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Time-dependent geochemistry of volcanic products from Colli Albani (Central Italy): clues to source and evolution of ultrapotassic magmas

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The Colli Albani ultrapotassic volcanic district (Central Italy) belongs to the Roman Province whose magmatism is thought to result from the combined effects of crystal fractionation and crustal assimilation on a parental magma derived from a metasomatized source mantle.

We investigated geochemical composition of lava flows, mafic granular hypoabyssal rocks, and clinopyroxene phenocrysts representative of the whole eruptive history of the district in order to constrain the variation of the mantle source of Colli Albani ultrapotassic magmas and their evolution over about 600 kyr. Furthermore we present new $^{40}Ar/^{39}Ar$ age determinations integrated with previously determined ages in order to define the precise time scale of the investigated products.

Previous isotopic data determined on clinopyroxene phenocrysts have shown that $^{87}Sr/^{86}Sr$ values of Colli Albani magmas continuously diminished during the 600-35 kyr time interval of the district eruptive history (Gaeta et al., 2006). The new data obtained on lava flow bulk compositions confirmed this trend. In particular, we analysed a lava lithic clast enclosed in the oldest pyroclastic deposit of the district ($\geq$561 ka) and the youngest lava flow erupted during the Faete Phase. These two samples represent, respectively, the most and one of the least radiogenic lava-type products so far analysed ($^{87}Sr/^{86}Sr$=0.711196 and 0.710114). Notably, $^{143}Nd/^{144}Nd$ isotopic ratios, presented here for the first time on samples representative of the whole eruptive history, show a general increasing trend in successively younger products (e.g., from 0.512118 to 0.512133, for the two samples above mentioned). However, magmas erupted during the Early Tuscolano Artemisio Phase (561-527 ka, Marra et al., 2009) are characterised by $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ higher than magmas erupted during the Late Tuscolano Artemisio Phase (460-350 ka, Marra et al., 2009).

We interpret the whole acquired dataset as reflecting a possible progressive depletion of the metasomatized mantle source of magmas. The new data combined with the old ones allow us to confirm the veined-mantle source for the Colli Albani primary magmas. The isotopicjump observed at the beginning of the activity may record magma-crust contamination processes involving not only carbonate crust (Mollo et al., 2010) as inferred for magmas erupted since the Late Tuscolano Artemisio Phase to the Albano Phase (36 ka, Freda et al., 2006) but also a metapelitic component. Alternatively, the isotopic jump could reflect a relatively sudden change in mantle metasomatic agent.

Freda et al., 2006 - Bulletin of Volcanology, 68: 567-591.

Gaeta et al., 2006 - Lithos, 86: 330-346.

Marra et al., 2009 - Journal of Volcanology and Geothermal Research, 179: 217-232.

Mollo et al., 2010 - Lithos, 114: 503-514.