Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20637

Carbonatites and Phonolites Linked by Mantle Derived Calcium in the Kaiserstuhl, Germany

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Carbonatites and alkaline magmatic provinces share a close petrogenetic link and are associated with each other within continental rifts. This link is established by fractionating a carbonated silicate melt originating from a metasomatized mantle, driving it into a two-liquid field [1]. The former carbonated silicate melt separates at this point into a carbonatitic and a calcium poor alkaline melt, forming volcanic provinces with bimodal compositions. Due to the calcium depletion, silicate melts are expected to have low calcium contents and calcium-rich phases like wollastonite are not expected. However, in the Kaiserstuhl volcanic complex (KVC) in Germany wollastonite bearing phonolites can be found. The presence of wollastonite is usually explained by assimilation of calcium from the wall rock rather than having a magmatic origin

To identify the origin of calcium that leads to the wollastonite formation, Sr-Nd-Hf-Ca isotope, major and trace element data from phonolites, wollastonite bearing phonolites, marls from the wall rock and carbonatites are used. We found that the wollastonite formation is linked to CaO concentrations up to 9.5 wt%, which is more than fractional crystallization models would suggest. The isotopic composition suggests a similar mantle source for the carbonatites and the alkaline rocks. Crustal contamination can be therefore ruled out, implying that the calcium is mantle derived and linked to the carbonatites. The sampled carbonatites are cumulate rocks, which is why experimental primary carbonatite melts [2] and partition coefficients are used [3] for the following models, respectively. By using these we demonstrate, that mixing between phonolites and carbonatites cannot lead to the observed composition of the wollastonite bearing phonolite. Instead, the composition of the wollastonite bearing phonolite resembles that of an unmixed carbonated silicate melt. We therefore show, that wollastonite could be also indicative for metasomatic overprinted mantle sources and not only for crustal contamination. The influence of the metasomatism of the mantle could therefore be underestimated in other carbonatite-alkaline provinces as well, that could provide insights into material cycles.

[1] Brooker & Kjarsgaard (2011), *Journal of Petrology* 52, 1281-1305.

[2] Foley et al. (2009), *Lithos* 122, 274-283.

[3] Martin et al. (2013), *Journal of Petrology* 54, 2301-2338.