Oxygen fugacity and $CO_2 – N_2$ fluid inclusions as remnants of fluid and geodynamic evolution of Ribeira Fold Belt, SE Brazil

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The studied São Fidelis - Santo António de Pádua (SFSAP) sector, located in central Ribeira Fold Belt, a Neoproterozoic granulitic belt that spans along the SE coast of Brazil, comprises abundant migmatitic gneisses (kinzigites and khondalites) and charnockites, as well as their deformed counterparts (blastomilonites) that resulted from late shearing and exhumation at the end of the Panafricano – Braziliano Orogeny.

The use of extensive methodology, namely fluid inclusion (FI) microthermometry, Raman spectroscopy, x-ray diffraction, mineral chemistry analysis and oxygen fugacity modelling, provided the following results: **i)** Magnetite-Hematite $ƒO_2$ estimates range from $10^{-17.799}$ to $10^{-11.538}$ bar for the determined mineral temperature range of 656 to 896º C (Bento dos Santos et al., 2005); **ii)** charnockites show $ƒO_2$ above the QFM buffer (QFM +1), while blastomilonites and migmatites have $ƒO_2$ at QFM -1, implying that the SFSAP sector rocks experienced $ƒO_2$ decrease as temperatures dropped; **iii)** 5 main types of fluid inclusions were observed, from oldest to youngest: a) N_2 (94 to 95 mol%) – CH_4 (5 to 6 mol%) FI; b) CO_2 and CO_2-N_2 (0 to 11 mol%) high to medium density (1.01 – 0.59 g/cm^3) FI; c) CO_2 and CO_2-N_2 (0 to 36 mol%) low density (0.19 to 0.29 g/cm^3) FI; d) CO_2 (94 to 95 mol%) – N_2 (3 mol%) – CH_4 (2 to 3 mol%) – H_2O and H_2O-CO_2 FI; and e) late low-salinity H_2O FI; **iv)** Raman Spectroscopy evidence two graphite types in khondalites: early highly ordered graphite cut by a disordered kind. The use of a Raman-based graphite geothermometer supplied temperature estimates ranging from 333º C, for the most disordered graphite, to 449º C, for the highest temperature type.

Combination of data taken from the previous methodologies allowed the characterization of fluid and geodynamic evolution of this lower crust segment in the last stages of the Braziliano cycle, namely that Ribeira Belt metamorphic fluids evolved from dominated N_2-CH_4 fluids to dominated CO_2-N_2 fluids during granulitic metamorphism at high oxygen fugacities as a combined process of CO_2 generated by graphite oxidation (Cesare et al., 2005) and CO_2 concentration after water removal to ascending granitic melts (Bento dos Santos et al., 2006), followed by late $ƒO_2$ decrease induced by the influx of water, turning carbonic fluids into CO_2-H_2O, and progressively into low-salinity H_2O fluids.

The stated fluid evolution happen due to rapid pressure drop during the late retrograde/exhumation path of Ribeira Fold Belt. Results show that at about 400-450º C rocks were exhumed to near surface depths, producing generalized low-density CO_2 inclusions, followed by surface water entrance. When $ƒO_2$ decreased substantially by mixture of carbonic and water inclusions, graphite deposited, forming khondalites.

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