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Tides And Relative Dissipation In Supercycles – An overview of tidal modelling work with OTIS and what's next.

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The supercontinent cycle and Wilson cycle describe the periodic formation and termination of supercontinents and ocean basins respectively. This cyclicity has occurred since the beginning of the Phanerozoic, however, it may have been active in some form much earlier (i.e., during the Proterozoic). The periodic opening and closing of ocean basins following the Wilson cycle has been found to affect the tides, as oceans grow and shrink over geological time, they occasionally allow open ocean tidal resonance to occur. These resonant periods are relatively short lived (~ 20 Ma) however, they profoundly affect the tidal energy budget of the planet while active.

We have now investigated the relationship between tides and "plate tectonics" during the Archean, Paleo-Proterozoic, Cryogenian, Ediacaran, Devonian, and during conceptualised future supercontinent scenarios. We find that periods of open ocean tidal resonance occur much more frequently in our tidal models after ~600 Ma. While earlier periods of Earth history where the Moon was physically closer produce higher relative tides, later periods such as the Ediacaran, Devonian and present day produce higher tides through open ocean resonance. This trend continues into the near future, with open ocean resonance likely occurring multiple times before the formation of the next supercontinent. Notwithstanding, the Cryogenian period represents an outlier in this trend, with very low tidal dissipation rates. We conclude that this is due to the global "snowball" glaciations of the time supressing the tide. Despite the Cryogenian outlier, our results are consistent with other deep-time modelling studies.

The result of the Cryogenian, and the disparity in time between periods which we have tidally modelled, show that more work is needed to fully reconstruct the tidal environment of the Earth in deep-time. Filling in the missing periods with tidal modelling efforts and including the effect of other components of the Earth system, (i.e., glacial periods/climate, orbital parameters, and tectonic setting) are all needed to establish a robust record of the tide in deep-time. This can then be further validated with other models and geological data of the tide to help us better understand Lunar orbital evolution, and the Earth system in the past and potentially in the future.