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Visualising Landscape Evolution with SRTM Data: Regional Landform Mapping in the Tanami

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Good landform visualisation is an essential first step in understanding landscape evolution, particularly in a continent that is so flat. Digital topographic data from the Shuttle Radar Topography Mission (SRTM), flown in 2000, covers 80% of the Earth's land surface with high quality but potentially undervalued elevation data, mostly at 3-second (~90-metre) resolution. The uniform quality of these data means that effective landform comparisons can be made not only across large regions in WA but also between different continents. However, this potential is only reached if visualisation techniques effectively discriminate different landforms at a range of scales. Multi-scale surface characterisation is a new approach to manipulating and visualising SRTM data that has revealed a complex landscape wherever it has been applied.

LandSerf software (Jo Wood, 1996) uses a multi-scale quadratic parameterisation algorithm that is particularly effective at extracting complex landform patterns in areas of low relief. Applied to the Tanami region this visualisation method has uncovered a hitherto unknown or poorly understood pattern of large-scale dissected pediplains, sheet-flood fans and relicts of a much older, possibly glaciated landscape. Relatively small-scale landforms, including the Wolfe Creek Meteorite Crater, are still well represented, further enhancing the use of the images in regional regolith-landform mapping.

Effective visualisation of the landscape is essential for understanding geochemical and hydrologic vectors, and therefore of direct benefit in planning and implementing regional exploration programs. Images created by the new method of SRTM visualisation are now a component in some digital exploration packages produced by GSWA, making them increasingly accessible to the exploration industry. The technique has also been applied to assist exploration in South America and Africa, and also in planning an Orangutan Sanctuary in Sumatra.

Understanding landscape evolution, both within and between widely separated regions, will be significantly enhanced using GSWA's new SRTM landform images.

An Alternative Model for the Genesis of Gold-Arsenic Deposits Hosted in Black Shale and Turbidite Successions

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Organic-rich mudstones or shales, within thick packages of calcareous or siliciclastic turbidites, have long been recognised as important host rocks for major gold deposits (e.g. Victorian Goldfield, Carlin District, Lena Gold Province, Otago Schist belt). Many of the deposits in these districts are referred to as orogenic gold deposits, emphasising the tectonic and metamorphic processes involved in the concentration of gold (Groves et al., 2003; Goldfarb et al., 2005). The current genetic models propose that the organic-rich sedimentary host rocks are the trap-rock for gold precipitated during deformation-related fluid flow, with the gold being transported by deep-sourced fluids of mantle or lower crustal origin, or in some cases from felsic magmas. Recent research at CODES (Wood and Large, 2007; Large et al., 2007) suggests the possibility that organic-rich black shales are potential source rocks for gold, arsenic and vanadium, and that the gold was originally trapped on seafloor organic material by chemical process during sedimentation and concentrated in arsenian pyrite during diagenesis. Later deformation leads to gold concentration in structural sites.

Detection of K-alteration in the Cloncurry District, NW Queensland, using Hyperspectral Mineral Maps

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Potassic alteration in the Cloncurry District is spatially and genetically related to IOCG deposits in the eastern Mount Isa Inlier, NW Queensland.

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Hyperspectral images, released by the collaborative Queensland NGMM project between GSQ and CSIRO, were validated as new tool for the detection of mineralisation related hydrothermal footprints.

At the IOCG deposit of Ernest Henry geochemically discrete alteration shells correspond to distinct mineral distributions. Regional sodic-calcic alteration was overprinted by potassic alteration with coeval biotite- and magnetite-veining, which was in turn altered by Cu-Au mineralisation and K-feldspar-alteration. The various envelopes of potassic alteration are interpreted as a general indicator for IOCGs in the Mount Isa Inlier (Mark et al., 2006, Min. Dep., v. 40, 769 - 801).

A combination of specific mineral maps, derived from hyperspectral imaging in the VNIR to SWIR-range, is used to detect potassic alteration in the Cloncurry District. "MgOH composition-" and "Fe^{2+} associated with MgOH-maps" enable us to separate amphibolite facies metasediments from hydrothermal breccias and various mafic units in the field area, based on their distinct amphibole and chlorite chemistry. Within some of the mafic intrusives these maps exhibit a change in the chemistry of the MgOH-bearing silicates, characterised by an increase of the Mg-content from core to rim. A change of the whole-rock chemistry is also characterised by an increasing K-feldspar-content towards the rim. Although K-feldspar can not be detected in the VNIR- to SWIR-range, weathering products of K-feldspar like muscovite and Illite are picked up by the "White mica abundance-" and "White mica composition-maps". The remotes sensing results are confirmed by PIMA analyses and will be compared with XRD-results.

Our study shows that hyperspectral mineral maps successfully identify hydrothermal alteration patterns and can be used as a powerful tool for exploration of IOCGs in the Mount Isa Inlier.

Redox-controlled Supergene Gold Enrichment within the Sunrise Dam Palaeochannel Deposit, Laverton, Western Australia

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Sunrise Dam is a world-class gold deposit located on the margin of a playa, Lake Carey, near Laverton, in the Eastern Goldfields Province of Western Australia. Coarse-grained, high-grade primary mineralization within shear-controlled quartz-ankerite-pyrite veins and ankerite-silica-sericite and pyrite alteration zones in Archaean sedimentary (BIF facies), volcaniclastic and volcanic rocks, has been exposed to weathering and buried by up to 80 m of semi-reduced and hypersaline-watersaturated sedimentary regolith cover, including a multiphase Eocene to Miocene palaeodrainage system. Three gold enrichment types are identified associated with active iron and sulphur redox fronts within the regolith and demonstrate that gold enrichment is strongly redox-controlled.

Approximately 450,000 ozs of gold were recovered from high-grade bonanza deposits, in excess of 1000g/t, within quartz-rich sand, gravels and conglomerates at the base of the palaeochannel. Some of this gold was detrital, preserved in oxidised sediment, but most occurred in partially reduced sediment characterised by distinctive yellow goethitic staining and showed evidence of *in situ* chemical reworking, such as highly irregular morphologies with branching protrusions, that extend along microfractures and partially wrapped matrix detrital grains, and high-fineness gold margins, inclusion-rich extremities, micron-sized octahedral and hexagonal crystal growths on their surfaces.

An upper, sub-horizontal gold enrichment zone at 18-25 m depth, extended laterally over a strike length of 700 m at a cut-off of 0.10 ppm Au, independent of sedimentary horizon and coincident with an upper iron redox front marked by strong yellow goethitic staining. Gold in high-grade portions, up to 20 g/t Au, was as high-fineness, fine-grained crystals and dendrites indicative of a multiphase chemogenic origin. Less extensive, subtle gold anomalous zones also occurred at 2-8 m and 12-15 m depth.

In addition to enrichment at the iron redox fronts, some of the supergene resource comprised low-fineness, micron-sized refractory gold grains encapsulated in alunite at grades of up to 5 g/t, within strongly reduced grey clay above a secondary sulphide zone characterised by supergene sulphides, mainly fine-grained framboidal pyrite and marcasite.

Recent advances in the application of hydrogeophysics and regolith geoscience for groundwater and salinity mapping and management

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Efforts to manage Australia's water resources more sustainably are hampered by inadequate knowledge of groundwater resources. In many aquifers, estimates of total resource and sustainable yields are often limited by a lack of geospatial and temporal hydrogeological data, and gaps in our understanding of key hydrogeological processes. More specifically, there are gaps in our understanding of surface-groundwater connectivity, inter-aquifer leakage, and water quality variations