

Arc architecture and melt filters recorded in plagioclase across the Central Andes

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Understanding the dynamics of magma storage and transport before, during, and after volcanic eruptions is crucial to forecast future volcanism, particularly in arcs known for hosting explosive eruptions. Plagioclase, a major component of arc magmas, is particularly sensitive to mechanical and thermodynamic changes and offers protracted records of magma dynamics. Here, we employ in-situ high-resolution geochemistry (major and trace elements, and Sr isotopes) to analyze complex populations of plagioclase crystals and volcanic matrix in Andean Arc volcanoes. Our samples span latitudinal and longitudinal gradients within the Central Andes, encompassing both monogenetic volcanoes (0.5-5 Ma) and polygenetic active volcanoes. Plagioclase crystals range from 50 - 4060 μm , An_{22-92} , and $^{87}\text{Sr}/^{86}\text{Sr}$ 0.70572 – 0.70714 in monogenetic volcanoes to 100 – 6800 μm , An_{11-100} , $^{87}\text{Sr}/^{86}\text{Sr}$ 0.70572-0.71041 in polygenetic systems, where the crystals show complex textures indicating magmatic fluctuations and disequilibrium. Anorthite vs MgO diagrams consistently define a peak at An_{60-65} , suggesting magmatic temperatures around 1100°C. Most compositions plot at the An_{60-65} peak, in accordance with filtering of eruptible melts regardless of volcano type (polygenetic or monogenetic system) and latitudinal or longitudinal distributions. This includes crystals from the back-arc region, questioning the notion of limited crustal input away from the main arc. Matrix geochemistry compared to plagioclase rims and microcrysts, reinforced magmatic disequilibrium in polygenetic systems, showing a less differentiated composition relative to the matrix. In monogenetic systems, these components appear to be more equilibrated with the final liquid. Notably, matrix compositions do show differences between the main arc (calc-alkaline) and the back-arc, characterised by limited chemical variations alongside significant alkali enrichment. Interestingly, our observations in plagioclase persist across the entire Andean volcanic arc, from northern to southern and austral regions, with a distribution peak for anorthite at An_{60-65} despite notable variations in subduction configuration. This highlights similar magma transport and storage across crustal architectures, prompting further investigation into intensive parameters and external inputs and their influence on magma dynamics in arc systems.