Magmatic evolution and intensive parameters of the Santa Maria Rhyolites, Paraná Magmatic Province, Brazil, as inferred from whole rock and mineral geochemistry

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The Santa Maria rhyolites correspond to a sequence of effusive glassy to hipocrystalline rocks occurring as lava-domes and flows in the southern portion of the Paraná Magmatic Province, south Brazil. Detailed field work in the Soledade-Gramado Xavier region has shown that they correspond to the uppermost sequence of the low-Ti magmatism, which is characterized by a succession of pahoehoe basalt-aa basalt-dacite-rhyolite.

The rhyolite magmas have some unusual characteristics such as high magma temperatures (up to 1,000oC, as indicated by apatite saturation and two-pyroxene thermometry), high H2O contents (2.5-3.5 wt%, estimated from the plagioclase geohygrometer), and consequently lower viscosities (~104 Pa.s) compared to typical rhyolites, what could in part respond for the dominantly effusive mode of emplacement.

The rhyolites are chemically homogeneous, with 71-73 wt% SiO2, 0.65-0.70 wt% TiO2 and enriched in K2O (4-5 wt%) and other incompatible elements (210–300 ppm Rb; 680–930 ppm Ba; ~350 ppm Zr and □ REE ~300 ppm) compared to the associated dacite units.

The scarce (~3-5 vol.%) 0.5-1.5 mm plagioclase phenocrysts have homogeneous cores with compositions varying from An46 to An54; resorption surfaces present in some crystals may be mantled by a thin, more calcic (An57-60) rim. Trace-element contents determined by LA-ICPMS are also relatively homogeneous; results of inverse modeling for Ba, Sr, Rb and LREE using Kds from literature are broadly consistent with crystallization from the host melts.

An increase in the temperature of the magmas suggested by resorption textures and inverse zoning of plagioclase may have occurred immediately prior to eruption, as a result of heating by latent heat of crystallization or, more probably, was due to injections of hotter magma, as evidenced by the occurrence of scattered dm-sized ball-shaped dacitic enclaves.

Lu-Hf isotope systematics of the ca. 3.92-3.96 Ga Acasta Gneiss Complex (NWT, Canada)

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The Acasta Gneiss Complex (AGC) is a remnant Hadean (pre-3900 Ma) ancient crust composed of strongly deformed, polyphase mafic to felsic gneisses that preserve a protracted multi-stage history of magmatic emplacement, inheritance, and subsequent tectono-thermal modifications that induced generalized migmatization. The complexities observed in these ancient gneisses have been documented in previous geochronological studies of the AGC (e.g. U-Pb, ^{147}Sm-^{143}Nd), and are evident also in the Lu-Hf isotope systematics. Here, we report new whole-rock Lu-Hf isotope measurements which show that some AGC gneisses have been disturbed by metamorphic garnet growth and/or migmatization and mineral segregation, while others have preserved their Lu-Hf isotope systematics relatively intact. Results reveal identifiable Hadean and later (Eo- to Paleoarchean) magmatic events at around 3960 Ma and again at 3600 Ma, with a major metamorphic episode of the complex at ca. 3730 Ma. The oldest and least contaminated gneisses yield a mean Lu-Hf regression age of 3945 ± 91 Ma, which is in good agreement with U-Pb zircon geochronology [1]. The role of yet older crust (4000-4200 Ma) in the formation of the AGC is also evident, but this crust was not ubiquitous. Assimilation calculations show that the mantle source of the least contaminated samples in the oldest age group had Hf isotope compositions near that of the chondritic uniform reservoir (CHUR) 3960 My ago.

[1] Cates et al. (submitted)

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