GEOCHEMICAL EXPLORATION FOR TIN DEPOSITS: APPLICATION OF CONVENTIONAL AND NOVEL TECHNIQUES IN CORNWALL, ENGLAND

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Introduction

Tin exploration has been in the doldrums since the price crash of 1985. However, the recent price change and projected supply deficit have resulted in the re-examination of old targets and search for new areas. This contribution details geochemical methods used in Europe with emphasis on those current in SW England where Treliver Minerals is conducting exploration. Geochemistry has formed an important part of the programme as geophysics has proven ineffective and exposure is very poor.

Methodology

Regional Exploration and Area Selection

Area selection is much aided by the availability of good regional geochemical (and geophysical) data. In Cornwall and Devon this was largely based around the Wolfson Atlas of England and Wales and subsequent follow-up as well as proprietary stream sediment data. The recent release of 3720 stream sediment and 1154 wide spaced soil geochemical data from the Tellus SW project of the British Geological Survey and NERC (TellusSW 2015) have added much and brought SW England up to the standard of other Variscan tin bearing areas e.g. Spain (Locutura et al. 2012).

Detailed Exploration and Target Selection

The main geochemical technique has been soil sampling, either near surface or in contaminated areas, at depth. This was proven effective by Billiton during the 1980s (Moon 2010). The challenge of the 2010s is to reduce costs and turnaround, if possible, by using portable XRF (pXRF) analysis. This technique has also been used on a routine basis by Treliver Minerals in deep sampling and initial scanning of drill core for assay during geological logging.

Results

Regional Exploration and Area Selection

Stream sediment data from Tellus SW are available for 48 elements by XRF analysis including some such as W, Ta, Nb for which overview data have been distinctly lacking. Comparison of the Wolfson Atlas data with TellusSW (Fig.1) shows similar patterns with obvious control of Sn and W mineralisation by granites. Data for Ta and Nb indicate association of higher concentrations with topaz and lithium granites, which have low Th/K ratios on airborne radiometrics and some of which host commercial kaolinite deposits.

More detailed stream sediment sampling has also been undertaken using a combination of aqua regia ICP-MS and pXRF (for total Sn) to determine local sources.

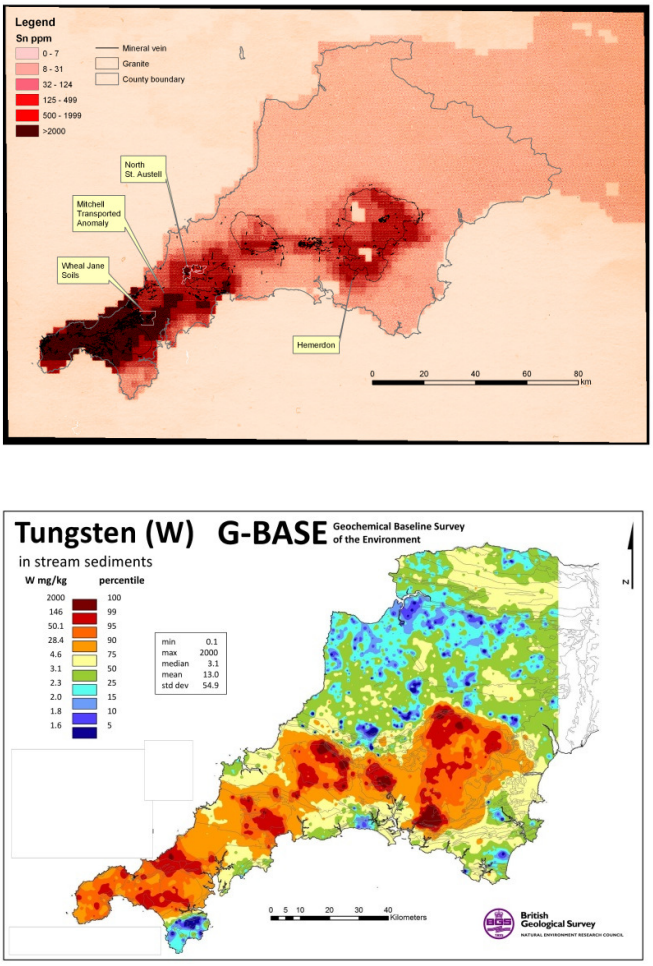

Figure 1. Regional Stream Sediment Sn and W. Top: Wolfson Atlas after Webb et al. 1978; Bottom: BGS Gbase from Tellus SW (2015).

Detailed Exploration and Target Selection

As the utility and most cost effective method of using pXRF was not known, an 400 m long orientation study across the main sulphide-poor Treliver Sn soil anomaly was undertaken in 2013 (north St. Austell area in Fig.1). In-situ measurements at shallow (~15 cm) and deep (~50 cm) depths were made and compared with pXRF measurements on dried, disaggregated samples which were also determined by fusion ICP-MS (Fig. 2). Although patterns are very similar in all depths and methods, it was decided that pXRF on dried, disaggregated samples was most effective as sample analysis could be undertaken at leisure in a field base and archived for any later analysis. The effective detection limit of Sn was ~100 ppm, which was satisfactory, and other elements have effectively been determined including W (using an Olympus instrument).

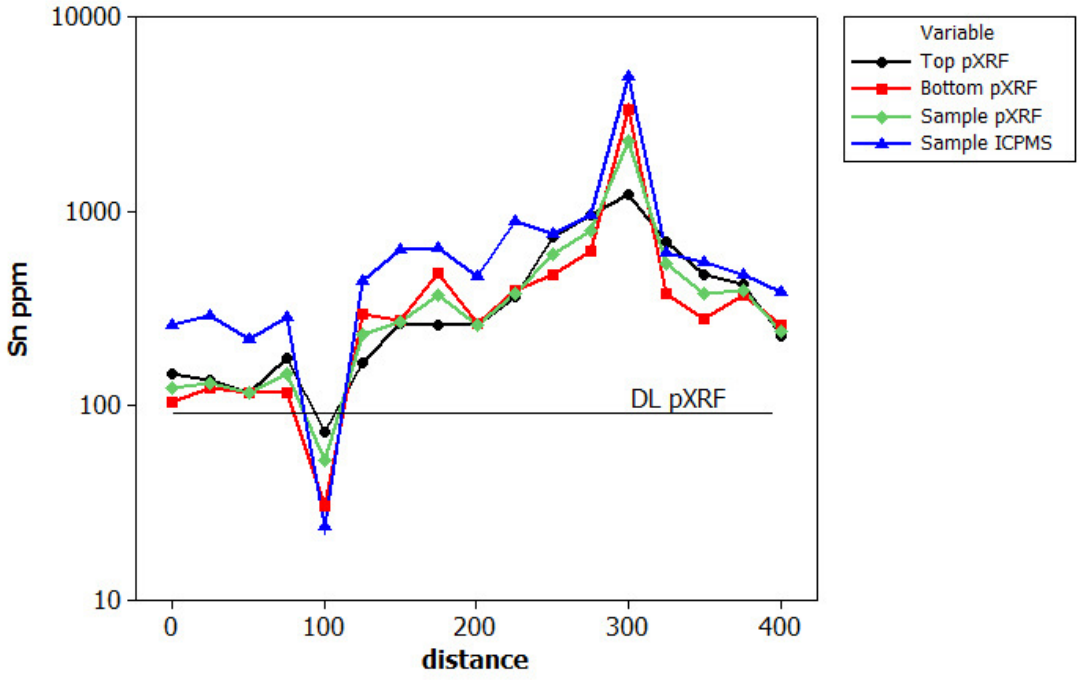

Figure 2. Comparison of in-situ sampling pXRF (top and bottom) with collected sample (Fusion ICP-MS) and pXRF. Line 191900E.

Discussion

Regional stream sediments and soils define the regional setting of mineralisation as well as contaminated areas. When coupled with airborne radiometric data these media enable styles of mineralisation, as well as differing phases of potential source granites, to be distinguished.

The pXRF shallow soil sampling method has been successfully and cost-effectively employed using graduate geologists on significant areas of interest to generate drill tagets. However in areas of contamination, deep sampling using pXRF is required. Portable XRF is also crucial in core scanning and logging.

Conclusions

Conventional stream sediment and soil sampling techniques have been adapted using pXRF to reduce costs and turnaround. These have aided area and target selection.

Acknowledgements

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