

Crustal evolution determines seawater Sr and Nd isotope records

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Radiogenic isotope ratios record time-integrated parent-daughter ratios, and are thus sensitive to the chemical composition and time. The oceans receive the integrated runoff from the continental surface and preserve these signals in marine sedimentary records. Radiogenic isotope records of seawater and marine sediments have been reconstructed over the past five decades for many of the radiogenic isotope systems. For some systems (Sr) excellent records do exist that integrate seawater signals for the entire ocean, whereas global records of radiogenic isotopes with short marine residence times are much more difficult to establish (Nd, Pb).

Here, I attempt to link long-term (Phanerozoic) records of marine radiogenic isotope systems to records of the evolution of the continental surface that interacts with the hydrologic cycle. For the present we can show that the dissolved and particulate loads from the continents integrate different portions of the continental surface (Peucker-Ehrenbrink *et al.*, 2010). For instance, the areas generating dissolved loads are characterized by significantly older bedrock (~400 Myr) than those generating particulate loads (~320 Myr), with both being younger than the mean bedrock age of the non-glaciated, exorheic portion of the continental surface (~450 Myr). This age bias reflects the disproportionate role active margins and high-standing ocean island play in exporting sediment to the oceans.

Using present-day systematics as a guide, I argue that the first-order trough-like shape of the Phanerozoic marine Sr isotope record reflects the rejuvenation of the continental surface involved in exporting Sr to the ocean from the early Phanerozoic to the mid Jurassic that is followed by an "aging" that continues into the Quaternary. This long-term evolution of the continental surface is mirrored by a similar, though much less well-constrained, record of rejuvenation affecting areas involved in exporting Nd to the oceans. As Nd export to the ocean is overwhelmingly tied to export of the detrital load to the ocean, the first-order co-evolution of both records is suggestive of underlying trends in the evolution of the continental surface that connects the terrestrial hydrologic cycle with the oceans.

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Fertile magmatism in a changing compression and extension regime on the Central Balkan Peninsula

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The Balkan Peninsula is one of Europe's mineralized regions with world-class ore deposits. Numerous Cu-(Au-Mo) porphyry and Au-(Cu) epithermal deposits are formed during the oblique Late Cretaceous northward subduction of the Tethys beneath the European continent and the Palaeogene postcollisional extension. Integrated U-Pb zircon, Sr-Nd-Hf isotope and geochemical analyses on Palaeogene rocks in W Bulgaria, SE Serbia and eastern FYR Macedonia aim to constrain the temporal and tectono-magmatic evolution of the region that favour significant ore-formation.

After the cease of the subduction at ~70 Ma and the accretion of the Morava-Rhodope/Getic units the region is marked by a collision/compression and break of magmatism till ~60 Ma when rift-like alkaline basalts in eastern Serbia formed. Their trace-element and isotope signature define a depleted source, similar to the European Asthenospheric Reservoir (Cvetkovic *et al.*, 2004). It is followed by Na-calc-alkaline rhyolites at ~45 Ma, displaying typical adakitic signature. Sr-Nd whole rock and Hf-zircon isotope data define a mantle dominated source ($^{87}\text{Sr}/^{86}\text{Sr}_{(i)}$ 0.7047-0.7051; ϵNd between -0.2 and +2.4; ϵHf -zircons of +4 to +10). Eocene adakite-like magmatic rocks can be traced further to S-SE in the Rhodopes and to Turkey, and are likely related to subduction-enriched lithospheric mantle but asthenospheric OIB-like mantle source could be an alternative option.

The Cenozoic magmatism in W-SW Bulgaria and E Macedonia changed to normal crustal-dominated granitic composition (33-30 Ma, $^{87}\text{Sr}/^{86}\text{Sr}_{(i)}$ 0.709-0.716; ϵNd -6 and -10; ϵHf -zircons -2 to -8), but was more mantle influenced in Surdulitsa (SE Serbia) at 34 Ma. The magmatism migrated further to SW and show magmatic ages at 29-24 Ma in Kratovo-Zletovo and the Buchim-Borov dol. Less radiogenic strontium ratios 0.7060 and slightly negative ϵNd -2.6 to -3.1 define an increase of mantle input from a subduction-enriched mantle lithosphere.

Tectonic reconstructions suggest a repeated change of compression/collision and extension episodes that were plausible for the generation of fertile magmatism. The latter reveal signature of subduction-enriched mantle source but magma composition was additionally crustal modified and controlled by the crustal composition and thickness.