Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.5419

SHALLOW MAGMA MIXING ABOVE THE OCCIDENTAL BOUNDARY OF ALTIPLANO PUNA MAGMA BODY: CONSTRAINING THE GEOTHERMAL HEAT SOURCES THROUGH THE CASE OF AZUFRE VOLCANO

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In the context of researching the heat sources that feed the Cerro Pabellón geothermal system (Northern Chile), we study the origin of the youngest andesitic (61–63 SiO_2 wt%) lava flow from the Azufre volcano (21°47'7"S; 68°14'23W). This stratovolcano is emplaced over a 70 km long NW-SE alignment above the occidental boundary of Altiplano Puna Magma Body (which is the largest active magma body on Earth) and located 10 km NW from the first geothermal power plant of South America. The significance of this volcano relies on the younger volcanic units developed around it (<150 ky), which correspond to dacitic domes (Chanca, Chac Inca and Cerro Pabellón; see figure 1) and our studied holocrystalline lava flow. This flow comprises aphanitic andesite enclaves (58–60 SiO_2 wt%) and phenocrysts of plagioclase, amphibole, biotite and orthopyroxene (15, 4, 4, 2 in vol%, respectively) together with scarce phenocrysts of clinopyroxene, quartz and olivine (~1 in vol% each one). The groundmass of lava and enclaves is made up of the same mineral chemistry, displaying amphibole microphenocryts and microlites of plagioclase, pyroxenes and Fe–Ti oxides.

We use different geobarometric and geothermometric techniques in phenocrysts and microlites along with crystallization simulations performed in MELTS freeware to study the magmatic evolution and identify a zoned crystal-mush magma reservoir emplaced at shallow crustal levels (~6,4 km of depth). In this way, based on textural features, mineral chemistry and thermometry results, an open system with two zones (Zone A and B) was identified for the magmatic system that fed the youngest lava flow of the Azufre volcano. Zone A (at high temperatures in the range of 916–1097°C) would represent a deep recharge zone where primitive melt (of composition similar to enclaves) intruded the bottom of the Zone B, which corresponds to a more evolved siliceous crystal-mush reservoir (at lower temperatures between 712–799°C). Thereby, during this incomplete magma mixing was made the magma chamber that trigged the last eruption stage of the Azufre volcano.

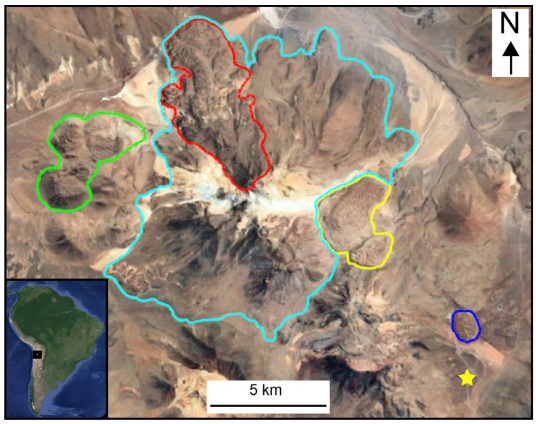

Figure 1: Satellite image highlighting the locations of the geothermal power plant (yellow star),the Azufre volcano (cyan line), the holocrystalline lava flow studied (red line) and the others younger volcanic units: Cerro Pabellón dome (blue line), Chac Inca dome (yellow line) and Chanca dome (green line).