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Tiny Titans: Exploring compositional patterns in subduction zones through global crystal and melt inclusions datasets

DANIELA ANDREA PARRA-ENCALADA, PHD STUDENT, TERESA UBIDE AND GIDEON ROSENBAUM

The University of Queensland

Presenting Author: d.parraencalada@uq.net.au

Arc volcanoes in subduction zones are intricate systems that involve complex interactions among source inputs, crustal contamination, polybaric storage, and volatile budgets. An integral understanding of these components is crucial for analyzing magma storage and transport in the lead-up to volcanism. Local studies on individual arc volcanoes provide crucial information on magma dynamics, yet the analysis of global datasets can provide a broader, global perspective on arc systems. Here, we utilize the GEOROC geochemical and petrological database to explore global compositional trends in crystals and melt inclusions from 30 arc systems worldwide, including oceanic and continental arcs. We first focus on plagioclase, the most abundant mineral in arc volcanic rocks, which is sensitive to subtle mechanical and thermodynamic changes affecting magmatic reservoirs and transport. Our preliminary findings reveal three distinct patterns in the composition of plagioclase within volcanic arcs. Following differences in crustal thickness and plumbing system complexity, the frequency distribution of anorthite compositions shows distinct peaks in continental arcs such as the Andean and Cascades regions (An_{60-65}) to oceanic island arcs, including the Izu-Bonin, Mariana, and Tonga arcs (An_{80-85}). Interestingly, a different pattern emerges in volcanic arcs that show a more complex distribution (i.e., islands encompassing largest areas, peninsular sectors, or reduced continental area), such as the Sunda, Scotia, and Central American arcs. Here, two distinct peaks are evident, one falling between An_{50-60} and another between An_{82-85}.

We anticipate that our findings will contribute to advancing our understanding of arc volcanoes. By leveraging large datasets, we aim to improve our comprehension of analogous geological environments.