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Self-cannibalisation of an active cumulate system (Blumone complex, Adamello, Italy): Geochemical and experimental evidence

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In the southern part of the Adamello Batholith (43-33 Ma; Schaltegger et al., 2019) in Northern Italy (Re di Castello superunit), we identified a multi-generational dyke suite with “exotic” chemical compositions intruding quartz-dioritic units surrounding a gabbroic complex. These dykes are characterised by SiO_2 contents between 43 and 46 wt.%, high Al_2O_3 (20-21 wt.%), and low MgO and Ni (below 6.5 wt.% and 40 µg/g, respectively), displaying a nepheline-normative character. Furthermore, they exhibit positive Sr and Ba anomalies. These chemical features exclude a possible primitive character or derivation from a typical calc-alkaline liquid line of descent, as identified for the Adamello Massif (Ulmer et al, 2018). The primocrystic cargo of these dikes (clinopyroxene, anorthitic plagioclase, and low-Si, high-Na pargasitic amphibole) displays striking similarities with cumulate crystals of the contiguous Blumone amphibole gabbroic cumulate, inferring mechanical interaction of these exotic liquids with and/or derivation from the cumulate complex. Amphibole-plagioclase equilibration temperatures of the dikes (875 to 775ºC) are consistent with thermal equilibration with the surrounding quartz-dioritic mush. Sharp contacts and dyke fragmentation are also observed and are thermally congruent with the ductile-brittle transition of a quartz-dioritic to tonalitic mush (Marxer & Ulmer, 2019).

Simple mass balance calculations modelling of the peritectic melting of pargasitic amphibole and high-An plagioclase (major mineral phases of the contiguous amphibole gabbroic cumulates) with simultaneous crystallisation of low-Al clinopyroxene reveal that melt compositions similar to these dykes can be achieved with amphibole-plagioclase proportions ranging between 65:35 and 50:50. To verify if peritectic cumulate remelting represents a possible generation mechanism of these dykes we performed experiments at 0.2 GPa.

Established phase equilibria of these dyke compositions reveal a lack of near-liquidus olivine, which is a rare phase in gabbroic complex. This is consistent with preliminary experimental results on cumulate melting, where olivine is also absent at high temperatures (> 1075ºC). These observations further disprove the petrogenesis of these liquids via a calc-alkaline liquid line of descent, where mafic magmas would be early saturated in olivine at low pressure further supporting their generation by local remelting of amphibole-plagioclase dominated mafic cumulates.Geochemical as well as experimental results both strongly point towards the

petrogenesis of these nepheline-normative, high-Al, low-Mg picrobasalts by low pressure peritectic melting of a pargasite-anorthite cumulate assemblage in an active magmatic system.

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