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Antimony deposit exploration of antimony by pXRF measurements: example from the Vendean Antimony District (France)

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Competitiveness of mineral exploration for companies is based on reducing costs and capital intensity, improving dynamics and shortening delays between target testing and feasibility analysis. As the use of in situ analyses increases, pXRF (portable X-ray fluorescence) represents a good perspective for a fast and reliable low-footprint exploration approach. This study was carried out as part of the European EIT Raw Materials project UpDeep, which aimed at the demonstration of the applicability of modern geochemical methods for the discovery of new critical metals ore deposits.

We revisited a historic Vendean Sb district, located in western France and southeast of Brittany. First mining activities on antimony ore deposits took place during the 18th century at La Ramée, followed at the beginning of the 19th century, by the discovery of a rich vein at Rochetrejoux, which led to new activities until 1925. The French Geological Survey (BRGM) conducted large-scale survey during the 1970-1980s by stream-sediment followed by soil sampling focusing on sediment anomalies, which led to discovery of around 20 new prospects distributed on a 50x20 km area, in particular at Les Brouzils, La Télachère and La Copechagnière. Mining operations started again until the mid-1990s at Les Brouzils mine. The area is characterized by extensive agricultural practices.

The geological framework of the area is Variscan metamorphic rocks (gneiss and amphibolites) and slightly metamorphised sedimentary rocks, locally crosscut by dolerite dykes. Variscan thrust and shear-zones generated a network of conjugated tension fractures, controlling Sb mineralisations emplacement. The Les Brouzils ore deposits consists of a principal lode system dipping at 70° and extending over at least 800 m horizontally and recognized up to 100 m vertically. The principal characteristic of this ore deposit is the presence of large blades of stibnite. Berthierite, pyrite and arsenopyrite complete the paragenesis. In the La Télachère prospects, trenches and drill holes on the two principal anomalies determined the presence of a quartz lode system with associated stibnite. Paragenesis comprises stibnite, arsenopyrite, galena, sphalerite, berthierite, chalcopyrite, tetrahedrite, pyrrhotite and gold in a quartz gangue. At La Copechanière, known deposits correspond to subvertical quartz NW-SE veins with stibnite, with thickness of 0.2 – 0.3 m. All the area is partially covered by plateaux silts and gravels of mixed allochtonous (eolian)

and autochtonous origin. Thickness of the plateau loess can be comprised in the range 0.5 – 2 m.

For this study, we performed shallow-soil sampling (Ah and B horizons) along profiles across known veins to capture the endogenic geochemical anomaly signals. Despite an expected bias with laboratory analyses, pXRF measurements effectively located the Sb veins, with Sb and associated pathfinder elements (As, Mn) patterns, especially when using the pXRF multi-element capabilities enhanced by compositional data processing methods. Similar geochemical patterns obtained for both studied horizons suggest that application of on-site approach to humic horizon can increase efficiency of the survey and decrease its impacts.