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Hydrothermal fluid flow evidenced by mineral alteration assemblages and chemistry of metamorphic rocks, sediments and volcanics on top of the southernmost Río de la Plata craton, eastern Argentina

Juan Cruz Martínez (1), Jorge A. Dristas (1), and Hans-J. Massonne (2)

(1) INGEOSUR-CONICET. Univ. Nacional del Sur, Departamento de Geología, Bahía Blanca, Argentina (jcmartin@uns.edu.ar), (2) Institut für Mineralogie und Kristallchemie, Universität Stuttgart, Stuttgart, Germany

Two horizontally widespread alteration zones of the Barker-Villa Cacique area, Tandilia ranges, share common alteration features recognized by petrography, X-ray diffractometry, electron microprobe analysis, bulk-rock geochemical analysis and K-Ar age dating. An asymmetric alteration pattern with development of an argillic clay mineral assemblage is typical at the Tandilia Late-Proterozoic unconformity zone between the migmatitic and meta-igneous basement, mainly of granodioritic composition, and a quartz-rich epiclastic overlying succession. The most pervasively altered rocks, presented at the unconformity, usually contain Na-bearing K-white micas, Na and K-bearing pyrophyllite, LREE-bearing aluminum phosphate sulphate (APS) minerals of the florencite-type and tourmaline. Transitional zones to unaltered basement rocks are dominated by K-white mica, chlorite and calcite. Ti-oxides also occur in the alteration profiles.

In the middle upper section the overlying sedimentary succession shows lenses of silicified breccias, reworked and altered pyroclastic material recognized as reddish and whitish clays and an alternating succession of reworked tuff material and epiclastic quartz arenites (Frisicale and Dristas, 2000). These rocks are usually cut by subhorizontal and vertical breccias (Dristas and Frisicale, 1992). The mineral paragenesis of the reddish and whitish clays corresponds to an advanced argillic alteration where isolated quartz grains are corroded by pyrophyllite-sericite. This alteration contains in addition to these minerals kaolinite $\pm$ tourmaline $\pm$ rutile $\pm$ APS minerals $\pm$ diaspore $\pm$ alunite. Pseudocubic Na-bearing alunite crystals are present either as veins or lenses mainly in the whitish clays. X-ray compositional maps on alunite reveal tabular-like cores with significant amounts of P, Ba, Sr, REE, Ca and Fe pointing to APS minerals of the florencite-type (Martínez et al., 2006). The intensity of alteration diminished upwards the succession.

The bulk-rock chemistry of altered rocks shows rapid changes from non-altered basement with a negative Eu anomaly (Eu/Eu* =0.24) to the most altered basement and sedimentary rocks at the unconformity with strongly positive Eu anomalies up to 11.7 and positive Ce anomalies (Martínez et al., 2010). In the same way, wall-rocks of alunite veins show positive Ce anomalies when the pyroclastic component is not diluted by epiclastic components. K-Ar ages determined on altered rock rich in secondary K-white mica of the basement and the interbedded altered tuff and quartz-rich layers point to minimum alteration ages of ca. 600 Ma (Bonhomme and Cingolani, 1980; Dristas & Martínez, 2007) in accordance with a K-Ar age determined on pure alunite veins of 650 $\pm$ 20 Ma.

Similarities in chemistry, mineralogy, alteration textures and ages allow us to interpret both alteration zones as related to fluid flow migration probably linked either to hidden igneous rocks, which are common in the Uruguayan portion of the Rio de la Plata craton, or to metamorphic fluids expelled during basement uplift by pressure release.