TellusSW: towards remapping granites, elvans and lamprophyres

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The TellusSW survey of 2013-4 consisted of airborne magnetic, radiometric, LiDAR as well as stream sediment and soil geochemistry. These data allow remapping of granites and temporally related rhyolite-porphyry (elvan) and lamprophyre dykes. Radiometric data are particularly useful in providing an overview of units within individual granite plutons, notably by using eTh/eK ratios as Th is mainly immobile. When coupled with Nb, Ta and Zr stream sediment geochemistry these data allow interpretation of different granite units, supporting previous models of older, simpler, and younger, composite, plutons. Lamprophyre dykes can also be detected using a combination of eTh and LiDAR and elvans using LiDAR and eK.

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Introduction

Geological mapping in Devon and Cornwall and subsequent interpretation is often difficult due to lack of outcrop. Airborne geophysical and regional geochemical methods can aid mapping by sampling areas that are difficult of access or poorly exposed. Airborne radiometric and magnetic surveys were first flown in Devon and Cornwall in 1956 and 1957-9, respectively. Regional geochemical surveys were also conducted in the 1960s, notably 1969 (Webb *et al.*, 1978). Many of these findings were incorporated into mapping of the 1970s onwards. However advances in geophysical data capture and positioning accuracy have led to a series of higher resolution public domain surveys in the UK: in the English Midlands, Isle of Wight and Northern Ireland, the latter combined with regional geochemistry and known as the Tellus project. The TellusSW survey was funded by NERC and covered Devon and Cornwall during 2013-4 on similar lines to that in Northern Ireland (TellusSW, 2015).

This contribution assesses the application of the TellusSW survey data to mapping the intrusive phases associated with the post-Variscan granite magmatism: the granites themselves, the associated quartz-porphyry (elvan) dykes as well as the temporally associated lamprophyre dykes. The emphasis is on the techniques used, particularly for the radiometric data.

TellusSW surveys

The TellusSW surveys consist of a number of geophysical and geochemical surveys (TellusSW, 2015). The data available to date (late 2015), and discussed to varying degrees in this contribution, are airborne magnetic and radiometric surveys, LiDAR as well as geochemistry.

The detailed parameters of the airborne radiometric and magnetic survey are discussed in Beamish and White (2014). These data were collected on 200-m flight lines with tie lines at 2000-m. Flying height was variable, typically 80 m over rural areas and 250 m over urban. Radiometric data are available online and were downloaded as total count (cps), eK % (^{40}K measured), eU ppm (^{214}Bi) and eTh (^{208}Tl) at 60-m intervals along lines from the TellusSW website (2015). As raw individual element channels contain 0 (zero) values which render ratioing between channels impossible, these zero values were replaced by 0.01 before gridding as 40-m cells using a square bi-cubic spline in ArcGIS 10.1, after masking off lines flown over the sea. Ratioing minimises the impact of variance due to correction of changes in flying height and rock exposure which are evident in individual channel and total count maps (Dentith and Mudge, 2014). These grids were combined into single images were used for interpretation, as were original radiometric data points.

LIDAR: LiDAR data were acquired by BAS in July-August 2013 with a 1-m ground resolution and height accuracy of <0.25 m. Data are available as DTM (Digital Terrain Models) and Digital Surface Models which represent the ground surface (with vegetation and objects above it removed) and the ground surface together with all objects above it, respectively (Ferraccioli *et al.*, 2014). These data were downloaded and hill shaded images generated in ArcGIS 10.2. combined into single images were used for interpretation, as were original radiometric data points.

Geochemistry: Stream sediment and soil geochemistry were obtained using samples collected and analysed using standard GBase protocols of BGS (Johnson, 2005). Samples were analysed using X-ray fluorescence on pressed pellets. Soil data were used as point locations but stream sediment data were plotted as drainage catchments derived from point data kindly provided by the British Geological Survey (BGS). These catchment plots are much more indicative of the overburden sources of the sediments than plotting as points or contouring as used in the TellusSW website (Moon, 1999). Catchments