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The Strontium curve : endoreism versus exoreism

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The trend of the 87Sr/86Sr ratio in oceanic waters displays two maxima during the Cambrian and present-day, and a minimum during the Jurassic, overprinted by shorter wavelengths oscillations (∼40 Myrs). Those variations are interpreted as a proxy for the flux of continental sediments to the oceans. High frequency variations are interpreted as alternations between periods of intense erosion during collisional phases, as exemplified by the Himalayan peak since 55 Myrs, and periods of continental erosion decrease with an isotopic composition dominated by the alteration of oceanic basalt. This explanation remains in many instances unsatisfying. Instead, we propose that not only the short-term, but also the long-term (Phanerozoic) evolution of the 87Sr/86Sr curve evidences endoreic/exoreic cycles of the river drainage on continents. During endoreic phases, the erosional product (chemical - particles) is only partially, if any, redistributed into the global oceans. The sequestrated sediments, which can be considered as “ghost erosional products”, produce widespread continental deposits (Devonian-Permian red sandstones for example). Conversely, during exoreic phases, the erosional flux is equal to the erosion of the relief (which product is directly exported into the ocean) and the release of the sediment load that was sequestrated during endoreic phases. Such cycles modulate the isotopic composition of the ocean waters accordingly. The dynamic deflection of the topography with widespread hinterland basins that is associated with orogenic cycles provides a good explanation for periods of short-term endoreism (20-40 Myrs). Such basins are capable of storing tremendous amounts of sediments, a process that is further reinforced by the sequestration of sediments in intra-mountainous basins (see for example the Variscan orogeny). The long wavelength of the 87Sr/86Sr trend is that of the Wilson cycle. Supercontinental aggregation promotes the widespread development of basins in the center of Pangea which have no outlet to the ocean, and thus starve the ocean from 87Sr rich sediments. Conversely, exoreism is expected to increase during continental breakup, as corroborated by the isotopic record since 150 Myrs. The 87Sr/86Sr ratio is thus a proxy for endoreism at various time scales, and as such shall not be regarded as a indicator of continental erosion.