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Lower mantle contribution to the genesis of carbonatites: the noble gases and carbon isotopic evidence

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It has been demonstrated that only 20 to 40% of the subducted CO_2 is extracted by decarbonatation of descending slab. This, and the fact that some carbonatites exhibit HIMU-like Pb, Nd and Sr isotopic signatures, led to models invoking a carbonatite origin by partial melting of ancient subducted carbonated oceanic crust. A recycled carbon origin for diamonds has also been suggested. However the mantle is the largest carbon reservoir of the Earth and a non-recycled (i.e. primordial) origin for the carbon in carbonatites cannot be discarded.

Some of the Cape Verde oceanic carbonatites present low $^{4}He/^{3}He$ ratios (down to 46,700; R/Ra up to 15.5) demonstrating that they sample a reservoir characterized by low time-integrated $(U+Th)/^{3}He$. Such a reservoir, being clearly distinct from the crust or from the upper mantle sampled by the 60 000 km long oceanic ridge system, is thought to be localized in the lower mantle. For continental carbonatites several authors has also interpreted noble gases isotopic compositions as reflecting the contribution of a reservoir with time-integrated $(U+Th)/(^{3}He, ^{22}Ne)$ and $^{40}K/^{36}Ar$ lower than the upper mantle, thus endorsing the contribution of the lower mantle [1;2;3].

Some carbonatites are also characterized by ^{129}Xe anomalies relatively to the air ($^{129}Xe/^{130}Xe$ up to 6.94 in Cape Verde). Considering that the recycling of carbonates, eventually characterized by high Te and Ba contents, would with time increase simultaneously the ^{129}Xe and ^{130}Xe, the observed ^{129}Xe anomalies cannot be explained by models calling upon crustal carbonate recycling. We interpret them in terms of an ancient mantle origin by decay of the now extinct ^{129}I. Moreover, experimental work has demonstrated that crustal carbonates are unlikely to be transported to lower mantle depth levels as a consequence of its removal by melting reactions. Thus, all the above described lower mantle signals are indicative of a non-recycled, lower mantle, origin for carbon, unless we admit that, during ascent, deep-seated mantle plumes entrain recycled carbon from the upper mantle. Nevertheless many carbonatites are also characterized by $\delta^{13}C$ values (-8.0 to -4.25 *per mil* in Cape Verde) lighter than those characterizing crustal inorganic carbonates, endorsing the role of primordial carbon to the genesis of carbonatites.

Taking into account that a recycled origin for some carbonatites is inescapable from carbon and noble gases signatures [e.g. 4; 5] we conclude that multiple origins (recycled vs. primordial) are possible for the carbon involved in the generation of carbonatitic magmas.

1. Sasada et al. (1997) – Geochim. Cosmochim. Acta, 61: 4219-4228
2. Marty et al. (1998)- Earth Planet. Sci. Lett., 164: 179-192
3. Tolstikhin et al. (2002) - Geochim. Cosmochim. Acta, 66: 881-901
4. Ray et al. (1999) – Earth Planet Sci. Lett., 170; 205-214
5. Basu & Murty (2006) – Chem. Geol., 234: 236-250

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