ZIRCONIUM AND THE ZIRCONS

BACKGROUND

The Federal Republic of Nigeria is Africa’s most populous nation and the economy has been overly dependent on revenue from the great oil reserves. In order to diversify its economy with the development of the solid minerals sector, the government has received support from the World Bank through the Nigerian Geoscience Association to implement the Sustainable Management of the Mineral Resources Project. Part of this project has been to initiate a national geochemical mapping programme through the Nigerian Geological Survey Agency (NGSA). This has been achieved by the Nigerian Geochemical Mapping Technical Assistance Project (NGMTAP) (2008 – 2011) led by the British Geological Survey (BGS) and including several geochemists from the Finnish Geological Survey (GTK). The principal objective of the BGS project was to train and equip Nigerian geoscientists with skills for regional geochemical mapping and this was achieved by the sampling of two pilot areas in Nigeria in 2009.

METHODS

Sample collection: Sediment was collected from the active drainage channels of 1st or 2nd order streams. The sediment was wet sieved through a 2 mm nylon screen and then a 150 µm nylon sieve and stored in Kraft™ paper bags to assist sample drying. Sampling density varied according to targeting of economic and potential mineralisation, with a minimum of 20–30 kg wet weight of sediments per km², and at least 1 sample per 200 km² in the study areas. Unlike many other elements, there was no clear correlation with the underlying geology and an aeolian potential of the cell: from 1 sample per 20 km² in the Minna Cell to 1 sample per 30 km² in the SW Cell. A panned concentrate was also collected from the <150 µm fraction.

Sample preparation/analysis: The initial sample preparation was done at the National Geoscience Research Laboratory (NGRL) in Kaduna, Nigeria. After air-drying samples were split to give an archive and analytical sample. Chemical analyses were done at the BGS laboratories (UK) on samples that had been processed in weight and minerals separated. A minimum of 57 elements were done by ICP-MS after a sodium peroxide fusion followed by HF/HCIO₄ extraction. Gold, Pd and Pt were determined using fire assay. Primary and secondary reference materials in addition to field duplicates and laboratory replicates were used to give quality control information.

Data analysis/mapping: A MS Access relational database was created for all the field and analytical data. Statistical analysis, interpretation and plots were done using open source R code. The principal output was a series of 1,500 000 classified symbol maps for each element plotted on a simplified geological base. ESRI ArcGIS v9.2 was used to generate these maps. The statistical analyses and plots, such as the probability plot and histogram shown in the map legend, were done using open source R codes.

RESULTS

The results of this work are reported in Lapworth et al (2012) and can be summarised:

- Multivariate statistical techniques (e.g. robust principal factor analysis) explored the results to understand the underlying processes controlling spatial geochemical variability. Major geochemical variations are shown to be controlled by source geology and provenance, as well as climatic/topographic processes, such as elements from drainage sediments during dry periods. More subtle variations are a result of land use and contamination from anthropogenic activity.

- Because of this close relationship with the geology for many elements, the geochemical maps can be used in geological mapping.

- The work has identified placer deposit targets of potential economic importance including Au, rare earth elements, Ta, Nb, U and Pt;

- The geochemical mapping provides important new background/baseline geochemical values for common geological terrains in Nigeria which can be extended into other parts of West Africa; and

- Very high levels of Zr were recorded in the fine stream sediment which has implications for the sample preparation and analysis. The source of the chemical has been the subject of further investigations (see below left).

OUTCOMES

The Nigerian Geological Survey Agency now has the equipment and the skills to complete a national geochemical mapping programme producing high quality and reliable data for exploration and other sectors. The project gave practical experience to more than 100 Nigerian geoscientists who actively participated in the project; and

- the regional geochemical data, along with other World Bank funded initiatives such as comprehensive airborne geophysics coverage, means Nigeria is well-placed to attract inward investment to its minerals sector to unlock its undoubted minerals potential.

MAIN PUBLICATIONS


KEYWORDS

Regional Geochemical Mapping in Nigeria: results from the collaborative project between the Nigerian Geological Survey Agency and the British Geological Survey

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