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Forum Comment

Large-scale glaciation and deglaciation of Antarctica during the Late Eocene

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Peters et al. (2010) present a hypothesis for a late Eocene glaciation, by interpreting an incision surface at Wadi Al-Hitan (Egypt) as indicating a 40+ m fall in eustatic sea levels. We argue that there is no evidence for a major fall in sea level, and that their calibration of the event is unproven.

The proposed fluvial incision surface is the base of a deep but localized incised channel complex (ICC) that incises underlying units (Fig.1). Conglomerates, interpreted as fluvial by Peters et al., both directly overly the ICC base and flanks, and occur as lenses and interlaminations in the basal part of the channel fill (Underwood et al., 2011). Conglomerate deposition was therefore contemporaneous with the initial channel fill, with interbedding of conglomerate and channel fill heterolith being inconsistent with multiple sequence boundaries. While land mammal fossils are present within the conglomerates (Peters et al., 2010), they are greatly outnumbered by marine mammal fossils. Of the many hundreds of fossils recorded by Underwood et al. (2011), one mammal bone was the only terrestrial element recovered, with no evidence of facultatively freshwater taxa. The land mammal bone showed considerable biostratinomic damage, whereas marine vertebrate fossils typically show very little or no abrasion damage. The chondrichthyan fauna of the ICC conglomerates contains taxa otherwise restricted to the Qasr el-Sagha Formation (sensu Underwood et al., 2011) associated with pelagic and nectobenthic taxa that are elsewhere largely limited to deeper-water paleoenvironments (Underwood et al., 2011), while the general absence of some species that dominate deep-water faunas elsewhere indicates that taphonomic mixing

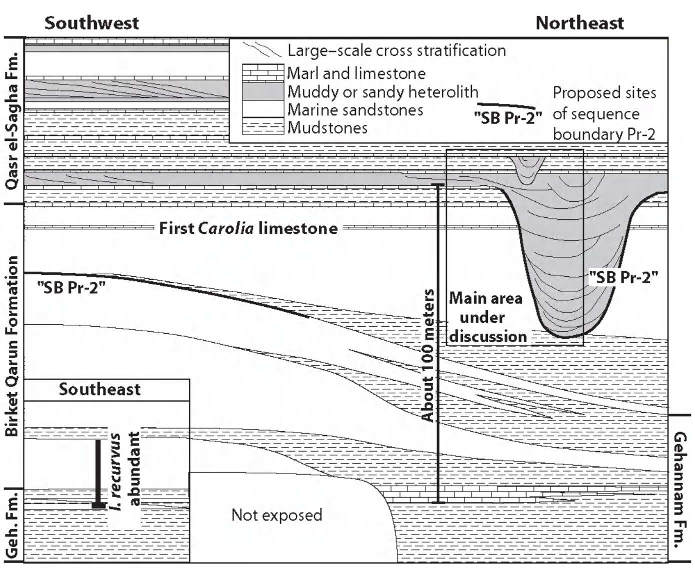

Figure 1. Diagrammatic representation (not true to scale) of the stratigraphy of Wadi Al-Hitan (Egypt), based on 53 measured sections. Note the interfingering of the Gehannam (Geh.) and Birket Qarun Formations. Horizons mentioned in the text are indicated. Fm.—Formation; *I*—*Isthmolithus*.

of other faunas has not occurred. The vertebrate fauna of the basal ICC is therefore essentially autochthonous, and indicates deeper water than the rest of the Qasr el-Sagha Formation, with rare land mammal remains representing allochthonous remains. Further evidence for the lack of derived fossils in the ICC is the absence of reworked shells of the robust calcitic invertebrates that form coquinas within the incised units.

Peters et al. cite the presence of plant fossils and the paucity of marine fossils as evidence for the non-marine channel. Plant remains and sedimentary architecture indicate close proximity to a sediment source, but give no evidence for reduced palaeosalinity. Lack of a marine biota by sediment dilution and taphonomic loss of aragonite is also seen in other horizons at Wadi Al-Hitan.

Small channels at a higher stratigraphic level within the Qasr el-Sagha Formation cited by Peters et al. (their figure DR2 [GSA Data Repository item 2010198]) appear to be restricted to the immediate proximity of the ICC, and thus channel development is likely to have been controlled by temporally persistent paleogeographical constraints rather than a temporal event.

The fill of the ICC overtops the channel to rest conformably on a bioclastic limestone. Individual laminae are seen to pass from the interchannel succession into the channel fill; the erosional contact indicated in Peters et al. in their figure DR2B is demonstrably false. The base of the heterolithic unit both within and outside the ICC is seen to be a single, continuous surface which can be traced for over 10 km. The base of the interchannel fill is planar, with no signs of pedogenic, erosional, or paleokarstic features indicative of subaerial exposure during the proposed sea-level fall recorded at this level by us or by Abdel-Fattah et al. (2010). Trenching of this contact showed shells at the top of the limestone projecting into the overlying sediments, with no truncation or contemporaneous weathering. The ICC thus represents a subaqueous erosional feature, probably a tidal ebb channel enlarged into a scour hole, with the conglomerates representing marine channel lags.

Peters et al. identified the base of the ICC as the Pr-2 sequence boundary at the base of the NP19–20 biozone. Peters et al. (p. 724) state that their dating is based on the overlapping ranges of nannofossils *Isthmolithus recurvus* and *Neococcolithes minutus*, indicating a date "near the base of nannofossil Zone NP19–20," but give no detailed information on the provenance of their samples. *I. recurvus* (indicative of NP19–20) is present within the Gehannam Formation (sensu Underwood et al., 2011), well below the top of the ICC and separated from it by several stacked depositional sequences (Fig. 1); clearly a significant period of time is represented within this interval. Abdel-Fattah et al. (2010) place the Pr-2 sequence boundary in Wadi Al-Hitan far lower than Peters et al. (Fig. 1), at a widespread regional surface. The last occurrence of *N. minutus* is within the lower part of NP19–20 (e.g., Perch-Nielsen, 1985), and we have not recorded *N. minutus* above the mid Birket Qarun Formation; the possibility that the specimens recorded by Peters et al. are reworked or incorrectly provenanced cannot therefore be overlooked. As NP19–20 spans ~1.8 m.y., and its top cannot yet be identified in the Fayum, the ICC cannot be considered as accurately dated.

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