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SEQUENCE BOUNDARY DEVELOPMENT: FUNDAMENTAL ASSUMPTIONS AND TESTS, WITH AN EXAMPLE FROM THE LATE OLIGOCENE–MIDDLE MIOCENE OF THE GULF OF SUEZ, EGYPT

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Sequence boundaries are geometrically recognized unconformities of subaerial erosion/nondeposition, their submarine equivalents, and their genetically correlative conformities. Fundamental assumptions about the development of such surfaces relate to 1) lateral continuity (vs objective traceability); 2) whether a first-order connection exists between subaerial to shallow marine discontinuities, mass failure on slopes, and deep-sea turbidite systems (reciprocal sedimentation); 3) the mechanisms and timescale over which discontinuities develop (geologically instantaneous vs protracted), and (a related issue) the criteria by which surfaces are mapped; 4) the relationship if any to the rise and fall of sea level, crustal deformation, salt and shale tectonics, variations in dynamic topography, and changes in the character and flux of available sediment; and 5) the circumstances, time scales and length scales over which the conventional age of a given physical surface may vary from one place to another. We know already from a combination of seismic reflection, downhole log, core, outcrop and deep-sea oxygen isotopic data that the relationship between patterns of sedimentation and drivers is a lot more varied (and interesting) than envisaged in 1977. Tests require high spatial and temporal resolution, and examples from diverse settings.

An example on which we are beginning to work relates to the combined roles of sea-level change and deformation in the development of stratigraphic discontinuities in late Oligocene to middle Miocene non-marine to marine strata of the Gulf of Suez, Egypt (27.82-13.82 Ma; e.g., Hewaidy et al., 2012, GeoArabia, 17: 103-120; Hewaidy et al., 2014, JAES, 100: 379-400). Eustasy is well constrained for this interval. Deformation is expressed by the episodic tilting of extensional fault blocks and the growth of fault-related folds (e.g., Sharp et al., 2000, GSAB, 112: 1877-1899). We hypothesize on the basis of preliminary data that it should be possible to determine ages at sub-million-year resolution using strontium isotope dating of both shell beds (nearshore depositional facies) and marine microfossils. Sequence boundaries are expressed by a combination of onlap, offlap/erosional truncation, valley incision, karstification and facies discontinuities.

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