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Assembly and detectability of eruptible magma prior to the giant Atana eruption (Central Andes)

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Giant volcanic eruptions have the potential to deeply impact human civilization. Yet, the mechanisms and timescale over which large volumes of eruptible magma accumulate in the Earth crust are not well understood. Such knowledge is, however, crucial in order to evaluate our capacity to capture the evolution towards a large explosive eruption using geophysical methods.

We will present new in-situ Sr-isotope data for plagioclase crystals from the 2500 km^3 Atana ignimbrite (Northern Chile). Interestingly, $^{87}Sr/^{86}Sr$ ratios in crystal cores show a large diversity ranging from 0.7086 to 0.7123 and converge towards a common value of 0.7095 in crystal rims, indicating that diverse crystal populations were entrained in a common melt prior to eruption. Modelling the diffusive re-equilibration of Sr-isotope gradients, we estimate a maximum residence time for the eruptible magma of <100 yrs. Using numerical simulations, we demonstrate that the growth of melt-rich lenses in crystal mush is consistent with the observations and rapid timescales. While the prospect of capturing such melt lenses with most geophysical techniques is pessimistic, forward modelling of microgravity anomalies indicates that such features are potentially resolvable. Our findings provoke a new assessment of the origin and hazard potential of large explosive eruptions.

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