ROYALTIES FOR REGIONS
EXPLORATION INCENTIVE SCHEME

Fine-fraction gold chemistry of regolith from the East Wongatha area, eastern Yilgarn Craton

by

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Regional-scale regolith geochemical data can be used to identify both bedrock-hosted mineralization and the extent of different bedrock lithologies, if regolith and bedrock are genetically linked. In areas of thick and transported cover, this link can be missing or overprinted, yet in parts of Chile, the USA, and Canada regolith geochemistry has been successfully used to detect buried mineralization through tens of metres of transported cover, usually by partial digestion of the fine fraction of each sample. This suggests that, in some cases, the geochemical signature of buried mineralization has successfully migrated to the surface and is preserved in the overlying transported cover. Partial digestion and analysis of the silt and clay fraction of regolith from the East Wongatha area (a part of the eastern Yilgarn Craton dominated by thick cover) shows that the extent of bedrock and areas of potential mineralization can be detected through thick and exotic cover, supporting the viability of using regolith geochemistry to detect mineralization even in areas of transported cover.

Regional setting

The East Wongatha project area, some 250 km east of Kalgoorlie, covers an area of approximately 13 000 km^2. The project spans the eastern part of the Yilgarn Craton and parts of the Gunbarrel Basin, Albany–Fraser Orogen, and Eucla Basin (Fig. 1). The area is characterized by about 3% outcrop and extensive sandplain cover (approximately 70%), which has a strong eolian component (McGuinness, 2010). Open-file drilling data indicate that in the western part of the project area, post-Archean cover can be up to 400 m thick, with a regolith thickness of more than 55 m in some areas.

Regolith sampling and analysis

Regolith from 835 sites was collected from a depth of approximately 80 cm using a power auger. The majority of regolith contains a high proportion of windblown quartz sand, which could act as a dilutant to both elements of economic interest and pathfinder elements. In order to minimize this quartz-dominated eolian component, the <50 µm (silt and clay) fraction was dry sieved from each sample and digested with aqua regia, a 3:1 mixture of hydrochloric and nitric acids. This is a partial digest that preferentially attacks sulfides, oxides, and carbonates but is largely unreactive to silicates (Chao, 1984). The digest aims to liberate the exogenic component of the sample (i.e. material loosely bonded or bound to the sample medium) while minimizing the input of the endogenic component — the sample medium itself, which may be primarily transported (Cameron et al., 2004).

The fine-fraction chemistry illustrates the effectiveness of a partial-digestion approach to detecting buried gold mineralization.

Fine-fraction gold chemistry

Aqua regia digestion and inductively-coupled plasma mass spectrometric (ICP-MS) analysis can provide a lower limit of detection for Au of one part per billion (1 ppb). Samples have an Au concentration range of <1 ppb to 29 ppb, with 36% of samples returning concentrations of less than the lower limit of detection (LLD). Statistical analysis of Au data where censored values are replaced by half the LLD show that outlier and extreme (i.e. anomalous, >9 ppb) values are largely found in the western part of the project area over areas of greenstone indicated by regional geophysical data and minimal outcrop. However, samples with anomalous gold concentrations are also found on strike extensions and adjacent to areas of greenstone, and extending from greenstones underlying parts of the Gunbarrel Basin. Other anomalous samples are found close to the Yilgarn Craton – Gunbarrel Basin margin in the south of the project area, and over isolated areas of more-magnetized bedrock associated with the Albany–Fraser Orogen.

The strong spatial association of anomalous Au in fine-fraction regolith and the geophysical expression of greenstones suggests that anomalous Au in regolith is sourced from greenstones. Open-file company data show that cover sequences in the areas of anomalous fine-fraction regolith Au over Yilgarn Craton greenstones are between 60 m and 80 m thick. Data for cover thickness (i.e. combined regolith and post-Archean sedimentary rock) in the Gunbarrel Basin southeast of the Stella Range greenstone belt indicate thicknesses of up to to 120 m (averaging 55 m) near samples with anomalous Au concentrations.

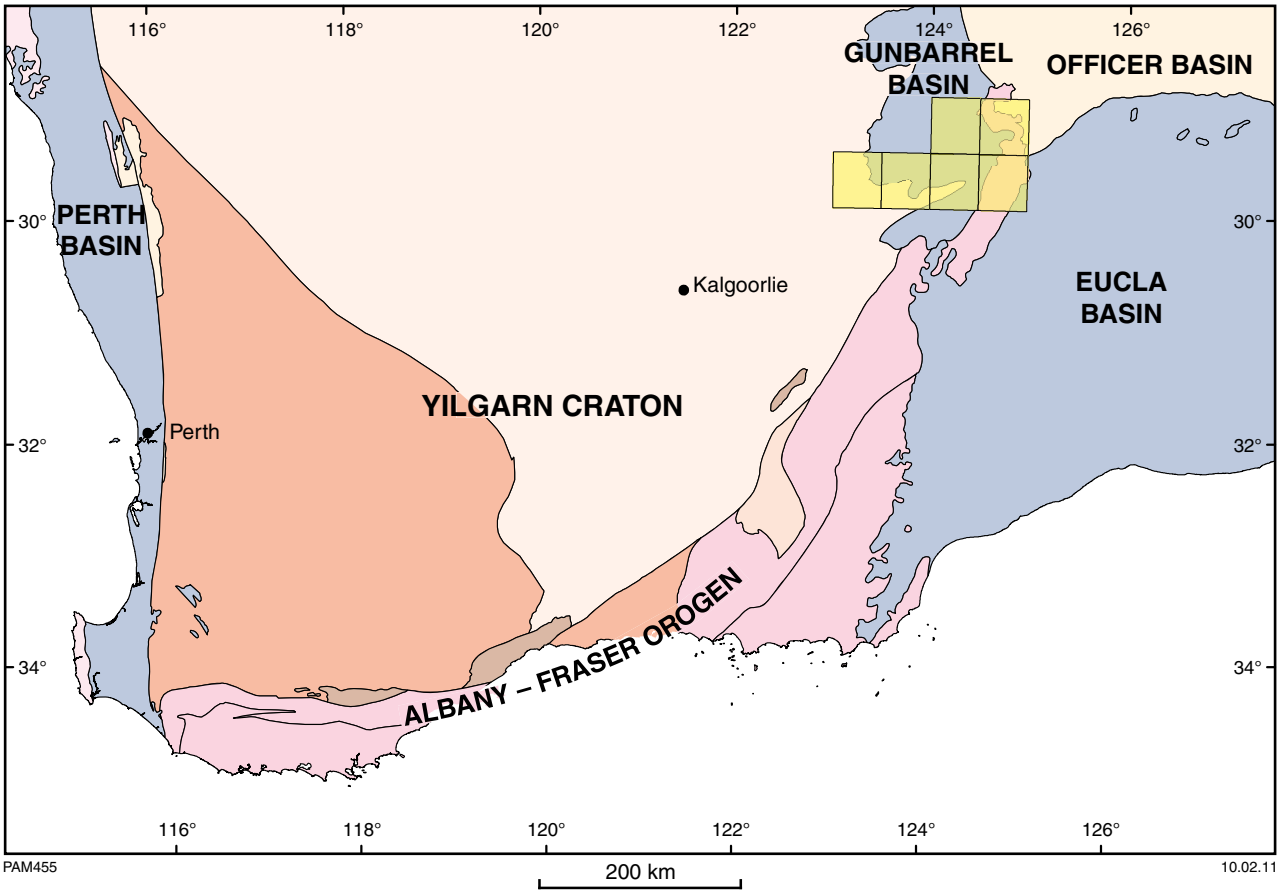

Figure 1. Location of the East Wongatha project area

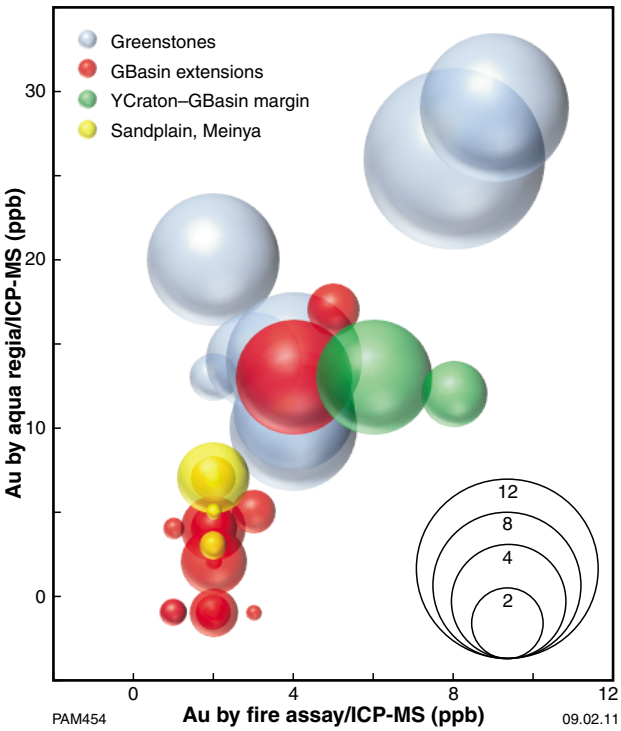

Figure 2. Scatterplot showing Au by fire assay/ICP-MS on the <2 - >0.475 mm fraction versus Au by aqua regia/ICP-MS on the <50 µm fraction (both in ppb), with symbols scaled according to gold concentration following deionized water digestion of the <50 µm fraction followed by ICP-MS analysis. Greenstones = samples on or close to Yilgarn Craton greenstones; GBasin extensions = samples over NW–SE magnetized rocks extending from greenstones under the Gunbarrel Basin; YCraton —GBasin margin = samples near the Yilgarn Craton — Gunbarrel Basin margin; Sandplain, Meinya = samples from sandplain-dominated regolith on Meinya 1:100 000 sheet

Fifty samples with varying Au concentrations have been further analysed by fire assay–ICP-MS (<2 mm – >0.475 mm fraction) and deionized water digestion–ICP-MS (<50 µm fraction). The plot of fire assay Au versus aqua regia Au (Fig. 2) has symbols scaled according to Au following deionized water–ICP-MS analysis. The overall positive correlation is accentuated by a number of samples over Yilgarn Craton greenstones and parts of the Gunbarrel Basin having elevated Au concentrations when digested by deionized water and subsequently analysed. These data show that gold is present in both the coarse- and fine-grained fraction of regolith samples, and can be released from the latter by even benign digests such as deionized water as well as more aggressive digests such as aqua regia. This indicates that some gold is present as extremely weakly bonded or bound micron-scale particles (c.f. Hough et al., 2008). If this is the case, then the strong spatial association of anomalous gold and greenstones implies that some gold has migrated vertically, possibly as small particles, through processes such as seismic pumping (Cameron et al., 2004), soil gas movement (Wang et al., 2007), redox chimneys (Cameron et al., 2004), along fractures or faults or in solution, and has then been deposited close to the surface (e.g. Lintern et al., 2009). These results endorse the potential for using fine-fraction chemistry of regolith to detect buried mineralization through thick transported cover.

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