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Chemical, petrologic and experimental constraints on the pre-eruptive conditions of Lascar volcano, Central Andean magma systems

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Lascar Volcano is a calc-alkaline stratovolcano located in the Central Volcanic Zone (CVZ), Northern Chile. The volcanic activity of Lascar started about 5 Ma ago and moved first eastwards and then westwards. Lascar represents the most active volcano of this area. Volcanic sequence has been divided into four main stages (43 to 26.5 ka for stage I, 26.5 ka for stage II, 22.3 to 9.3 ka for stage III and 7.1 to present for stage IV). The major rock types of Lascar are mainly porphyritic andesites to dacites with plagioclase as the dominant phenocryst. The activity of Lascar has been characterised by cyclic behaviour involving the growth and subsidence of lava domes, degassing of the magma, and vulcanian to plinian eruptive events culminated in the bigger eruption on 1993. Geochemical analyses combined with experimental simulations are used to discuss the role of mixing and fractionation during magma ascent and the pre-eruptive conditions in the magma chamber.

Hornblende-plagioclase and clinopyroxene-orthopyroxene thermometry, magnetite-ilmenite thermo-oxy-barometry and amphibole barometry, were applied to characterize the magmatic conditions of the most recent eruptions from stage IV (for details see Banaszak et al., this session). Hornblende-plagioclase thermometry as well as clinopyroxene-orthopyroxene pairs yielded a large and continuous temperature interval of crystallization from $\sim$ 850 to 1010°C. Temperature and oxygen fugacity determined from magnetite-ilmenite pairs vary from 840 to 950 ºC at oxidizing conditions from 1.0 to 2.0 log units above NNO. The compositions of amphiboles provide estimates for pressures from 200 to 500 MPa for Lascar andesites. Geochemical data such as strontium (87Sr/86Sr = 0.7057-0.7066) and oxygen isotopes (18O = 6.5–7.1) from Lascar volcanic sequence demonstrate significant crustal contamination.

Additional constraints on the pre-eruptive conditions could be derived from melt inclusions in mineral phenocrysts of Lascar lavas, bombs and pyroclastics. Several samples have been investigated, showing that phenocrysts of plagioclase, ortho- and clinopyroxenes and also rare olivines contain entrapped and well-preserved melt inclusions. The dimensions of inclusions vary from less than 10 to more than 100 μm. For the measurements only the inclusion larger than 50 μm were selected. Plagioclase phenocrysts were analysed first, and melt inclusions reveal dacitic to rhyolitic compositions. The analysis of volatiles indicates the presence of chlorine, fluorine and sulphur but in relatively small concentrations. Further work is in progress to analyse concentrations of H2O and CO2 in the inclusions (in particular, in olivine).

An andesitic white pumice has been chosen as starting composition for the crystallization experiments. This sample is representative of the last stage (i.e. stage IV) eruptions, with magma composition containing $\sim$ 58 wt% of SiO2 and $\sim$ 5 wt% of MgO. The major phases present in this sample are plagioclase, two pyroxenes and amphibole. Accessory phases are also oxides, sulphides and rare olivine. Plagioclase has a calcic composition (An30-70), while clinopyroxenes are dominated by augite composition. First experimental results will be presented.