

## LREE-enriched plagiogranites from the Oman ophiolite

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For the formation of felsic, evolved rocks in oceanic crust (i.e. plagiogranites) four very different models have been proposed: (1) partial melting of gabbroic rocks, (2) late-stage differentiation of MORB, (3) immiscibility of tholeiitic melt and, (4) partial melting and assimilation of altered dikes. Recent experimental studies [1] support the concept that hydrous partial melting of a gabbroic source rock leads to the formation of plagiogranitic melts. The source of the water which is required to trigger partial melting is also under discussion. In a subduction setting water-rich fluids may enter the mafic crust from below [2] or seawater may gain access to the deep oceanic crust via a microcrack system [3]. In the latter case, the REEs of plagiogranitic melts are expected to show N-MORB type patterns, which is observed for all published plagiogranite analyses from the Oman ophiolite [(La/Sm)<sub>CN</sub> usually <1]. Trace element modeling also shows that a 10% melt generated by seawater-induced melting of gabbro will have a REE pattern that matches these plagiogranites. We present REE data for two suites of plagiogranites from the Wadi Haymilyah, Hayln block, Oman ophiolite. One suite of plagiogranites shows atypical strong LREE enrichment with (La/Sm)<sub>CN</sub> = 3-4.5; the other suite has 0.7-0.9. The LREE-enriched plagiogranites occur in the peridotite as well as in the gabbro section, in close spatial proximity to the plagiogranites with typical N-MORB like REE-patterns. No correlation between bulk rock composition (e.g., SiO<sub>2</sub>: 55.5 to 78.6 wt%, K<sub>2</sub>O: 0.2 to 4.6 wt%) and LREE-enrichment can be observed. If these atypical plagiogranites were also generated by hydrous melting of a LREE-depleted gabbro, subduction related fluids may have caused the LREE-enrichment. Our study shows that REE-patterns of petrological similar plagiogranites may help to constrain the source of the water triggered partial melting, which can be seawater-derived or related to ascending subduction zone-related REE-enriched fluids.

[1] Koepke *et al.* (2007) *CMP* **153**, 67-84. [2] Ishikawa *et al.* (2002) *Geology* **30**, 899-902. [3] Bosch *et al.* (2004) *JPET* **6**, 1181-1208.

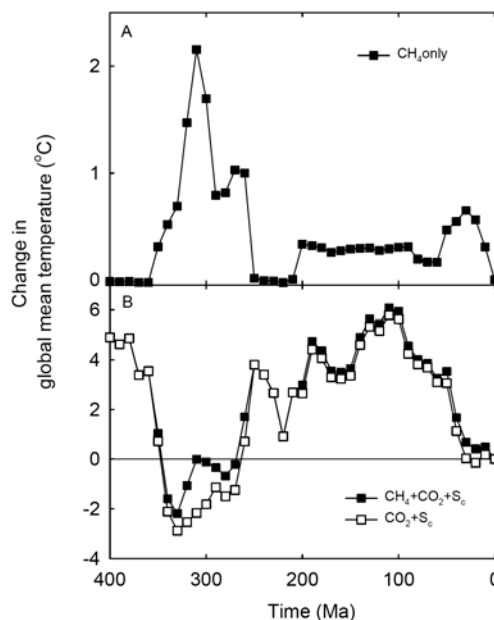
## Strontium isotopes, basalt weathering and Phanerozoic CO<sub>2</sub>

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Using a combined model for the strontium and carbon cycles that considers the terrestrial weathering of volcanic and non-volcanic silicate rocks, the weathering of younger and older carbonates, basalt-seawater reaction, and marine carbonate burial, the ratio of volcanic (mainly basalt) weathering to total silicate weathering is calculated as a function of time from the oceanic record of <sup>87</sup>Sr/<sup>86</sup>Sr. The volcanic proportion is then used to modify the equations for calculating atmospheric CO<sub>2</sub> levels over Phanerozoic time via the GEOCARBSULF model by the addition of a new non-dimensional volcanic weathering factor. The effect of uplift and physical erosion on weathering is also modified by using only the distribution over time of the abundance of sandstones and shales, and not Sr isotopic data that had been used previously. Estimated physical erosion is further used as a guide to the mean <sup>87</sup>Sr/<sup>86</sup>Sr of granitic rocks undergoing weathering.

Results indicate large variations in the volcanic proportion of silicates undergoing terrestrial weathering over time. Lower CO<sub>2</sub> values than those of GEOCARB III or GEOCARBSULF were found for the Mesozoic with the degree of lowering depending primarily upon the intrinsic weatherability of volcanics vs nonvolcanics. An increased minimum in CO<sub>2</sub> during the Late Ordovician is in agreement with the presence of a continental glaciation at that time, and, using intrinsic volcanic/non-volcanic weatherability between 2 and 5, variations of Jurassic and Cretaceous CO<sub>2</sub> agree with independent work based on liverwort delta <sup>13</sup>C values.



[1] Berner (2006) *Am. J. Sci.* **306**, 295-302.

[2] Berner (2008) *Am. J. Sci.* **308**, 100-103.