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Host rock architecture controlling the emplacement of shallow magma reservoirs: Inferences from Miocene plutonic bodies in Central Chile

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Miocene magmatism in Central Chile is characterized by intense coeval tectonic activity changes, which controlled, for example, the composition and location of the volcanism: shifting from an extensional setting to a compressive one, volcanic sequences became more silicic and plutonic activity migrated slightly eastward. Under this scenario, the San Gabriel (SGP, 12.4-13.5 Ma U-Pb in zircon and ∼60 km3 exposed volume) and La Gloria plutons (LGP, 9.9-11.1 Ma U-Pb in zircon and ∼120 km3 expose volume) were emplaced at the eastern border of an intra-arc basin (Abanico basin), spatially associated to several N-S syncline and anticline folds. The geometry of both intrusives is dominantly elongated in a N-S direction, which are located at the same level of a stratigraphic discordance. These field observations suggest that the emplacement of SGP and LGP was strongly controlled by the architecture of the host rocks.

Petrographic, compositional and internal structural features of both plutons allow inferring the magmatic evolution of the such reservoirs. SGP presents broad compositional and textural variations, suggesting low emplacement rates with limited internal homogenization by convective stirring. On the contrary, the LGP is a more homogeneous, indicating higher injection rates and enhanced convective stirring. Both plutons were likely constructed by magma input of similar compositions (intermediate 60-65 wt.% SiO_2), but geochemical and textural data indicate that melt extraction from crystallizing mushes was more efficient in SGP compared to LGP, giving place to the more pronounced compositional variability.

The detailed examinations of both plutons suggest that: (1) blinded inverse faults and axial plane faults that progressively folded the country rocks controlled the magma ascent, whereas the stratigraphic discordances acted as rheological barrier that promoted lateral magma flow. Injection rate did not seem to play a major role in the emplacement location. Ubiquitous presence of host rock blocks into the plutons indicate that magmatic stoping was key both cases. (2) The internal differentiation and compositional diversification of both reservoirs was controlled mainly by differing injection rates, favoring the heterogeneity in a lower injection rate scenario, but not necessarily favoring a greater volume of the bulk extracted silicic melts.

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