Supplementary information for:

Sill-controlled salinity contrasts followed post-Messinian flooding of the Mediterranean

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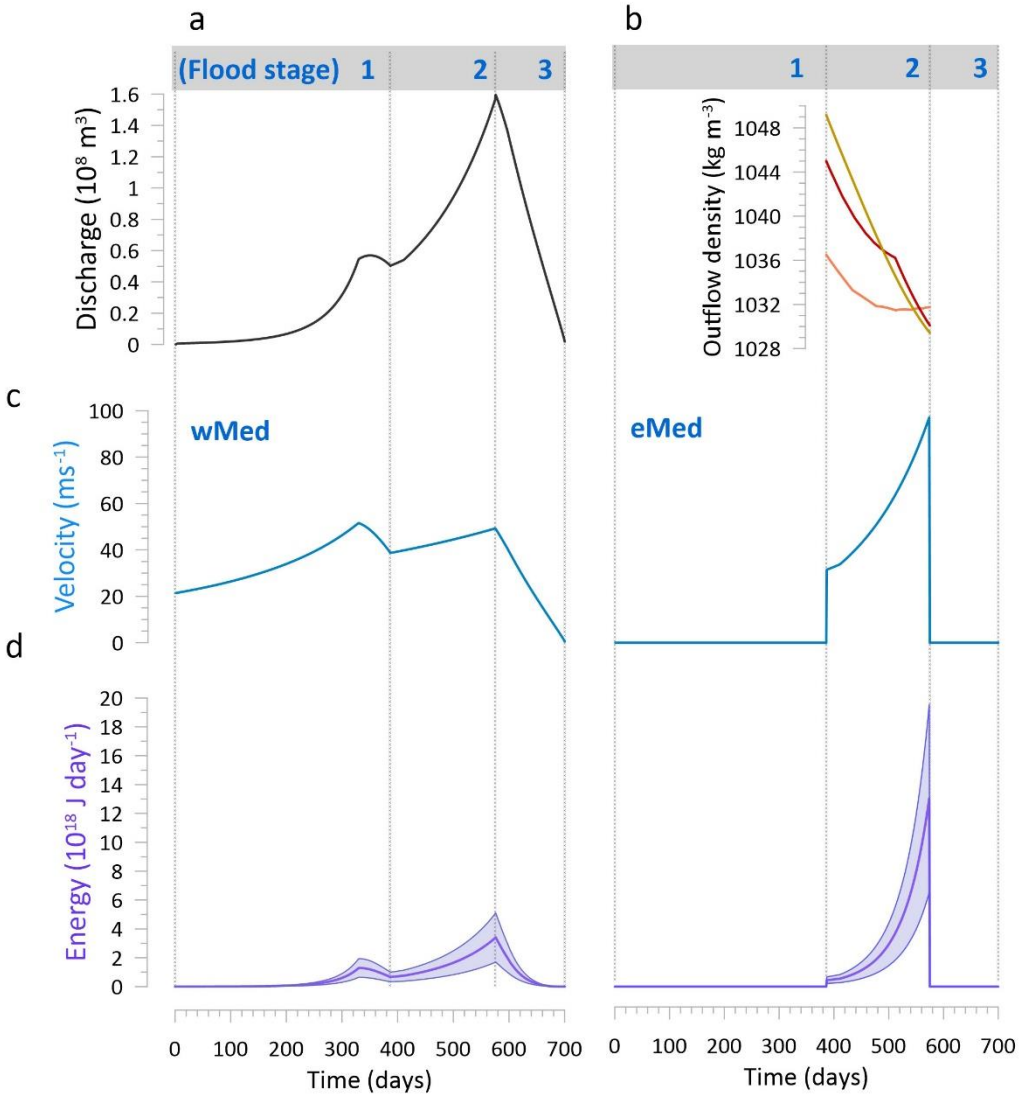
Supplementary figure 1 |Evolution of the flooding event in the wMed and eMed. a, Daily flood discharge through the Strait of Gibraltar. **b,** Evolution of eMed inflow water density during ZFS 2 at different mixing efficiencies (ME) in the wMed (orange = 10% ME; red = 20% ME; yellow = 30% ME). **c,** Flood velocity in the wMed and eMed. **d,** Kinetic energy available for mixing in wMed and eMed. Thick purple lines are energy availability at 20% ME. Upper and lower envelopes demarcate energy availability at 30% and 10% ME. ZFS 1, 2, and 3 are the three main Zanclean flooding stages (see main text Fig. 2).



Supplementary Table 1: A record of the Miocene to Pliocene transition recovered from Mediterranean DSDP and ODP sites. This includes a total of 46 sites[64]: Deep Sea Drilling Project (DSDP) Leg 13 sites, DSDP Leg 42A – 8 sites, Ocean Drilling Program (ODP) Leg 107 – 7 sites, ODP Leg 160 – 11 sites, ODP Leg 161 – 6 sites.

Western Mediterranean					
Site	**Location**	**Water depth (m)**	**Complete record across the M/P boundary**		**Nature of the boundary**
			Present	**Not Present**	
Deep Sea Drilling Project (DSDP) Sites					
121	Western Alboran Basin	1163		✓	Suspected lower Pliocene to upper Miocene hiatus. Lower Pliocene *Sphaeroidinellopsis* acme zone was not recovered[65].
122	Valencia Trough	2146		✓	Basal Pliocene transgression is not recorded[65].
123	Valencia basement ridge	2290		✓	Basal Pliocene transgression is not recorded[65].
124	Balearic Rise	2726		✓	More than 1 million years of the earliest Pliocene record missing[65].
132	Tyrrhenian Sea	2835	✓		Pliocene foraminiferal pelagic ooze overlying calcitic-dolomitic-pyritic marl (Late Miocene evaporite series) [65].
133	Sardinia Slope	2563		✓	M/P boundary hiatus[65].
134	Balearic Abyssal Plain	2864		✓	About 0.8 million years of earliest Pliocene sediments missing[65].
371	South Balearic Basin	2792		✓	About 1 million year hiatus at the base of the Pliocene[66].
372	Menorca Rise, west Algero-Provencal Basin	2699		✓	MPl-1 and MPl-2 biozones missing; M/P boundary is recorded as a drilling artifact[66].
373	Tyrrhenian Basin	3517		✓	Only down to MPl 3 biozone recognized. No M/P boundary present[66].
Ocean Drilling Program (ODP) Sites					
650	Marsili Basin	3516		✓	Oldest sediments are late Pliocene (MPl 6 biozone) [67].
651	Tyrrhenian Basin	3578		✓	Oldest sediments are late Pliocene (Piacenzian stage, MPl 6) [67].
652	Central Tyrrhenian Sea	3446	✓		Mainly earliest Pliocene gypsiferous nannofossil ooze overlies Messinian Sediments[67].
653	Western Tyrrhenian Sea	2828	✓		Foraminiferal ooze of MPl 1 biozone overlies an upper Messinian unit

					characterized by brackish water facies[67].
654	Upper Sardinian Margin	2208	✓		Early Pliocene foraminifer-nannofossil ooze overlies Messinian grey marls and gypsum[67].
655	Gortani Ridge, Western Vavilov Basin	3290		✓	Pliocene biozone MPl 3 is present. No continuous M/P boundary recognized[67].
656	De Marchi Seamount	3597		✓	Oldest sediments probably of Messinian age. Pliocene record is not complete; a long gap is present[67].
974	Central Tyrrhenian Sea	3454	✓		Earliest Pliocene yellowish brown to olive grey nannofossil clay overlies Messinian sediments[68].
975	South Balearic Margin	2200	✓		Earliest Pliocene bioturbated nannofossil ooze and clay sequence overlies Messinian evaporative sequences[68].
976	Western Alboran Sea	1108		✓	Hiatus at M/P boundary[68].
977	Eastern Alboran Basin	1984		✓	Unclear whether the M/P boundary was reached because the earliest section is complex[68].
978	Eastern Alboran Basin	1929	✓		MPl 1 biozone (foraminiferal ooze) overlies Messinian sediments (not reliable) [68].
979	Southern Alboran Basin	1062		✓	Oldest sediments date to late Pliocene[68].
Eastern Mediterranean					
Site	**Location**	**Water depth (m)**	**Complete record across the M/P boundary:**		**Nature of the boundary**
			Present	**Not Present**	
Deep Sea Drilling Project (DSDP) Sites					
125	Mediterranean Ridge	2782		✓	Sedimentation gap of 1.5 million years exists at the M/P boundary[65].
126	Cleft in Mediterranean Ridge, Ionian Sea	3730		✓	No Pliocene sediments recovered[65].
127	Hellenic Trench	4636		✓	Stratigraphic inversion detected; Cretaceous limestones overlying upper Pliocene oozes[65].
128	Hellenic Trench	4640		✓	Quaternary section penetrated; no M/P boundary present[65].
129	Strabo Trench, Levantine Basin	2832-3048		✓	No proper M/P boundary. Earliest Pliocene *Sphaeroidinellopsis* acme-

					zone present as downhole contaminants[65].
130	Mediterranean Ridge, Levantine Sea	2979		✓	Only Quaternary sediments present[65].
131	Western Nile Cone	3035		✓	Only Quaternary sediments present[65].
374	Ionian Sea	4078	✓?		M/P boundary obscured by diagenesis of earliest Pliocene horizons. Weakly defined boundary. Diagenetic gypsum included in Pliocene sediments. Sapropelic layers present in earliest Pliocene section[66].
375	Florence Rise, west of Cyprus	1900		✓	~1-million-year hiatus at basal Pliocene[66].
376	Florence Rise, west of Cyprus	2101	✓		Two M/P boundaries present as a drilling artifact. Prominent black layer present, rich in organic carbon, and finely laminated in its lower part dates to earliest Pliocene – Known as the "mystery sapropel" [66].
377	Mediterranean Ridge cleft	3718		✓	Quaternary sediments overlie Miocene sediments, no M/P boundary present[66].
378	Cretan Basin, Aegan Sea	1835		✓	Earliest MPl 1 zone missing. Olive grey marls of MPl 2 age in contact with selenitic gypsum[66].
Ocean Drilling Program (ODP) Sites					
963	Strait of Sicily	470		✓	Oldest recorded sediments date to early Pleistocene[69].
964	Near Calabrian Ridge, Ionian abyssal plain	3657		✓	Sediment record is complete only to 4 Ma[69].
965	Eratosthenes Seamount	1507		✓	Hiatus from middle to early Pliocene (tectonic instability) [69].
966	Eratosthenes Seamount plateau	940		✓	Hiatus at M/P transition[69].
967	Northern slope of Eratosthenes Seamount	2554	✓		Pliocene sedimentation begins with 1-m-thick layer rich in organic matter (this study). We relate this to the mystery sapropel.
968	Lower slope of Cyprus Margin	1960		✓	Hiatus from 3.57 Ma to late Miocene (inferred to result from tectonic uplift of southern Cyprus) [69].
969	Mediterranean Ridge	2000	✓		Pliocene sedimentation begins with a sapropel. This bed is considered an equivalent of the "mystery sapropel"

				described from the Florentine Basin, DSDP Hole 376[ref.19].
970	Mediterranean Ridge northern flanks	1953-2079	✓	Sedimentary record incomplete. Oldest sediments are early Pliocene[69].
971	Mediterranean Ridge	1933-2143	✓	Earliest recorded sediments are Pleistocene[69].
972	Mediterranean westernmost outer deformation front	3931	✓	Earliest sediments are late Pliocene[69].
973	Toe of the Mediterranean Ridge accretionary wedge	3694	✓	Earliest sediments are Pleistocene[69].

Supplementary Table 2. Biostratigraphic datums for ODP Site 967[22] for the interval shown in Extended Data Fig. 2. Ages given here are calibrated to the latest astrochronology[70].

Location indicated in Extended Data Fig. 3	Biostratigraphic datum	Age (ka) (astronomically calibrated)	ODP 967 Hole A sample location[22]	Equivalent depth (m) in ODP 967 splice used here	Age (ka) of the location in the splice
a	Last Messinian sediments	5333 (flooding surface)	13H-4 109-111 cm	~128.16	~5330
b	MPL1 (influx of *Neogloboquadrina acostaensis*)	5320	13H-4 78-80 cm	127.86	5323.81
c	AB *Sphaeroidinellopsis*	5300	13H-3 113-115 cm	126.70	5280.68
d	AE *Sphaeroidinellopsis*	5210	13H-3 25-27 cm	125.79	5234.38

Events a and b agree closely with our chronology. Events c and d differ by ~-19 and ~+24 ka, respectively, compared to our chronology. It should be noted that the shipboard biostratigraphy was developed using samples from Hole 967A at 10-50 cm resolution, which is equivalent to ~5-25 ka age uncertainty based on events a and b. Therefore, we rely on our higher- (1-cm) resolution, calibrated XRF data to develop the new chronology. AE, Acme end; AB, Acme base.

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