Hydrogeochemistry of water resources from abandoned Freixeda gold mine (NE Portugal)

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Freixeda mine is located in NE Portugal and was exploited for Au, Ag and Pb. It belongs to the Auriferous Methalogenic Province of NW of Iberian Peninsula. The mineralization is associated with sulphide minerals in quartz veins, located in metasedimentary paleozoic formations.

Water samples were collected from a gallery with acid mine drainage (AMD), $3.5 < pH < 4.0$, and from groundwater and surface water, upstream and downstream from the mine influence. Water from Ribeira de Freixeda upstream from the AMD confluence is not affected by the mineralization and has $Ca\text{-}HCO_3$ type, slightly basic pH with no detectable As and no significant concentration of trace metals. Downstream from the AMD, surface water becomes $Ca\text{-}Mg\text{-}SO_4$ type with elevated concentrations of As, Zn and Mn.

Groundwater from a spring outside the influence of the mine has a pH of 6.5 and is of $Ca\text{-}Na\text{-}HCO_3$ type with no anomalous trace element concentrations. Groundwater exploited from a deeper well is of $Mg\text{-}SO_4$ type, pH about 7 and has high concentrations of As, Zn, Mn and Fe.

Conclusions from this study are that water resources of Freixeda are affected by sulphide mineral oxidation which releases cations, SO_4^{2-} and H^+ ions. These free H^+ ions contribute to the dissolution of carbonates (present in cement of metasedimentary rocks) and to the hydrolysis of silicate minerals (plagioclases) promoting the alkalinity and pH increase.

Concentration of As in surface water is much lower than in groundwater probably do to adsorption of As on Fe oxyhydroxides, that precipitates in stream sediments. This suggestion is supported by the absence of dissolved iron in surface-water samples. Even so, the amount of As (190 ppb) in surface water is above the limit for human consumption or watering. In groundwater, the oxidation-reduction potencial and pH conditions that allow Fe to remain in solution could be responsible for the higher concentration of As (850 ppb).

Introduction to the CAMECA IMS 7f-GEO

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SIMS is applied to a variety of applications in Geoscience, because it offers sensitivity compatible with very local isotopic and/or elemental analysis of solid samples.

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Typical analytical performance of the IMS 7f-GEO for stable isotope analysis ($^{18}O/^{16}O$): for an analysis area of 10x10µm², a single analysis internal error of less of 0.3 per mil is reached for a total integration time < 60sec. Detailed instrumental features and experimental data will be presented.