Erosion and weathering in Taiwan

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Systematic monitoring of river loads helps refine and extend the map of internal dynamics and external feedbacks in Earth's critical zone. Our focus is on Taiwan where hillslope mass wasting and fluvial sediment transport are driven by earthquakes and cyclonic storms. The biggest trigger events cause instantaneous erosion and seed a weakness in the landscape that is removed over time in predictable fashion. This gives rise to patterns of erosion that can not be understood in terms of bulk characteristics of climate, such as average annual precipitation, a result that is repeated elsewhere. Erosion harvests particulate organic carbon from rock outcrop, soil, and biomass. In Taiwan, most non-fossil POC is carried in hyperpycnal storm floods. This may promote rapid burial and preservation of POC in turbidites. Abundant POC in ancient turbidites has a distinct terrestrial signature, confirming the removal of carbon from short-term circulation by this mechanism. Silicate weathering too is facilitated by rapid erosion. However, weathering within the shallow subsurface, where the effects of erosion are most direct, only yields a part of the dissolved load of rivers. During and after heavy precipitation contributions from surface and shallow sources dominate, but the fraction of dissolved load derived from silicate weathering is relatively low in these conditions. At all other times the dissolved load of Taiwan's rivers is dominated by a weathering flux from deep within the rock mass. Erosion may facilitate this by perpetuating pervasive brittle deformation, opening pathways for deep groundwater.

Compound-specific stable isotope reconstruction of the paleoelevation of the Western U.S.

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Hydrogen and carbon isotope analyses of individual plant-derived organic compounds provides a novel means of reconstructing the isotopic composition of ancient precipitation and biologically-related factors such as water use efficency. We analyzed the H and C isotope compositions of long carbon-chain normal alkanes preserved in Eocene and younger fluvial and lake sediments from the Sierra Nevada and Western U.S. to reconstruct the isotopic composition of ancient precipitation. Hydrogen isotopes of individual leaf-waxes extracted from early Eocene sediments decrease by 30‰ across the ancient Sierra Nevada range, a magnitude similar to that observed in the hydrogen isotope composition of authigenic minerals of similar age. In combination, these data provide evidence for large isotopic gradients in precipitation related to high-standing Eocene Sierra Nevada topography. In contrast, long-term changes in the hydrogen isotope composition of leaf-waxes from sediments in the rainshadow of the Sierra exceed 50‰, however the timing and magnitude of change differs markedly from that observed in the isotope composition of coexisting authigenic minerals. Coupled organic molecular and authigenic mineral isotope proxies are used to distinguish between regional changes in paleoelevation and local hydrology of the Western U.S.