The Geochemistry and Genesis of the Marinkas Quellen Carbonatite complex, southwestern Namibia.

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The 525 Ma Marinkas Quellen (MQ) Complex of southern Namibia, part of the Kuboos-Bremen Line (KBL) of alkaline igneous centers [1] consists of granites, nepheline syenites and carbonatites and is the only carbonatite locality in the KBL [1]. MQ carbonatite variteties include calcio-carbonatites, magnesiocarbonatites and ferrocarbonatites. The enrichments in Ba, Nb and the REE vary widely in the carbonatites, with La ranging from 45 to 11154 ppm. All the carbonatites are characterised by large Zr, Hf, Ti depletions. Zr/Hf ratios ranges from 40 to 500, all greater than the chondritic value of 36. Such large Zr/Hf fractionations are often associated with carbonatite metasomatism. The values of carbon and oxygen isotope ratios of bulk carbonate in Marinkas Quellen carbonatites vary significantly (e.g., $\delta^{13}C$ = -3.95 to -6.02‰; $\delta^{18}O$ = 8.84 to 22.22‰). The carbon isotope compositions are in the mantle range, while the oxygen isotope values extend to higher than typical mantle values, presumably due to interaction with hydrous fluids. All but two of the carbonatite samples have initial $^{87}Sr/^{86}Sr$ ratios falling in the range of 0.70236 to 0.70408. Of the remaining samples, one, a ferrocarbonatite, has a higher value of 0.70503 that is likely due to contamination by the surrounding rock or assimilation in the lower crust or Sr exchange with groundwater. The other, a magnesio-carbonatite, appears to have experienced an increase in its Rb/Sr ratio due to alteration, resulting in an over-corrected initial $^{87}Sr/^{86}Sr$ value.

The relatively low Sr isotope ratios of most samples, plus their $\varepsilon_{Nd}(t)$ values (+3.9 to +4.8) values suggest that the carbonatite magma was generated from a long-lived low Rb/Sr, high Sm/Nd, relatively depleted mantle source. The radiogenic Pb isotope composition of the carbonatites ($^{206}Pb/^{204}Pb_i$ ratios from 18.06 to 22.38), suggests a high U/Pb source, akin to the HIMU mantle end member. This points to a sub-lithospheric (asthenospheric) source with only a relatively minor contribution from enriched lithospheric mantle.

[1] Smithies, (1992) PhD thesis Rhodes Univ. Grahamst, 197.