to evaporative effects in the parent water. These data cast considerable doubt on the meaning of the whole rock stratigraphic trends published previously.

Kent DV, Olsen PE & Witte WK, *J. Geophys. Res*, **100, B8**, 14,965-14,998, (1995).

CC03 : WEam12 : G2
Milankovitch Cyclicity and Sea-Level Change in the Late Eocene-Early Oligocene Interval; Evidence for Rapid and Extensive Antarctic Glaciation at 33.5 Ma?

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We have studied an expanded succession of coastal marine, estuarine and lacustrine sediments of Late Eocene-Early Oligocene age in the Isle of Wight southern England. In this succession, a strong Milankovitch signal (406, 100, 40 and weaker 20Ka) is recorded from the relative abundance of neoformed illite and illite-smectite, which formed in soils by seasonal wetting and drying. The orbital timescale is calibrated using magnetostratigraphic, and to a lesser extent, biostratigraphic data. Combined orbital calibration and sequence stratigraphic analysis allows us to identify the major control on sea-level as the 406Ka long eccentricity cycle, which caused sea-level to fluctuate by 10-15 m. These values have been determined from the amount of incision at observed at sequence boundaries on a regional scale. Minor sea-level changes of 1-3 m were controlled by obliquity. The position of the Early Oligocene heavy $\delta^{18}O$ event can be inferred in the Isle of Wight from its magnetostratigraphic proxy (base of chron 13n). We have determined the sea-level fall at this level to be approximately 12 m, close in magnitude to drops associated with the preceding 3 Late Eocene 406 Ka sequences. This evidence does not support recent estimates of a 50-90 m sea-level fall within the Early Oligocene based on the calculation that a significant part of the oxygen isotope event was caused by rapid Antarctic ice buildup. Rather, orbitally driven sea-level changes throughout the Late Eocene-Early Oligocene, although probably glacioeustatic in origin, remained of similar magnitude.

CC03 : WEam13 : G2
From Icehouse to Greenhouse: Clues from Permian Benthic Faunas of the Southwestern Tethys for the Interpretation of Extreme Climate Changes

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Carbonate-secreting Permian benthic faunas of the Sultanate of Oman reflect climate changes with a previously unknown high resolution and will help to calibrate paleoclimate studies as well as paleogeographical reconstructions.

Upon Permo-Carboniferous glaciogenic deposits (Al Khlata Formation), mixed carbonate-siliciclastic sediments of the Sakmarian (Lower Permian) Saiwan Formation display a biotic composition similar to the heterozoan association (as defined by James 1997) and are interpreted as products of a non-tropical carbonate factory. Fossiliferous float- and rudstones contain brachiopods, bivalves, gastropods, bryozoans, and crinoids indicating cold-water conditions and lack tropical skeletal grains. Cross-bedded sediments from subtidal carbonate dunes and beds with horizontal bedding, which represent tempestites, are both typical for cold-water shelves. Following an unconformity, fluviatile, lacustrine, and shallow-marine siliciclastic sediments with tree trunks (Gharif Formation) were deposited and overlain by a thick limestone-marl sequence of the Khuff Formation and the lateral equivalent Saiq Formation (Wordian-Roadian age, Middle Permian). Cold-water taxa from Gondwana represent only 12.5% Khuff brachiopod genera, while tropical Tethyan taxa make 44% (Angiolini et al. 1996). By contrast, carbonates of the Saiq Formation are dominated by tropical rugose corals, calcareous algae, large alatochonchid bivalves, and fusulinids. The Upper Permian depositional sequence of the Arabian platform is terminated by mudstones indicative of a Sabhka environment and points to an constant increase in aridity.

Reef communities rimming the margin of the Arabian platform and isolated seamounts exhibit changes with respect to reef types, framework preservation, and biotic composition. Lower Permian benthic communities are biodetrital bryozoan reefs comparable to cold-water buildups of the Northwest Pangean shelf, while Middle and Upper Permian sponge and coral communities constructed reefs resembling tropical counterparts of the equatorial Tethys. These reefbuilders and calcareous algae exhibit close biogeographic relationships with faunas from the South China block, Kitakami terrane, and Tunisia representing the optimum of Permian tropical reefs.

Sedimentological and paleontological data contradict previous interpretations of the whole depositional sequence as tropical and point to a constant change in climate from icehouse to greenhouse conditions. The mechanisms responsible for the amelioration of climate need further examination: Generally, the proposed 15° northward migration of Pangea (e.g. Ziegler & Gibbs 1996) caused during the Permian a drift of the Arabian plate in the tropical realm and increased the diversity of benthic communities. On the small scale, the contemporaneous occurrence of cold-water faunas (Khuff Formation) and tropical faunas (Saiq Formation) may result from temperature stratified carbonates on a ramp setting.

Angiolini L, Bucher H, Platel JP, Roger J, Broutin J, Baud A, Marcoux J & Al Hashmi H, *Permophiles*, **29**, 62-63, (1996).
James NP, *SEPM Spec. Publ*, **56**, 1-20, (1997).
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CC03 : WEam14 : G2
Late Triassic-Jurassic Clay Mineral Suites of the Fennoscandian Border Zone and the East European Platform: Effects of Pangean Seasonality, Aridity and Humidity

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Late Triassic and Jurassic detrital clay mineral suites of the Fennoscandian Border Zone show high detrital smectite and/or kaolinite contents, moderate illite contents, and low chlorite contents compatible with expected mid-latitude warm equable greenhouse conditions. Norian seasonal aridity promoted the forming and preservation of haematite cemented arkoses and smectite-dominated playa lake clays (smectite >> kaolinite). The Rhaetian opening of internal seaways into Pangea triggered the transgression of the Central European basin areas. On their NE margin (the Fennoscandian Border Zone) this led to humid onshore conditions, which supported peat accumulation, meteoric flushing, palaeosol development and deep weathering of the crystalline basement. Due to stripping of the regoliths, kaolinite is a dominating detrital mineral in the receiving sedimentary basins from the Rhaetian and throughout the Jurassic (kaolinite > illite >> chlorite & smectite (I/S)). Minor clay mineralogical variations within the humid climate Rhaetian-Jurassic successions were controlled by the pronounced block-and-graben-relief hydrology, the depositional environment and the eodiagenetic conditions, rather than by climate. In deltaic and alluvial coal-bearing successions the detrital clay mineralogy is very constant (kaolinite “ illite >> chlorite). Conversely, in shallow marine deposits the quantitative variation is notable (kaolinite “ illite > variable smectite >> chlorite). The marine environments preserved the original clay mineral composition better, but was potentially subjected to influx of exotic reworked mud. Gypsum and caliche nodules associated with traces of smectite ambiguously indicate increased aridity in Late Jurassic times. Analysis of mainly marine Middle to Late Jurassic clay mineral suites of the East European Platform (Lithuania and NE Poland) clearly shows an upwards increasing smectite content at the expense of kaolinite. This implies an increasing aridity in the sediment source areas, and shows that the major arid belt to the south and west of the study region migrated north- and eastwards. The sedimentary environments of the East European Platform were better suited than those of the Fennoscandian Border Zone to preserve and homogenise the Late Jurassic arid climate signal (i.e., the smectite content), due to the passive tectonics (low relief, minimal hydrological effects), the marine depositional environments, and the extensive sediment mixing during sediment transport. However, the role of bathymetric effects, i.e., selective clay mineral sorting during marine transport due to sea level change, are not yet clear.