Pb isotopic evidence of a cognate origin for Cr-poor megacrysts in southern African kimberlites

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Megacrysts of the Cr-poor suite are abundant in southern African kimberlites and have Ti contents that are too high, and Mg-numbers that are too low, to be in equilibrium with normal mantle peridotite. The origin of magmas parental to Cr-poor megacrysts has been the topic of debate for decades. Similarities in Sr, Nd and Hf isotope data between megacrysts and their host kimberlites have been taken to support a genetic relationship (e.g. [1]). However, the only extensive study to include Pb isotope data, on the ≈72 Ma Gibeon (group 1) kimberlite province of southern Namibia (Davies *et al*. 2001), shows a clear difference in Pb isotope composition between kimberlites and clinopyroxene megacrysts, with the megacrysts having low $^{206}Pb/^{204}Pb_i$ (17.7-18.9) and relatively high Δ7/4, suggestive of a DUPAL affinity. This has led to the hypothesis that megacrysts are not genetically related to their host kimberlites, but rather are xenocrysts, possibly with an ultradeep mantle origin.

We will present Pb as well as Sr, Nd and Hf isotope data for Cr-poor megacrysts from Cretaceous southern African kimberlites obtained by MC-ICPMS using low-blank methods. Our preliminary data for Gibeon clinopyroxene megacrysts indicate that, contrary to Davies *et al*. (2001), they have relatively radiogenic $^{206}Pb/^{204}Pb_i$ ratios (19.1-20.4) with low Δ7/4 and Δ8/4, suggestive of a HIMU isotopic affinity. This is consistent with their low $^{87}Sr/^{86}Sr$ and mildly radiogenic $^{143}Nd/^{144}Nd$ ratios. Additionally, the Pb concentrations we determined (0.08 to 0.14 ppm) are lower by factors of 2 to 5 than those obtained by Davies *et al*. [2]. Our Pb isotope data for Gibeon megacrysts closely approach but do not overlap those for the Gibeon kimberlites (e.g. $^{206}Pb/^{204}Pb_i$ = 18.6-19.1). The less radiogenic Pb and higher $^{87}Sr/^{86}Sr$ ratios of the Gibeon kimberlites relative to the megacrysts may reflect significant assimilation of metasomatized lithospheric peridotite (having relatively unradiogenic Pb and radiogenic Sr) by the kimberlites, whereas the megacrysts appear to have crystallized from a proto-kimberlite magma fairly deep within the lithosphere and thereby avoided substantial lithospheric contamination.

[1] Nowell *et al*. (2004) *J. Pet*. **45**, 1583–1612. [2] Davies *et al*. (2001) *J. Pet*. **42**, 159–172,

REE-minerals petrochronology in metamorphic rocks

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REE-bearing accessory minerals (monazite, allanite and xenotime) with high Th and U contents, are used as geochronometers to date sedimentary, magmatic and metamorphic rocks. Dating of such minerals often yields several age populations in low-grade metamorphic rocks. Since volume diffusion is inefficient under these conditions, age variations are attributed to (re)crystallization episodes and correct age interpretations require identification of the process and conditions under which REE-mineral (re)crystallized. The aim of this study is to present REE-mineral textures and compositions depending on the physico-chemical conditions. REE-mineralogy has been addressed along three metamorphic transects: two Barrovian sequences (Central Alps, Switzerland; Lesser Himalaya, Nepal) and one high-pressure low-temperature profile (Rif, Morocco). Results, combined with data from the literature, converge to a reaction sequence between allanite and monazite from low to high temperature:

Monazite ⇒ Allanite ⇒ Monazite

At the contact with veins, REE-mineralogy is commonly modified. This confirms that REE-minerals can record a fluid/rock interaction event, rather than a thermal climax. In samples where Fe, U and S are partly oxidized, the significant incorporation of As_2O_5 into monazite (as few wt. %) appears to be a convincing fingerprint of oxidizing conditions.