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Plumbing system processes of the Pleiades Volcanic Field (Antarctica) – texture, chemistry and in-situ Sr isotopes of crystal cargo

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The Pleiades Volcanic Field (PVF) is a Quaternary volcanic field located in northern Victoria Land. PVF is made up of a dozen monogenetic, partly overlapping scoria and spatter cones that erupted over the last 900 ka. Some of the volcanic products depict a complete mildly Na-alkaline differentiation trend from alkali basalt to trachyte, whereas other products belong to a strongly alkaline less complete trend, from tephrite to tephriphonolite, with rare phonolite. The occurrence of a complete alkaline association is quite unusual among monogenetic volcanic fields, thereby testifying to an evolution of the plumbing system under unusual conditions.

To investigate the architecture of the PFV feeding system, we ran an in-depth study of the texture and chemistry of the crystal cargo of selected representative samples of the mildly Na-alkaline differentiation trend. Phenocrysts of olivine, clinopyroxene and plagioclase have been studied by means of FE-SEM-EDS imaging, coupled with EPMA-WDS major element analyses, LA-ICP-MS trace element analyses and in-situ LA-MC-ICP-MS Sr-isotope systematics.

The geochemical-isotopic results led us to depict a complex architecture of the plumbing system, in which the alkaline trend is originated by the interplay of fractional crystallization, crustal assimilation and intra-association mixing processes. In detail, mixing among differently evolved magma batches, with distinct radiogenic signatures, was the principal cause of the formation of intermediate compositions at a depth corresponding to 0.4-0.5 GPa. Thus, the development of the complete alkaline trend was a consequence of a prolonged stall of magma at crustal depth due to an incapability of eruption. This prolonged residence time made differently evolved batches of magmas available for intra-association mixing and crustal assimilation. Considering the context of a glaciated terrain, it is reasonable to attribute the prolonged residence time to external factors, such as fluctuation of the ice cover, which likely influenced the stress field conditions of the shallow crustal reservoirs.