Fraipontite in the hydrothermally overprinted oxidation zone of the Preguiça mine, Southern Portugal

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The Preguiça mine is a carbonate-hosted nonsulfide zinc deposit situated in the Magnetitic-Zinciferous Belt of the Ossa-Morena-Zone, Southern Portugal. The metamorphosed primary Zn-Pb sulfide mineralization is hosted by Lower Cambrian dolomite marbles and suffered a supergene oxidation in the upper 90 m during the Tertiary. In the porous, goethite-dominated gossan a variety of secondary minerals including willemite, mimetite, descloizite, cerussite, plattnerite and very rare smithsonite occur. Travertine-like masses of calcite and in part zincian dolomites, as well as massive white clay in the brecciated gossan are conspicuous.

Thirty clay-bearing samples were analyzed using XRD and in part by ATR-FTIR and ESEM with EDX. The rare trioctahedral 1:1 Zn clay mineral fraipontite was identified as the dominant component in all analyzed clay samples with minor amounts of quartz, alunite, goethite and kaolinite. The chemical compositions of the sample material range from 17 – 33 wt. % SiO_2, 44 – 58 wt. % ZnO, 9 – 14 wt. % Al_2O_3 and 1.8 – 8.2 wt. % Fe_2O_3. EDX analyses of fraipontite reveal notably lower alumina contents whereas silica and zinc contents are higher than values reported for fraipontite from other locations. FTIR spectra of fraipontite resemble those from the type locality Moresnet, Belgium. However, splitting of the principal Si-O stretching band (984 cm^{-1} and 935 cm^{-1}) may indicate a low level of tetrahedral Al-for-Si substitution in accordance with the low measured alumina contents. The OH deformation band can be resolved into two overlapping bands at 650 cm^{-1} and 615 cm^{-1} and may indicate partial occupancy of octahedral sites by iron.

Stable oxygen isotope data of secondary carbonates (calcite, zincian dolomite, smithsonite and cerussite) and willemite clearly indicate the involvement of low-temperature hydrothermal fluids at Preguiça. The carbon isotope data of all secondary carbonate minerals are constant and low (-11.0 to -8.3 ‰ V-PDB) indicating the absence of carbon from the marine carbonate wall rocks or the atmosphere. Elevated temperatures and low pH may have promoted the formation of fraipontite and willemite instead of the more common supergene Zn minerals sauconite and hemimorphite.