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Tsunamis in ancient epeiric seas

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Most ancient epicontinental seas preserved in the stratigraphic record were exceptionally shallow and possessed a subdued bottom topography. These seas were variably open to the ocean, both physically and chemically. Consequently, if they were impacted by tsunamis, these could have been generated by both intra-basinal faulting as well as extra-basinal events. From the outset four criteria seem axiomatic: (1) the frequency of tsunamis would have been much less than that of storms; (2) vast areas of the sea bottom could have been within tsunami wavebase; (3) tsunami effects within storm wavebase would have been reworked; and (4) the larger tsunamis had a deeper wavebase than the severest storms. But, not only because very little is known about tsunami processes off modern coasts, sleuthing for their effects in the stratigraphic record of non-actualistic seas is doubly challenging.

'Allochthonous' tsunamis may have had to negotiate marginal shoals or banks which would have led to local breaking, attenuation and diffraction before they were felt in platform interiors where they could have caused localized scour. An example of this is the intraclastic rudstones in the Middle Cambrian La Laja Formation of western Argentina (Pratt & Bordonaro, 2007). 'Autochthonous' tsunamis would have caused broad scours from passing or breaking waves, followed by reworking by the wave-train. An example of this is the intraclastic rudstones in the Upper Cambrian Deadwood (Emerson) Formation of central Montana (Pratt, 2002) and Upper Cambrian of southwestern Alberta (Pratt, in prep.). Such tsunamis would have been accompanied by near-field earthquake-induced ground motion which could have left a signal in the form of substratal deformation features. Regardless of where tsunamis originated, enormous areas of the low-relief land surface would have been inundated by bores from broken waves, and backwash from these areas would have generated offshore-directed bottom currents and often linear scours like channels and gutters. Mesoproterozoic examples of these are coarse sandstones and ooidal grainstones in the lower Belt Supergroup of western Montana and southwestern Alberta (Pratt, 1998a, 1998b, 2001), and sandstones in the Proterozoic George Formation of northern British Columbia (Pratt & Long, in prep.). There must be many other cases in which tsunami deposits can be successfully distinguished from storm deposits and peritidal facies—the previous interpretations for these particular examples. In general then, the effects of tsunamis have been overlooked in epeiric sea strata which has led to misunderstandings of the tectonic, sedimentologic and paleoclimatic characteristics of these regions.