Magnesium isotope composition of globally distributed modern brachiopods: Implications for paleo-seawater δ^{26}Mg reconstructions

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Magnesium isotope composition (δ^{26}Mg) of marine carbonates can potentially be used as a tracer for constraining past changes in the oceanic Mg cycle. Shells of articulated brachiopods composed of diagenetically resistant calcite [1] have proven to be particularly valuable archives of isotope composition and certain physicochemical properties of past ocean water [2]. Here we present δ^{26}Mg (DSM3) and δ^{18}O (PDB) variations, and trace element (Sr/Ca, Mg/Ca) contents analysed in six different species of modern brachiopods (*T. transversa, T. sanquinea, T. septentrionalis, T. congregata, L. uva, M. pisum*). The sampling locations of the above species cover a global scale, thus representing major water bodies, including: North Pacific (Palau, San Juan Island), South Pacific (Doubtful Sound), North Atlantic (Bay of Fundy, Bonne Bay), and Southern Ocean (Antarctica, South Africa). Accordingly, the mean habitat temperatures (HT) of the studied shallow-water brachiopods cover a wide range from cold (~3°C, Signy Island, Antarctica), through intermediate (~8 to 15°C, Friday Harbour, Doubtful Sound) to warm tropical settings (~29°C, Koror, Palau). Our results indicate that samples, which plot on the '*Global Brachiopod Mg-Line*' (defined by a shell $MgCO_3$ content relative to its HT [3]), show also a coupling between their δ^{26}Mg and δ^{18}O values ($R^2 = 0.93$; $p < 0.05$). Importantly, the overall temperature sensitivity of δ^{26}Mg in brachiopod calcite is weak (~0.01‰ per 1°C), implying that it may be a suitable archive for paleo-seawater δ^{26}Mg. Brachiopods that fall either below or above the *Global Mg-Line* yielded systematically lighter δ^{26}Mg, and also elevated Sr/Ca ratios, suggesting that these were influenced by processes, such as anomalous precipitation rates (changing growth patterns) or environmental stressors.

[1] Brand and Veizer (1980) *J. Sed. Petrol.* **50**, 1219-1236. [2] Veizer *et al* (1999) *Chem. Geol.* **161**, 58-88. [3] Brand *et al* (submitted) *Chem. Geol.*

Is Late Cenozoic, post-subduction volcanism in the Sierra Nevada (California) a consequence of lithospheric downwelling?

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Physical disaggegation of continental mantle lithosphere can trigger melting either in downgoing lithospheric material, upwelling sublithospheric mantle, or in newly exposed shallow lithosphere. A record of such disaggregation should therefore be decipherable from space-time-compositional patterns in any resulting volcanism. In practice, however, such an assessment is complex, as illustrated by Late Cenozoic volcanism with the Sierra Nevada of eastern California (U.S.). Here, geologic and geophysical observations are consistent with the Late Cenozoic, downward removal of continental margin arc lithosphere subsequent to the development of a slabless window beneath the region. In the southern Sierra Nevada, Late Cenzoic volcanism is entirely post-subduction (<16 Ma), but only a distinctive, short-lived episode of mafic, ultrapotassic volcanism, low ε_{Nd}(T) (~-6 to -9) at 3.5 Ma can be convincingly linked to lithospheric removal. This link relies on chemical and isotopic data from lithospheric xenoliths entrained in older, Miocene volcanic rocks found in the same region [1]. The xenolith data suggest that only spinel peridotites embedded in shallowmost portions of Miocene mantle lithosphere had sufficiently low ε_{Nd}(T) (~-6 to -9) to have spawned the Pliocene volcanism. As a result, physical removal of the mantle lithosphere and exposure of this originally shallow lithosphere to supersolidus conditions is a plausible trigger mechanism for the 3.5 Ma volcanic event. In contrast, no equivalent, low ε_{Nd}(T), ultrapotassic volcanism exists in the northern Sierra Nevada. A transition does occur in volcanic rock compositions at ~3Ma, from continental arc volcanism to high HFSE and high LREE trachybasaltic andesites. Rather than being a result of lithospheric removal, this transition likely corresponds to the opening of a slab window beneath the northern Sierra Nevada and subsequent conductive heating of intact mantle lithosphere. These data illustrate that there are multiple trigger mechanisms for post-subduction magmatism along continental margins, not all of which require lithospheric downwelling or delamination.

[1] Ducea and Saleeby (1998), *Earth Planet. Sci. Letters* **156**, 101-116.

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