Mid and heavy REE in carbonatites at Lofdal, Namibia

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Carbonatites provide most of the World's rare earth elements (REE) but are characteristically enriched in the light REE with low contents of the more highly sought after mid and heavy REE. The Lofdal carbonatite complex, 35 km NW of Khorixas, Namibia, is an exception in that it contains hundreds of carbonatite dykes, some of which are mid and heavy REE-enriched, containing up to 3% xenotime-(Y) in dolomite-ankerite and ferruginous calcite carbonatite. Gd and Dy are the most abundant lanthanides in the xenotime-(Y). ThO_2 content is the main environmental problem with REE deposits and at Lofdal, there is up to 1 wt% ThO_2 in magmatic xenotime-(Y) and usually lower, about 0.3 wt%ThO_2, in hydrothermal xenotime-(Y). However, many rocks contain Th silicate. The hydrothermal xenotime-(Y) occurs in shear zones and associated calcite has a high $^{87}Sr/^{86}Sr$ ratio of 0.70804, $\delta^{13}C$ (‰V-PDB) of -3.66 and $\delta^{18}O$ (‰V-SMOW) =18. The xenotime-(Y) at Lofdal is the same age as the main carbonatite (765 ±16 Ma) and thus later metamorphic alteration can be ruled out. However, together with the presence of xenotime-(Y) in albitised country rocks and carbonatite-free shear zones, there is good evidence that most of the xenotime-(Y) formed from a carbonatite-related hydrothermal system circulating around the dykes.

Magmatic processes during the formation of Monte dei Porri Volcano, Island of Salina, Aeolian Islands, Italy

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The island of Salina is the second largest of the Aeolian Islands, the subaerial expression of the Aeolian Magmatic Arc, located in the Tyrrhenian Sea, southern Italy. Salina lies in the centre of the arc and exhibits the widest variation in geochemical composition across all the Aeolian Islands, ranging from high-alumina basaltic to dacitic lava flows to rhyolitic pumiceous tephras erupted from 6 volcanic centres.

The Monte dei Porri volcanic eruptions were the last cone building events on the island occurring between 67ka and 13ka and occurred after 60ka of repose. The units consist of basaltic-andesite to dacite lavas, interlayered with unconsolidated tephras consisting of juvenile scoria fragments, entrained lithics and rhyolitic pumices. Phenocryst assembleges consist of calcic plagioclase (often with oscillatory zoning), clinopyroxene (augite), olivine and titanium-iron oxides ± orthopyroxene (often zoned), K-feldspar and quartz. Melt inclusions are a ubiquitous feature of all units and appear to be recrystallized in the lavas and occur as both recrystallized and glassy inclusions with and without vapour bubbles in the tephras. Rare primary fluid inclusion assemblages are also present in the tephras.

Raman spectroscopy of the glassy melt inclusions of the tephras reveals the presence of volatiles in the melt inclusion glass in the form of H_2O. CO_2 was not found in the glass or the vapour bubbles. Geothermometry based on plagioclase-liquid and clinopyroxene-liquid models indicates crystallisation temperatures of ~1200°C for feldspars and ~1050°C for clinopyroxene phenocrysts.

Petrographic analysis suggests the mixing of one or more magmas with different compositions played an important role in the evolution of the magmatic system.