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Neogene erosion and accumulation rate increase: revisited

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Glacial erosion and Quaternary cold-stage warm-stage climate cycling have been cited as mechanisms to increase local relief and erosion rates in mountainous regions and to explain observations of increased Neogene sedimentation rates. However, quantification of long-term glacial erosion rates from in situ cosmogenic radionuclides from large continental areas mostly covered by cold-based ice during the Quaternary show very low erosion rates over several glacial cycles. Moreover, empirical relationships between basin slope and fluvial denudation rates and the global distribution of areas with high elevation and high slopes show that increasing slope angles in mountainous glaciated areas would add only a negligible amount to the total global flux of continental sediment to the oceans. In addition, isotope ratio proxies of dissolved metals in seawater, measured in chemical ocean sediments, lack clear evidence for an increase in terrigenous denudation. In particular, the stable isotope 9Be, derived from continental erosion, shows no change in its ratio to meteoric cosmogenic nuclide 10Be, derived from rain over the past 10 My. These data are at odds with the suggested increase in sedimentation rates during the late Cenozoic.

One potential explanation for the discrepancy between the sedimentation rate data and other data sets is that sediment cores might show only apparent increases in the Neogene sections (Sadler, 1999). For example, in some cases, measured sediment thicknesses for different time intervals lack corrections for sediment compaction. Compaction of the lower portions of the cores drastically increases the apparent thickness of the more recent (Quaternary) sediment. In addition, sedimentation rates often only appear higher for recent sections in cores due to an artifact of an averaging timescale that decreases up-core. Such an averaging time scale decrease arises, in part, from better chronological resolution in recent times. Cannibalization of older sediment might add to this effect. Moreover, it is a mathematical certainty that a heavy-tailed distribution of hiatus periods from intermittent sediment transport processes will result in a power law decrease in observed deposition rate as the measurement interval increases (Schumer and Jerolmack, 2009).

Together, these data question a clear, global-scale Quaternary climate-erosion connection that would be unique in Earth's history.

Sadler, P.M., 1999, The influence of hiatuses on sediment accumulation rates, in Bruns, P., and Hass, H.C., eds., On the Determination of Sediment Accumulation Rates: GeoResearch Forum 5: 15-40.
Schumer, R., and Jerolmack, D.J., 2009, Real and apparent changes in sediment deposition rates over time. Journal of Geophysical Research 114: F00A06, doi:10.1029/2009JF001266.