Compositional gap at La Picada (CSVZ, Chile) results from critical cristallinity and compaction

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La Picada is a stratovolcano located at 41°S in the Andean Central Southern Volcanic Zone (CSVZ) (38°S-41.5°S in Chile) that results from the subduction of the Nazca plate beneath the South American continent. A collection of 52 samples defines a differentiation trend from basalts to basaltic andesites and dacites (50.9 to 65.6 wt. % SiO_2) that displays a compositional (Daly) gap between 57.0 and 62.7 wt. % SiO_2. Quenched glass pockets between crystals in basaltic andesites and dacites extend the trend to 76.0 wt. % SiO_2. Samples occurring on both sides of the gap show contrasting textures. Basalts and basaltic andesites (50.9 to 57.0 wt. % SiO_2) are lavas rich in macrocrysts (18-54 vol %) of Pl (An_{93-28}), Ol (Fo_{86-51}), Cpx (Mg# = 82.8-55.2) and Opx (Mg# = 74.1-56.1), plagioclase being the dominant phase. On the contrary, the dacites, which were only observed in dykes, are poor in macrocrysts (<10 vol %) of Pl (An_{68-46}), Cpx (Mg# = 72.2-60.3) and Opx (Mg# = 63). The use of a collection of geothermobarometers and hygrometers based on crystal and lava compositions indicate that the parent magma had a low H_2O content (1.4-1.8 wt. %) and crystallized at an oxygen fugacity close to FMQ+0.3 in a main storage region located at shallow depth (~ 0.2 GPa).

The differentiation trend from the basalts to the most evolved basaltic andesite (56.2 wt. % SiO_2) mainly results from fractional crystallization and can be modelled in two steps: subtraction of a gabbroic cumulate (up to 54.8 wt.% SiO_2) followed by a gabbronoritic cumulate with a total fractionation of 43%. Experimental data on a basalt similar in composition to the parent magma of La Picada at the same *P*-fO_2-H_2O conditions show that crystallization can produce evolved liquids (andesite to dacite). This is in agreement with the calculated composition of the matrix in the basaltic andesites which is andesitic, suggesting that andesitic liquids were indeed produced in the main magma storage region of La Picada. The occurrence of a Daly gap is thus interpreted as resulting from a combination of critical cristallinity, the point at which a magma has the rheological properties of a solid, that was reached in the basaltic andesites within the magma chamber followed by filter pressing that collected the dacites.