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Silicic volcanism in the Paraná Magmatic Province: progress on stratigraphy, crystallization conditions and origin

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Dacites and rhyolites from the Paraná Magmatic Province (PMP) formed from high temperature silicic melts (~1000°C; <2 wt.% H_2O), and are relevant to understand petrogenesis and eruption of magmas. The oldest silicic rocks in the PMP are dacites from the low Ti sequence (southern PMP) forming discontinuous bodies, which show important compositional variation (Caxias do Sul, Jacuí and Anita Garibaldi subtypes) and differences in paleomagnetism. They close a volcanic cycle formed by "Gramado type" basalts (Torres and Vale do Sol Formations), characterized by a more oxidized character (fO_2~ NNO), resulting from assimilation of melts from continental crust accompanied by fractional crystallization, indicated by geochemistry and isotopic signature of whole rocks (Sr, Nd) and plagioclase phenocrysts (Sr). They were followed by a sequence with typical tholeiitic character (Barros Cassal and Esmeralda Fm., fO_2~ FMQ), also compositionally expanded (basalt-andesite to minor dacites) and produced by AFC. The Santa Maria Rhyolites, at the top of the low Ti sequence, extend continuously for at least 285 km, maintaining the same geochemical and paleomagnetic signature. They show the highest viscosities (SiO_2~ 72wt%; H_2O <1.5wt%), and are best candidates for a dominantly explosive emplacement. U-Pb zircon dating by CA-ID-TIMS indicate that the entire succession of low-Ti silicic volcanism occurred in a short interval at ~133.6 Ma.

Silicic rocks occur at the base of the younger high-Ti PMP sequence (Chapecó trachydacites) as smaller discontinuous bodies. The whole-rock and phenocryst geochemical and isotopic signature reveal clear affinities with high-Ti basalts, with minor crustal contribution. Genetic models include remelting of basalt underplates, fractional crystallization and, more recently, liquid immiscibility. Their U-Pb zircon ages (~132.9 Ma) confirm rapid northward migration of the PMP volcanism.

The porphyritic character of the PMP silicic rocks, in particular the dacites and trachydacites (10-25%vol. plagioclase, pyroxene and Ti-magnetite "phenocrysts"), calls into question the composition of the original melts. Although the chemistry of phenocrysts is mostly consistent with that of whole rocks, the presence of antecrysts is indicated by textural disequilibrium, variations in their Sr and Hf isotopic composition, and by non-reproduction of part of the mineralogical assemblage observed in our experimental studies.

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