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Geochronological constraints on plumbing system evolution under a variable ice load - The Pleiades Volcanic Field, Antarctica

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The Pleiades Volcanic Field, located in northern Victoria Land (Antarctica), consists of more than 20 monogenetic scoria cones and at least two lava domes, with eruptive activity spanning from about 800 ka to the present. Although most of the individual centres have a monogenetic appearance, their erupted products display a wide compositional range, defining both a continuous, mildly Na-alkaline evolutionary trend and a more scattered, strongly Na-alkaline trend. These two trends differ not only in major and trace element compositions but also in their Sr, Nd, and Pb isotopic signatures. To investigate the petrogenetic processes responsible for the development of these trends, we performed thermodynamic modelling using Magma Chamber Simulator, quantifying the relative roles of crystal fractionation, magma mixing and crustal contamination. Our results indicate that both series derive from a common alkali basalt parental magma. However, they diverge during in-crust evolution: the strongly alkaline association can be explained by fractional crystallisation alone, whereas the mildly alkaline association requires the combined effects of fractional crystallisation and crustal assimilation. To reconstruct the temporal evolution of this long-lived plumbing system, we performed $^{40}Ar/^{39}Ar$ geochronology on representative products of the two main magmatic trends. The results indicate that all intermediate products of the mildly alkaline association are younger than 100 ka, suggesting that assimilation and intra-association mixing became dominant processes in the subvolcanic system since around 100 ka. We propose that the increased load associated with a thickened glacial cover during this time span, coinciding with the last glacial period, promoted extended magma residence times in the upper crust. Such protracted storage would have favoured crustal assimilation, differentiation, and mixing, ultimately contributing to the development of a more complex plumbing system and a shifting path in magmatic evolution.