

Mg-, Sr-incorporation and calcium isotopic fractionation during calcium carbonate precipitation

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Trace elements and Ca isotope ratios in calcium carbonate (CaCO₃) are useful for paleoenvironmental reconstructions. The correct application of these proxies depends on an accurate understanding of their interdependence as well as their interaction with the environmental conditions. In the present study, unseeded calcium carbonate precipitation experiments were carried out using a CO₂-diffusion technique [1]. The experimental setup was run (i) at various Mg/Ca ratios (0 to 5), and/or (ii) in presence of polyaspartic acid, whereas the pH level and concentrations of Ca and Sr of the growth solution were adjusted to modern seawater values.

Calcite crystals are formed at low temperatures and low Mg/Ca ratios, while aragonite is preferentially formed at higher Mg concentrations and/or at elevated temperatures (e.g. 40°C). Mg incorporation into calcite leads to rounded Mg-calcite crystals with smaller elementary cell sizes. Vaterite is formed at higher saturation degrees (Ω), usually in the presence of polyaspartic acid. Elevated temperatures tend to result into a higher Mg- and a lower Sr- incorporation as well as a lower $\Delta^{44}\text{Ca}^{40}\text{Ca}_{\text{CaCO}_3(\text{s})-\text{Ca}(\text{aq})}$ fractionation in calcite and aragonite. The latter parameter is also smaller for vaterite ($\Delta^{44/40}\text{Ca} \approx -0.4\text{‰}$) compared to calcite ($\Delta^{44/40}\text{Ca}$ varies from -0.9‰ at $\Omega \approx 7$ to -2‰ at $\Omega \approx 26$) and aragonite ($\Delta^{44/40}\text{Ca}$ varies from -1 to -1.6‰). However, $\Delta^{44/40}\text{Ca}$ -values indicate an inverse correlation with the distribution coefficient of Sr (D_{Sr}) for the three modifications and a direct correlation with the distribution coefficient of Mg (D_{Mg}) for calcite. Respective processes and proposed models are discussed.

[1] Tang J. *et al.* (2008) *GCA* **72**, 3718-3732.

Geochemical signatures of arc and back-arc magmatism in the Eastern Manus Basin

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The Eastern Manus Basin (EMB) is a pull-apart basin situated between the Djaul and Weitin faults in the Manus Back-Arc Basin, Papua New Guinea. Active subduction takes place at the New Britain Trench, ~200km to the south, where the Solomon Sea Plate is being subducted. The EMB represents initial back-arc rifting, when crustal thinning facilitates the ascent of hot asthenosphere and the formation of en echelon neovolcanic ridges before seafloor spreading sets in. A comprehensive suite of rock samples has been collected during an RV *Melville* cruise in 2006. Magmatism in the EMB is dominated by calc-alkaline rocks, mainly andesites to rhyodacites, but high-magnesium andesites and island-arc picrites with MgO up to 17 wt.% as well as boninites (in olivine melt inclusions) can also be found.

The rock composition in this transitional arc/back-arc environment is dominated by the grade of mantle depletion in the source region and the refertilization processes by subduction-derived components. Most samples from the EMB show ²³⁸U-excess, implying that fluid transport took place from the slab into the wedge. Selected trace-element ratios correlate with distance from the trench, e.g. Ba/Nb and Pb/Nd decrease with increasing distance.

The most depleted arc-picrite to andesite sample-series from localities closest to the trench have extreme depletions in Nb, Ta, Hf, Zr and relative high Sr/Y (≥ 30), but also the highest input of slab-fluid related components, as indicated by high Ba/Nb, Sr/Th and Pb/Nd. Flat to slightly LREE-enriched REE-patterns suggest prior source depletion instead of adakite-like melts to be the origin of high Sr/Y. The diversity in fluid-immobile and fluid-mobile elements in rocks from the Eastern Manus Basin indicates variable degrees of melting (and/or previous melt depletion) and a range of subduction-related components.

It appears that both fluid-mediated mass transfer from the subducting plate and assimilation of metasomatized arc lithosphere played a role.