Magnesium isotope fractionation in inorganic and biogenic calcite

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Mg isotope fractionation was investigated in inorganically precipitated calcite as well as in the skeletons of various marine calcifiers grown under controlled laboratory conditions.

Our prilaminary results suggest that Δ^{26}Mg of inorganic calcite is -2.4±0.2 ‰ (n=5, 2σ) at a constant temperature of 25°C. The degree of fractionation appears to be independent of Mg content (0.4 to 3.7 mole % of $MgCO_3$) and precipitation rate (log R ~ 2 to 4 μmol/m^2/h). Our results agree well with data from calcitic speleothems and their drip waters (Δ^{26}Mg= -2.7±0.2 ‰; [1]) as well as high-Mg calcite data of sclerosponges, red algea and calcitic corals (Δ^{26}Mg= -2.5±0.2 ‰; [2]), spanning a temperature range of >20°C.

Δ^{26}Mg of *Amphistegina* spp., a benthic foraminifer that forms high-Mg calcite (~5 mole% of $MgCO_3$), is -1.9±0.2 ‰ for a temperature range of 18 to 33°C. The degree of Mg isotope fractionation appears to increase with increasing Mg content (i.e., decreasing pH and increasing temperature).

Δ^{26}Mg of coccolithophores, *Emiliania huxleyi* and *Coccolithus pelagicus*, are constant (at -1.1±0.2 ‰ and -0.8±0.1 ‰, respectively) at seawater Mg/Ca ratios of 1 to 5 mol/mol. This is in contrast to low-Mg tests of foraminifera, which show a much larger degree of Mg isotope fractionation (-4.7±0.5 ‰; [2,3]). Although coccolithophores and most foraminifera maintain the Mg content of their shells very low (<0.5 mole% of $MgCO_3$), their distinct Mg-isotope signatures suggest different pathways for Mg during biomineralization.

[1] Galy *et al.* (2002) *Earth Planet. Sc. Lett.* **201**, 105-115. [2] Wombacher *et al.* (2006) *Geophys. Res. Abstr.* **8**, 06353. [3] Pogge von Strandman (2008) *Geochem. Geophys. Geosyst.* **9**, Q12015.

Melting of carbonated eclogite at 3.5-5.5 GPa: An experimental study

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The goal of the study was to experimentally investigate the possible role of carbonated eclogite in genesis of kimberlites and related rocks, as has been proposed in previous studies. We aim to locate the solidus and partial melt compositions of carbonate-bearing eclogite as functions of pressure, temperature and SiO_2 content. The experimental compositions were GA1 [1] to which 10% of calcite (10%cc) was added, and Volga+10%cc which is identical to GA1 but with 6.5% less SiO_2. GA1+10%cc models altered oceanic crust, recycled into the convecting mantle via subduction. Volga+10%cc models subducted mafic crust, which may have lost a siliceous component during dehydration and/or silicate melting in the subduction zone. Piston-cylinder experiments were conducted at 3.5-5.5 GPa and 1000-1400°C.

The mixes crystallized under sub-solidus conditions at 3.5 GPa as garnet + clinopyroxene + carbonate + rutile ± K-feldspar ± apatite. At higher pressures coesite is also present but K-feldspar and apatite are absent. The alkali components (particularly K) strongly reduce the solidus temperature. At 3.5 GPa the solidus of GA1+10%cc is below 1050°C. At 4.5 and 5.0 GPa the estimated solidus is slightly below 1100°C. The solidus in Volga+10%cc for all the examined pressures is at least 150°C lower than GA1+10%cc, in good agreement with silica-undersaturated composition SLEC1 [2]. Initial melts are potassic calcic-dolomitic compositions, probably dominated by melting of accessory phases K-feldspar and carbonate. Higher degree melts become more siliceous with increasing temperature.

However, the solidus remains at higher temperatures than the hottest estimated subduction geotherm [3]. Thus subducting carbonates in eclogite may reach the deeper convecting mantle where they may partially melt to produce carbonate-rich liquids which could have a role in fertilizing the surrounding peridotite mantle and producing enriched magmas.

[1] Yaxley & Green (1994) *EPSL* **128**, 313-325. [2] Dasgupta *et al.* (2004) *EPSL* **227**, 73-85. [3] van Keken *et al.* (2002) Geochem. Geophys. Geosys **3**.