GSWA'S REGIONAL REGOLITH GEOCHEMISTRY PROGRAM: AN OVERVIEW

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Introduction

The Geological Survey of Western Australia's regolith geochemistry program (1994 – 2001) provided baseline information on the distribution and composition of regolith for the mineral exploration industry. At its inception, the program focussed on parts of the Eastern Goldfields, but most projects were carried out in 'greenfields' areas, particular the Capricorn Orogen. Each of the twenty projects involved systematic sampling of regolith on a nominal 4 x 4 km grid over 1:250 000 map sheet areas, equating to approximately 1000 sites per sheet. Each sample was analysed for more than 50 analytes using a 'total' analytical approach, with these data presented as both a digital dataset, and as a series of element concentration maps shown in relation to regional geology. At each sample site, information was recorded about regolith, landforms, and bedrock geology, which was used to ground-truth regolith-landform maps, compiled from remotely-sensed data such as aerial photographs, Landsat and radiometric imagery.

Explanatory notes accompanying each set of maps contain a summary of geology and mineralization, the approach to regolith sampling, geochemical analysis, and regolith map compilation, and discussions dealing with the relationship of regolith chemistry to different regolith-landform types and regional geology. A compilation of all open file exploration company activity dealing with surface geochemistry, extracted from GSWA's WAMEX database, is summarised in a spreadsheet and a related activities map.

Regolith Mapping

The approach to regolith classification is based on the landform position and composition of regolith (Hocking et al., 2001). Apart from showing the distribution of various regolith types, regolith maps can also show the genetic relationship between different regolith types. For example, regolith over part of the Murchison Granite-Greenstone Terrane on the eastern part of the Byro 1:250 000 map sheet (Morris and Verren, 2001) comprises granitic rubble and areas of silicified granitic rock on or near outcrop. Adjacent and downslope is proximal colluvium with abundant granitic detritus, flanked further downslope by lower-gradient deposits, which are better sorted, finer grained and lacking lithic fragments. In areas of minimal slope, two types of alluvium is found in drainage channels; older deposits are consolidated and locally incised, whereas younger deposits are unconsolidated, and found in active drainage channels.

Regolith sampling and geochemistry

For GSWA's regolith geochemistry program, the preferred sample medium is stream sediment, but where streams are poorly developed, colluvium or sheetwash, sandplain, or lake sediment has been sampled. At each sample site, an analytical and archive sample of approximately 2 kg and 4 kg respectively of the <6 mm material was collected. The < 2 mm and + 0.45 mm fraction of the analytical sample was subsequently milled and analysed. This size fraction was chosen to minimise the nugget effect of coarse-grained fragments, and the dilution effect of aeolian material. Data recorded at each site includes the GPS location, site and sample number, the position of the sample in an idealised landform profile, an estimate of the regolith clast, matrix, and cement proportions and type, and the presence of secondary units (e.g. silcrete, calcrete) and bedrock nearby.

Analyses were carried out by commercial laboratories. To monitor any inter-laboratory variation, samples were analysed using the same analytical conditions where possible, and a series of in-house standards were used throughout the program. To achieve suitably low detection levels at the lowest price, most analyses were carried out using inductively-coupled plasma (ICP) spectrometry for a total of more than 50 analytes. Gold and platinum-group elements (PGEs) were analysed by fire assay preconcentration and an ICP or atomic absorption spectrometry (AAS) finish.

In addition to providing the analytical data as a digital data file, a series of spot concentration maps against bedrock geology were produced. The size of the spot is proportional to the concentration of the element, apart from statistically anomalous concentrations, which are shown as a star. In some cases, certain combinations of elements were used to construct an index to highlight the potential for certain types of mineralization, following the approach of Smith and Perdrix (1983) and Smith et al. (1989) for the detection of chalcophile element corridors in parts of the Yilgarn Craton.

Statistical analysis of regolith geochemical data

Regolith chemistry can be statistically examined to determine the relationships of different regolith types, and the relationship of regolith and underlying bedrock. This approach has been used to identify a residual or transported origin for two different types of sandplain on the Byro 1:250 000 map sheet, and to track the relative proportions of mafic and felsic rocks from two different Archaean terranes on the same map sheet (Morris and Verren, 2001). In another application, Morris et al. (2000) used clustering to estimate the relative contributions of residual and transported regolith to sandplain deposits in the Fraser Range area.

Integration of Regolith Geochemistry with Other Datasets

Since 1997, a measurement of the Earth's gravitational field was made at each regolith sampling site during GSWA's 4 x 4 km spaced regolith geochemistry program, greatly improving the quality of gravity data in most areas, where regional coverage was typically at 11 x 11 km grid spacing. These data have been combined with aeromagnetic data, regolith and bedrock mapping, and regolith chemistry to identify different styles of Proterozoic mineralization in the eastern part of the Capricorn Orogen (Morris et al., 2003). Sanders et al. (1997) combined Landsat imagery, airborne radiometric data and regolith chemistry for the Mt Phillips map sheet, noting a high correlation between potassic granitic rocks and K_2O in regolith, and a coincidence of enhanced radiometric uranium with greater U concentrations in areas of silicified regolith.

Conclusions

The GSWA's regolith geochemistry datasets provide comprehensive information on the distribution and composition of regolith in Western Australia, and an up to date summary of exploration activity, geology, and mineralization. By sampling at a uniform sample density over areas unconstrained by bedrock geology or structure, any bias in sampling is minimised. The regional coverage and sample density allows integration of regolith chemistry and mapping with other similar-scale datasets such as gravity, aeromagnetics, and bedrock mapping to produce derivative studies highlighting areas of potential mineralization.

Regolith geochemical data are available from GSWA as digital GIS datasets for each 1:250 000 sheet covered by the program, at $100 per map sheet.

References

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