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Tidal Rhythmites: What, Why, How and Where?

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Despite the observation that, in the modern world, 8 of the 12 largest deltas and the majority of estuaries are either tide-dominated or strongly tidally influenced, many geologists fail to recognize tidal influences in the rock record, perhaps, in part, because of pre-existing paradigms. Tidal rhythmites are a particularly distinctive type of tidal sediment and consist of sandstone-mudstone couplets that display bundling patterns with a characteristic hierarchical periodicity. Tidal rhythmites are important because they: 1) provide evidence for marine overprints in continental-dominated successions; 2) are high-resolution chronometers that can be used to determine sedimentation rates; 3) can be used to calculate lunar orbital parameters and thereby lunar retreat rates; and 4) provide constraints on the completeness of the stratigraphic record. In Holocene depositional systems, tidal rhythmites develop: 1) on tidal flats and point bars within estuaries; and 2) in prodeltaic and delta-front settings. Similar depositional settings are recorded by Carboniferous tidal rhythmites in the Appalachian Mountains of the USA within which a hierarchy of semi-diurnal, diurnal, fortnightly (neap-spring) and monthly periodicities is recognizable [1, 2, 3]. Annual cycles in the Upper Missisippian Pride Shale average 10 cm thick and are attributed to monsoonal climatic forcing. The Neoproterozoic Elatina Formation in South Australia contains complete neap-spring cycles from which the number of days per synodic month has been estimated at 29-30 [3]. Iron formations may also be a product, at least in part, of tidal forcing [4]. Counts on the late Archaean Weeli Wolli Formation in Western Australia reveal 28-30 Fe/Chert lamina couplets per cycle that are interpreted to represent either diurnal increments arranged into annual cycles or, more likely, fortnightly increments arranged into annual cycles with 28-30 cycles per year or 14.5 synodic months per year [4]. Data from the above two intervals have been used to reconstruct lunar retreat curves. The oldest record of tidal sedimentation is preserved as diurnal thick-thin pairs of mud-draped foresets, and incomplete neap-spring cycles are recognized in the 3.2 Ga Moodies Group [5].

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[3] Buller et al (in press) AAPG Centennial Volume

[4] Williams (1990) Rev Geophys 38: 37–59

[5] Eriksson and Simpson (2000) Geology 28: 831-834