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Explosive-effusive transitions during silicic volcanism in Southern Brazil: characterization of feeder system, stratigraphy and physico-chemical parameters

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The magmatism related to the reactivation of the Brazilian Platform and the opening of South Atlantic Ocean during the Juro-Cretaceous period originated one of the largest igneous provinces on the planet, the Paraná-Etendeka Magmatic Province. Most of this magmatism is constituted by tholeiitic basalts, with subordinated amounts of silicic (dacite-rhyolite) rocks. Despite the well-defined stratigraphy and the extensive studies of generation processes (for both mafic and silicic components) along the last decades, the eruption style of silicic volcanism remains unsatisfactorily known. Detailed mapping associated with textural analysis recently carried out at silicic rocks from the southern Brazil may shed some light on this theme. At the vicinities of São Marcos (RS, Brazil) structures recognized as the feeder system of silicic volcanism occur aligned along a NW-SE zone. The description of different morphological domains at those structures indicates the coeval occurrence of processes of magmatic flow (through stretching and folding mechanisms) and fragmentation, which together with high heat flux, seem to have been a very efficient magma ascent mechanism. The alignment of these structures, the systematic repetition and cross-cutting relations between the described morphological domains, remelting features and the occurrence of younger NW-SE trend basaltic dykes at this zone point towards a fissural system with polycyclic recharging. Estimations of pre to syn-eruptive physico-chemical conditions indicate that the silicic magmas was characterized by unusual high temperatures (∼1000-1020°C), low viscosities (∼104-5 Pa.s) and water contents (<2% vol.).
The combination of detailed mapping, fractal dimension calculations and textural analysis of related deposits allowed us to recognize both explosive and effusive phases. The first silicic volcanic occurrences at the region correspond to a low-explosivity pyroclastic phase, characterized by proximal rheoignimbrites and breccias, possibly resultant of “boiling-over” eruptions. After this phase, a transition between explosive and effusive events is suggested by the occurrence of hybrid deposits, which gradually give place to lobated lavas. The subsequent transition and locally alternation with new (possibly) rheoignimbritic deposits suggests oscillatory fragmentation processes at the conduits, related to decompression and volatiles exsolution in an effective permeable system (consistent with a fissural configuration).