Using radioelement distributions to classify a composite granite batholith in the South West England Orefield

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The South West England Orefield is well-known for its polymetallic magmatic-hydrothermal mineralisation associated with the composite Cornubian granite batholith. The mineralisation contains elevated concentrations of a range of metals (e.g. W, Sb, Bi, As, Be, Cd, Ga, Ge, In, Li, Nb, Ta) used in high-technology and clean energy applications and for which security of supply concerns exist [1,2,3]. Exploration for these elements requires improved understanding of the spatial distribution of granite types and their relationship to the different mineralisation styles and parageneses. Previous granite classifications defined granite types based on mineralogical and/or textural observations from field sampling [e.g. 4]. However, these divisions over simplify mineralogical variation (e.g. micas), and the sample density is inadequate to reflect the heterogeneity of the batholith. Classifications based on whole-rock geochemistry, provide a more objective classification method [e.g. 5] and can guide mineral exploration, particularly in poorly exposed areas.

The Tellus South West Survey collected airborne radiometric data over the surface extent of the granites. This continuous sample set has allowed us to produce a 'geochemical' classification of the granites using potassium, thorium and uranium concentrations calculated from gamma-ray emissions. The gridded data were manipulated as ratios and relative abundances [6]. Principal Component Analysis was used to reduce noise from spurious pixels associated with high water content in peat. These spurious pixels were subsequently removed using a 'supervised' classification (Minimum-Distance). The data were standardised to zero mean and equal variance.

An 'unsupervised' classification (K-means) was used to automatically and objectively classify the remaining data in 9-dimensional space (based on the input variables). Six classes were found to be optimum for delineating geochemical variations within the granites. Here, we present this new classification of the granites using continuous data covering the whole batholith. We also consider how to incorporate ground-based geochemical and satellite multispectral (Landsat) data into the classification.

References

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