the same function. Reed and leather receptacles, however possess different properties. They are not preserved in the archaeological record and cannot therefore be equated with specific vessel types illustrated on seal impressions. One possible leather receptacle is the bucket shape which becomes popular in Akkadian glyptic art (e.g. Collon 1982 pl. 21 no. 148; Matoušová-Rajmova 1975, 63 no. 49b).

Finally, large storage bins are illustrated on several Uruk/Jamdat Nasr seals (Fig. 9.5, no. 26; Frankfort 1939b 31; pl. 5g; Wiseman 1962, pl. 2a; Woolley 1935, pl. 67 a and b). Baudot (1979, 55) considers these represent a form of 'cult-vase' although the more prosaic interpretation of 'two baskets' (Wiseman 1966, 1) is probably a more accurate description. Pottery storage bins are frequently found in situ but ceramic jars of the size depicted on seal impressions could not be transported without considerable effort.

9.2.4 Drinking vessels

Drinking scenes appear frequently in Sumerian art and have been painted on pottery (Fig. 8.85) as well as carved on stone plaques and seals (Table 9.1, H & F and Fig 9.4; Amiet 1980, pl. 90 no. 1183 and Woolley 1935, pl. 70a). The size and shape of the jar and the length of the drinking tubes vary considerably between different seal

impressions. In some cases the bottle is large with a rounded base and wide mouth (Fig. 9.4, no. 18; Amiet 1980, pl. 90 nos. 1190 and 1194), while in others a long-necked jar is illustrated (Fig. 9.4, no. 23). The bottle is sometimes small and ovoid (Woolley 1935, pl. 70a) and sometimes large and ovoid (Amiet 1980, pl. 90 no. 1186). Buchanan (1966, pl. 19 no. 230) illustrates a sealing with a rare form of drinking vessel in a wide conical shape (Fig. 9.4, no. 21) and square shapes are also represented (Buchanan 1966, pl. 19 no. 239). By the Akkadian period the drinking vessel has assumed the shape of a barrel (Buchanan 1966, pl. 28 no. 360; Collon 1982b, pl. 34 no. 242) and squat jar shape still prevail (Buchanan 1966 pl. 28 no. 362).

Stands which support drinking vessels have virtually disappeared by the Akkadian period. Early sealings, however, depict numerous stands ranging from tripods (Fig. 9.4, no. 22; Amiet 1980, pl. 90 no. 1186; Buchanan 1966, pl. 19 no. 231) to small stools (Fig. 9.4, no. 23) and solid stands (Fig. 9.4, no. 20; Amiet 1980, pl. 90 no. 1194). Two examples of sealings from Ur illustrating a drinking scene depict the drinking vessel and a pair of figures in a boat (Fig. 9.4, no. 59; Legrain 1936, pl. 30 no. 523). The method of drinking from these vessels is invariably the same; through drinking tubes which occur singly (Buchanan 1966, pl. 19 no. 239), or in pairs or in combinations of three or five. Presumably in the latter case the extra central straw aids the escape of air whilst the pair of figures sup their beer. In only one case are the straws dispensed with and a figure ladles liquid from the drinking vessel into a conical bowl (Amiet 1980, pl. 90 no. 1186).

With so many different representations of drinking vessels it might be suggested that the contents vary according to different types of vessel. Where jars are positioned above 'tripods' it is possible that the beverage is being heated, although there appears to be no evidence for a flame under any of the 'tripods'. On one seal impression a drinking vessel in the form of a triple vase perhaps indicates that the beverage consumed is being strained (Amiet 1980, pl. 90 no. 1183). Finally, in one instance, the drinking vessel looks remarkably like an early form of hookah (Fig. 9.4, no. 24).

9.2.5 Stands and stemmed dishes

In addition to seals which depict drinking vessels on small stands (Section 9.2.4) similar stands are also illustrated supporting large storage jars (e.g. Matoušová-Rajmova 1975, 58 no. 7). A more central role, however, is assumed by a taller version of this type of stand, presumably equivalent to the large hollow stands found in ED II and later ceramic assemblages (Table 8.1, Type 11.2). In common with stemmed dish shapes (Table 8.1, Type 10) the stands appear in some offering scenes (Frankfort 1934, pl. 3a; Legrain 1936, pl. 31 nos. 533-535 & 547). In some cases it appears that a libation is being poured over the stand from a spouted jar (Fig. 9.3, no. 13) or a goblet (Fig. 9.3, no. 14) and in almost every example where either a stand or a stemmed dish is depicted a figure is seated facing it. This figure is presumably an enthroned king or god, implying that a form of ceremony or ritual is being enacted (Legrain 1936, 45 no. 533).

The function of stemmed dishes has been the subject of continued speculation. They have been described as 'fruit stands' (Delougaz 1952, 85) and 'braziers' (Mackay 1925, 24; 1929, 146) and even as the basin part of a prestigious form of washing set where an upright-handled jar supposedly represents the humbler form of spouted jar (Moon 1982, 66). There can be little doubt that the suggested use of the stemmed dish as an offering table (Woolley 1934, 388) is supported by evidence from seal impressions. The problem remains, however, as to whether this constituted its sole function. A possible illustration of ritual cleansing, where the stemmed-dish appears as a form of wash stand is depicted on a seal impression from Ur (Fig 9.3, no. 13) although this is not a good example of a stemmed-dish type. It is likely that stemmed dishes used in offering scenes are illustrations of stone or metal types such as the examples from Ur (Woolley 1934, pl. 180c & pl. 266) and that their more ubiquitous ceramic counterparts were used for humbler tasks. If stemmed dishes had a more practical use in the household it does not appear to have merited the attention of seal cutters. Whilst utilitarian items such as cups and jars are to be found on many of the archaic seal impressions, stemmed dishes are rare and do not occur in the context of utilitarian vessels.

9.3 PRODUCTION

A number of seal impressions depict regimented groups of figures alternating with vessels. The two most common forms of this type of scene are the rows of pigtailed figures seated before triple-mouthed jars (Fig. 9.1, no. 1; Buchanan 1966, pl. 2 nos. 14, 15, 17 & 18; Porada 1948, pl. 3 nos. 7E - 16E) and lines of seated figures facing each other with arms outstretched towards a jar between them (Fig 9.1, no. 3). These scenes conjure images of industrial activity and it is possible that the figures are producing pots. Invariably seal impressions of this type illustrate only one vessel form presumably being manufactured. It is implicit in the portrayal of several figures grouped together and employed in making only one type of vessel that this represents a form of mass production.

Although seal impressions do not facilitate a study of pottery manufacture through all the stages from the potter's wheel to marketing of vessel types it is perhaps possible to identify some of these stages. Baudot identifies a form of oven (Fig 9.2, no. 8; Baudot 1979, 55 no. 87 and 57 no. 23) which could also indicate storage of pottery or even pottery being stacked in a kiln ready for firing. A clearer example of what may be preparation and loading of a kiln is illustrated on three seal impressions from Susa (Amiet 1980, pl. 16 nos. 267-269). In Fig. 9.1, no. 5 two figures appear to be mounting a ladder to a platform on which are placed domed objects. Below the platform is a structure which could represent the chambers of a kiln firebox. In the second sealing (Fig. 9.1, no. 6) a figure again climbs up a similar structure but in this case the domes on the platform look more like jars and the figure is carrying a rectangular object. To the right of the field a number of horizontal lines may represent vessels which have been stacked together (Baudot 1979, 38). An alternative interpretation is that these lines represent bundles of kindling collected in preparation for firing the kiln. On the third seal impression (Fig. 9.1, no. 7) a figure climbs up steps set into the side of a domed structure and faint traces are visible of a second dome. This is perhaps the most plausible illustration of a kiln although recognisable vessel types cannot be identified on this sealing. Since these kilns could also be interpreted as 'bread ovens' it has to be concluded that different functions are being represented by a single form.

Following the firing of pottery vessels it might be expected that the potter would transport his wares to a market centre or at least display the products to local consumers. Seal impressions frequently illustrate the transport of large jars in carrying devices (Section 9.4). In some cases jars placed in these carrying devices are associated with long tassels (Amiet 1980, pl. 16 no. 264; Baudot 1979, 57 no. 18) which appear to consist of strands of rope continuing from the harness and left free for fastening at the neck (Section 9.4). A possible explanation of rows of jars illustrated in this manner associated with seated figures is that the jars have reached the 'packaging stage' where they are being inserted into rope harnesses prior to distribution. The vessels may either be destined for sale as storage jars or used as containers for the subsequent sale of foodstuffs or liquor.

9.4 DISTRIBUTION AND TRANSPORT

In the light of evidence for what is presumably mass production of pottery (Section 9.3), it is surprising that sealings do not appear to depict the marketing or distribution of pottery, with the exception perhaps of an interesting seal from Susa (Fig. 9.1, no. 4; Amiet 1980, pl. 16 no. 265). This seal impression depicts four figures seated amongst a variety of vessel types, ranging from jars in what are assumed to be carrying devices to a triple-mouthed jar and a lidded jar. Several other 'boxes' and containers are also illustrated and one figure appears to be negotiating with two other figures (one seated and one standing) over a pile of 'dishes'. Whilst it is not possible to suggest that this seal illustrates a potter selling his wares, it is apparent that some form of transaction is taking place. The scene is perhaps intended to depict a market place where various vessels are displayed possibly by three different potters (three of the seated figures); alternatively, produce in container vessels may be the subject of the transaction.

Large amphora-type jars surrounded by a frame or net-like structure are a common theme in schematic representations of vessels on seals (e.g. Fig. 9.1, no. 2; Buchanan 1966, pl. 46 nos. 703-706; Legrain 1936, pl. 2 no. 19; Van Driel 1983, fig 13a). These frames have been variously described as tassels (Buchanan 1966, 128-129) or carrying devices in the form of nets or baskets (Baudot 1979, 13; Legrain 1936, 32 nos. 330 & 332; Van Driel 1983, 45). The design of these devices varies between different seal impressions. Some sealings portray large jars which appear to be mounted within a substantial framework and are either hand-held (Baudot 1979, 57, no. 21) or slung on poles between pairs of figures (Fig. 9.4, no. 24). Alternatively, smaller round-bodied jars are depicted totally enclosed by a form of net or basket again suspended from a pole. The latter may perhaps be interpreted as a type of woven basket with loops through which poles may be inserted. The former device, however, is more robust in appearance and could conceivably represent a cradle fashioned out of strong rope. This suggested method of transporting large and heavy container vessels is given further credance by representations of rope harnesses immitated in clay and applied as a from of decoration to the external surface of coarse ware jars (e.g. Postgate 1983, pl. 6a). That this harness is not rigid is implicit in designs where the ropes extend beyond the main harness structure in a

type of fringe or tassel (e.g. Amiet 1980, pl. 16 no. 264; Baudot 1979, 57, no. 19). These are equated with loops of net which may have been intended to be tied together at the rim of the jar (Section 9.3; Fig. 9.2, no. 10; Baudot 1979, 13) prior to transporting the vessel perhaps to the temple or a local market.

It is well attested that pottery was not simply exchanged at a local level. Seals have contributed to the evidence for trade between the Sumerians and sites down the Arabian Gulf and beyond as far as the Indus Valley (Allchin and Allchin 1982, 186-187). The evidence for export of pottery down the Gulf is discussed in Sections 6.2 and 8. Ceramic jars filled with either foodstuffs or liquid can become cumbersome objects and although the carrying devices for coarse container vessels may have partially solved the problem it is unlikely that large numbers of jars could be transported for any great distance in this way. The travelling merchant, however, had access to waterways permitting both riverine and ultimately maritime trade. Abundant evidence that the Sumerian merchants relied upon this method of transporting goods is provided in Sumerian literary compositions (Kramer 1977, 62-63). Whilst representations of vessels being transported in boats are apparently not a theme employed by seal cutters, some seal impressions do illustrate boats which appear to contain goods presumably intended for trade (e.g. Woolley 1935, pl. 67e). Much of the evidence for trade and distribution of commodities, however, is built up from a knowledge of the literary sources and scientific analyses must be used to establish the movement of the containers used for transporting such commodities.

9.5 CONCLUSIONS

The most striking feature to emerge from a study of the vessels depicted on seal impressions is that scenes are illustrated from everyday life in addition to the ritual ceremonies. An element of ritual is almost always present in glyptic art but this does not appear to overwhelm the portrayal of more mundane aspects of daily life.

Sealcutters were apparently concerned primarily with representing daily activities and ritual practices (Baudot 1979, 15). Accurate renderings of vessel forms were therefore unimportant. In characterising a range of different activities, however, such as pastoral/dairy scenes (Fig. 9.2, nos. 9-11; Moortgat 1967, fig. 122), banquet scenes (Fig. 9.3) and drinking scenes (Fig. 9.4) attention to detail is evident from the painstaking representation of vessel types ascribed to different functions. It is frequently possible, therefore, to assign specific functions to different vessel forms illustrated in glyptic art of the archaic period. This facilitates comparisons between broad typological groups, such as cups (conical bowls: Table 8.1, Type 1.1) spouted jars (Table 8.1, Type 5) and large (storage) jars (Table 8.1, Type 2.3) found in excavated late fourth and third millennium pottery assemblages.

The importance of ceramics to these ancient societies is perhaps implicit in the numerous representations of rows of vessels alternating with seated figures which have been interpreted as scenes of pottery production (Section 9.3). It is possible to speculate still further and suggest that in the case of the squatting, pigtailed figures (Fig. 9.1, nos. 1 & 2) production of vessels is by women either in pottery workshops or at home. It would not be true, however, to confine the production of pottery exclusively to women since different figures may frequently be identified similarly associated with pottery production (Fig. 9.1, no. 3).

Evidence for the transport of vessels appears to be confined to large jars probably acting as container vessels or storage jars, and the distribution of these vessels over long distances is portrayed on archaic seal impressions.

In conclusion, therefore, it is clear that studies of ceramic assemblages concerned with vessel function and the possible importance of ceramics to late fourth and third millennium societies can benefit from comparisons with vessel forms illustrated in glyptic art.

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10 BIBLIOGRAPHY

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