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Sequence Stratigraphy of the Lower Miocene Moghra Formation in the Qattara Depression, Northwestern Desert, Egypt*

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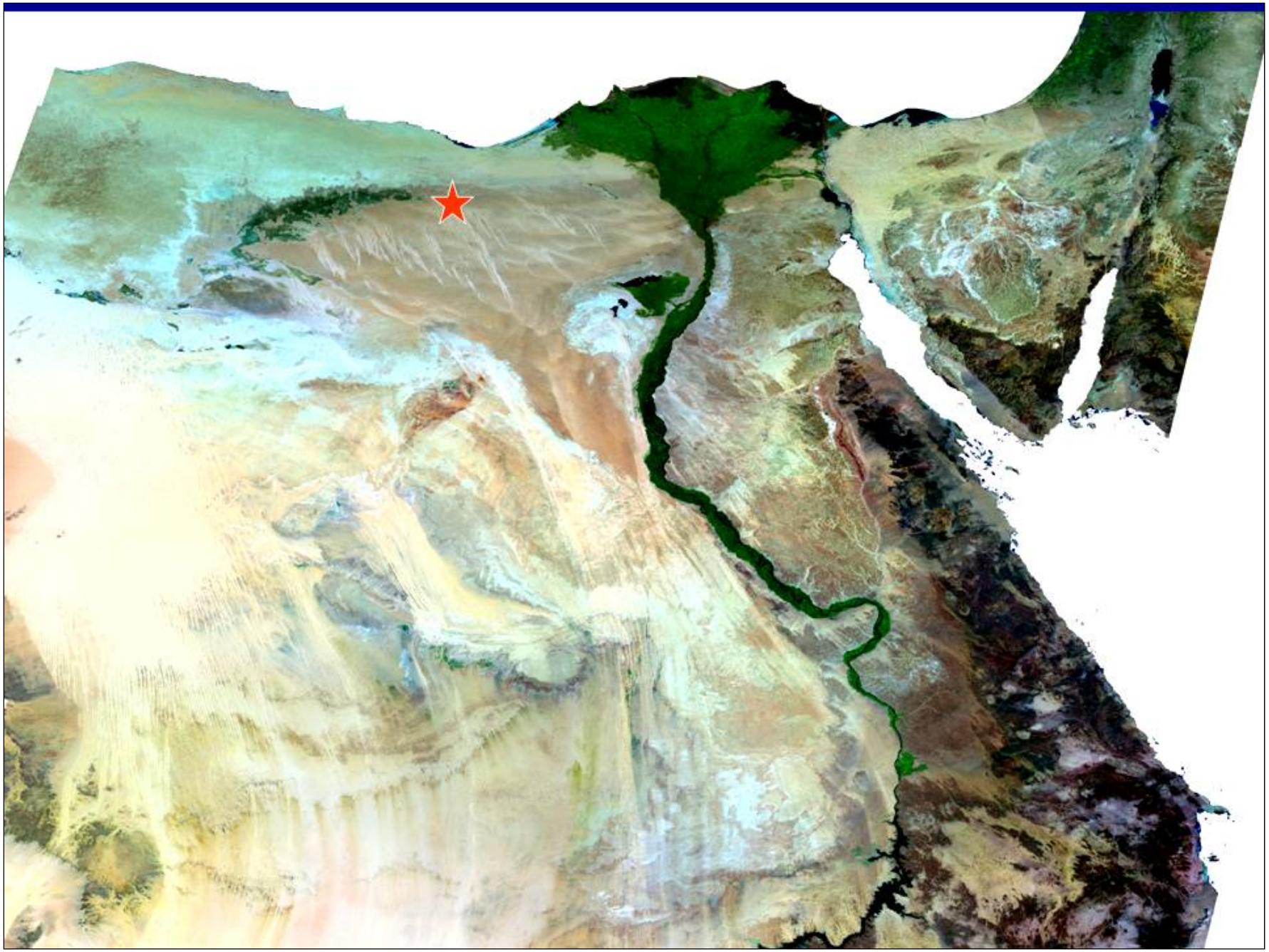
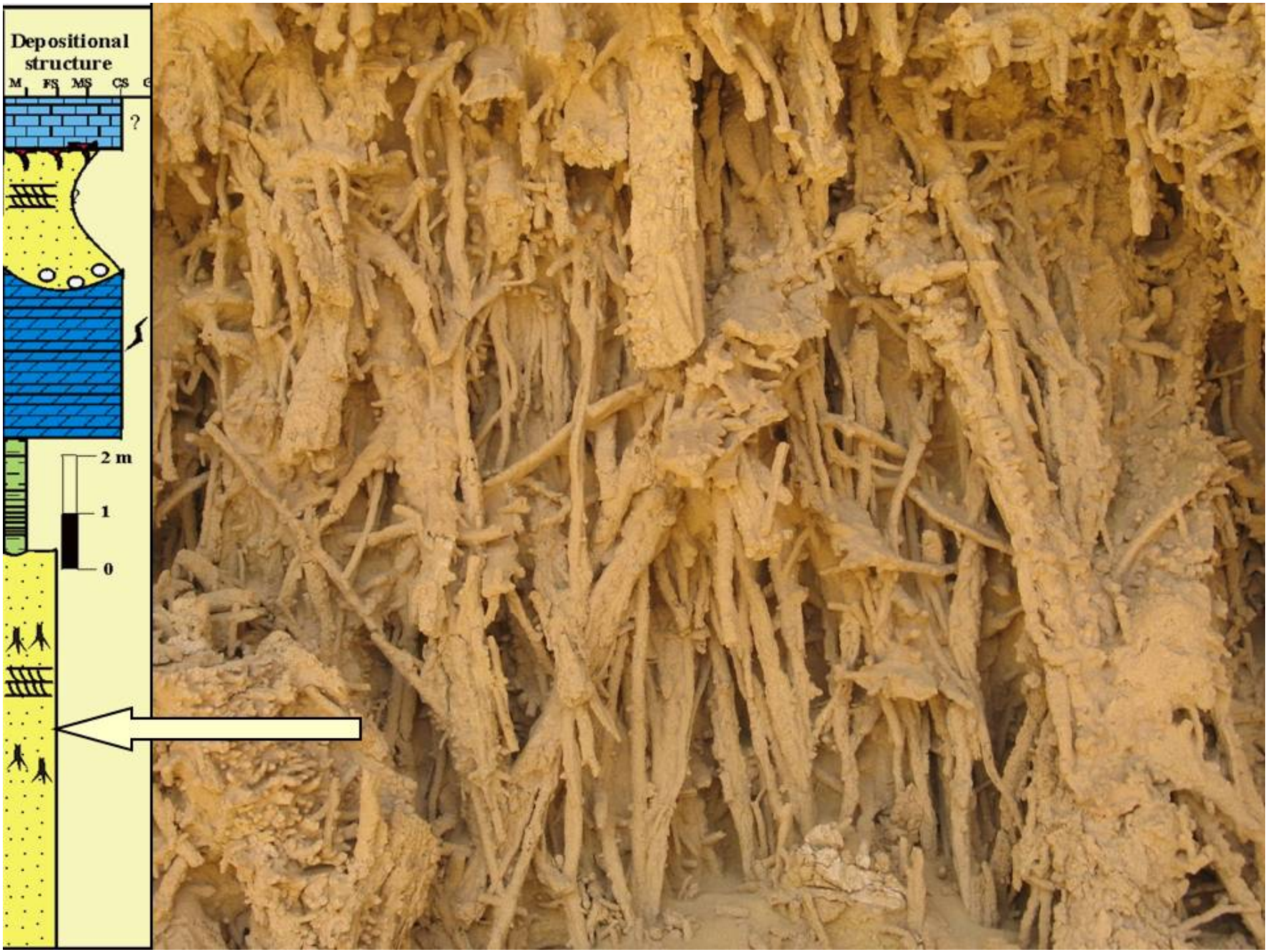
Abstract

A sequence stratigraphic interpretation is presented for the lower Miocene Moghra Formation in the Qattara Depression of northwestern Egypt, based upon 18 measured sections and the mapping of physical surfaces in superb desert outcrop over a lateral distance of more than 30 km. The Moghra Formation, which is exposed in a series of south-facing escarpments, consists of ~200 m of estuarine and marginal marine sandstone, siltstone, shale, and minor limestone, arranged into a series of transgressive-regressive cycles bounded by regional erosion surfaces with <15 m of local erosional relief. These surfaces are partially armored by thin ferruginous pebble conglomerate containing petrified wood and bone fragments. The cycles, reaching thicknesses of up to 45 m each, are dominated by transgressive deposits. The lower part of each cycle consists of unconsolidated cross-stratified sand and sandstone with locally abundant vertebrate fossils, petrified logs, *Thalassinoides* and *Ophiomorpha* burrows. These deposits, which are interpreted as a backstepping estuarine channel complex, are capped by pervasively bioturbated *Ophiomorpha*-bearing sandstone beds with marine fauna. In some cases, the marine beds pass upwards into a thin interval of regressive shale and siltstone, but such deposits are commonly truncated by the next master erosion surface (sequence boundary). Taken together, the Moghra sequences exhibit an overall transgressive trend, culminating in the open marine Marmarica Limestone. Provisional ages, based on a combination of biostratigraphy and strontium isotope stratigraphy, range from 21-17 Ma. The deep-marine oxygen isotope record for this interval is highly cyclic, with a subtle shift (to less positive $\delta^{18}O$ values) that is consistent a small sea-level rise. However, regional subsidence is required to account for most of the observed stratigraphic thickness. We infer that the preferential preservation of transgressive half-cycles is due to the filling of available accommodation during high-order sea-level rises, and to bypassing to the Mediterranean margin

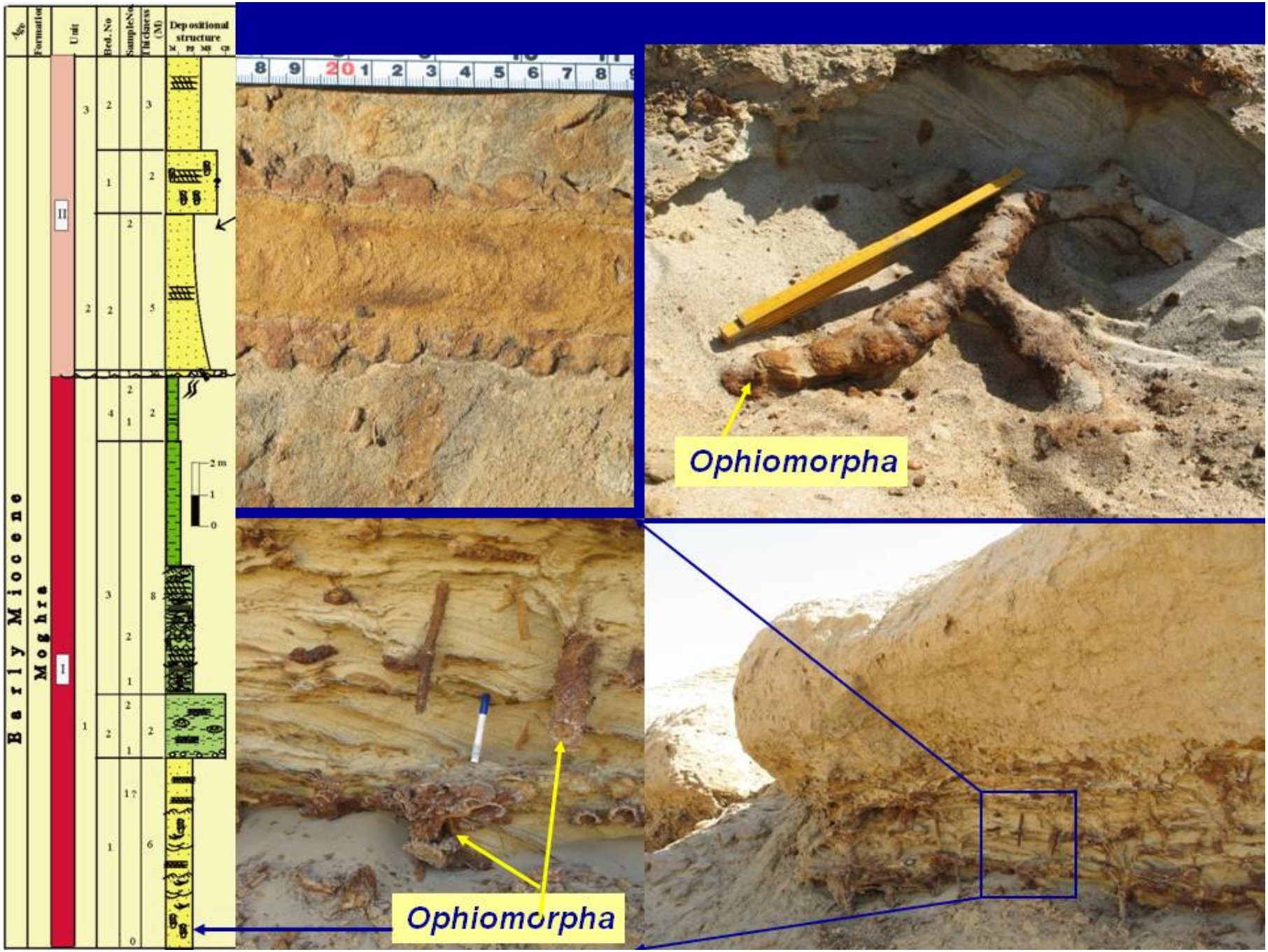
during sea-level falls. The Moghra outcrops are significant as a superb archive of fluvially dominated marginal-marine reservoir sands, and as a reference for the timing of eustatically generated sequence boundaries in a tectonically simple setting far from the North Atlantic region. New drilling at the New Jersey continental margin (IODP Expedition 313, 2009) will focus on the same lower Miocene interval.



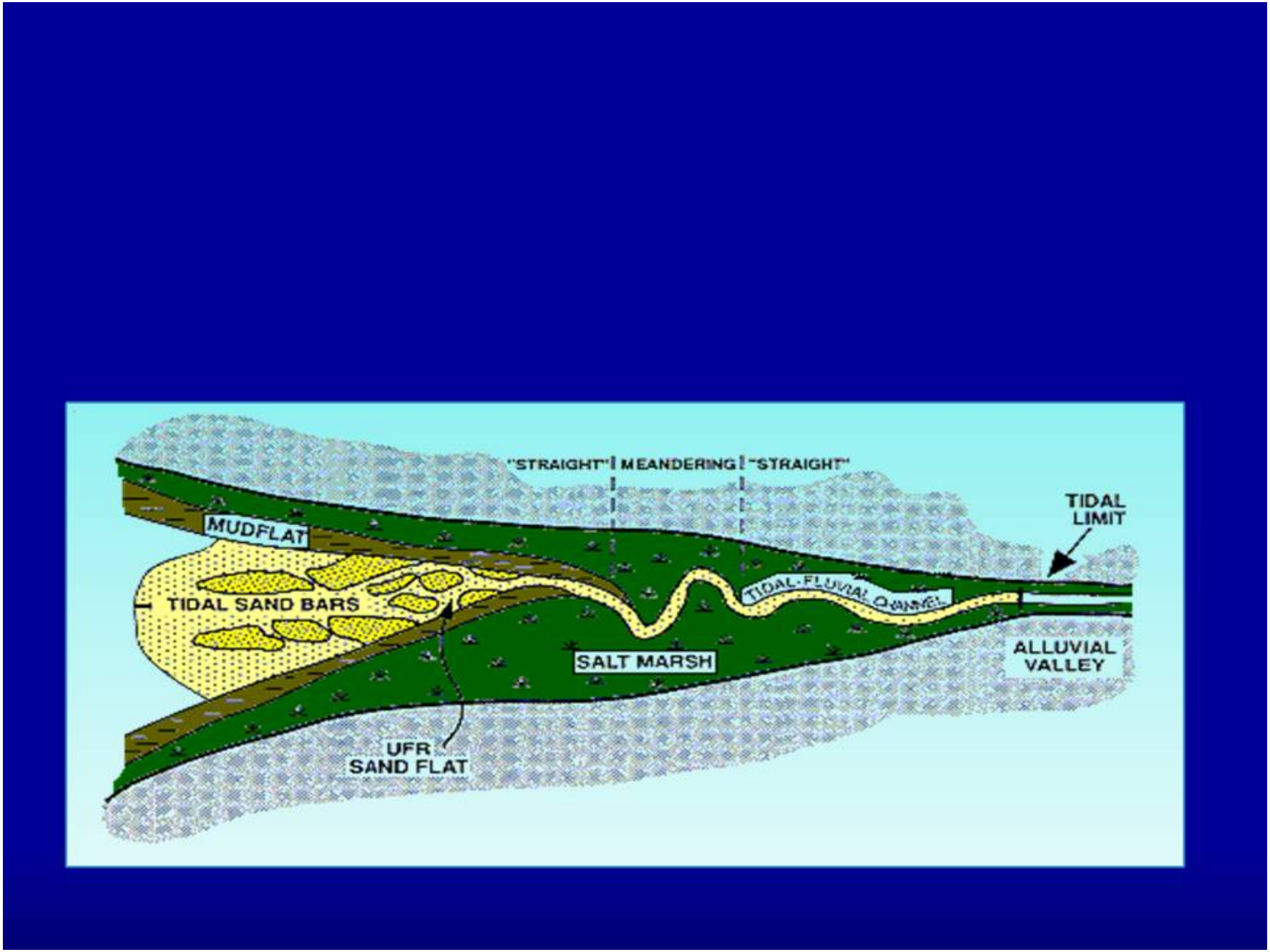
Location map.



“Mangroves” sandstone.



Bioturbated *Ophiomorpha* sand.



Depositional model (from Dalrymple et al., 1992).

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