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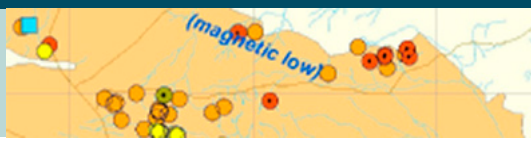
Tanami – North Australia Project wraps up

New datasets reveal geological evolution and mineral systems of North Australian Craton



David Huston

A six-year collaborative study has produced major changes in our understanding of the geological make-up and mineral potential of the North Australian Craton. Now available on CD-ROM from Geoscience Australia, this new window into the evolution and metallogenesis of this important region is the result of the Tanami – North Australia National Geoscience Accord Project involving Geoscience Australia, the Northern Territory Geological Survey (NTGS) and the Geological Survey of Western Australia (GSWA).

Extensive collaboration

The North Australia Project began in July 2000, when NTGS geoscientists briefed Geoscience Australia geoscientists on the geology of the Arunta region during a 10-day field trip. The NTGS provided in-depth knowledge of the geology of the area gained from regional and more detailed mapping, while Geoscience Australia added specialist knowledge in geochronology, geochemistry and metallogenesis. In 2004, the GSWA joined the project to map the western Tanami region, making the North Australia Project one of the first National Geoscience Accord projects to cross state boundaries.

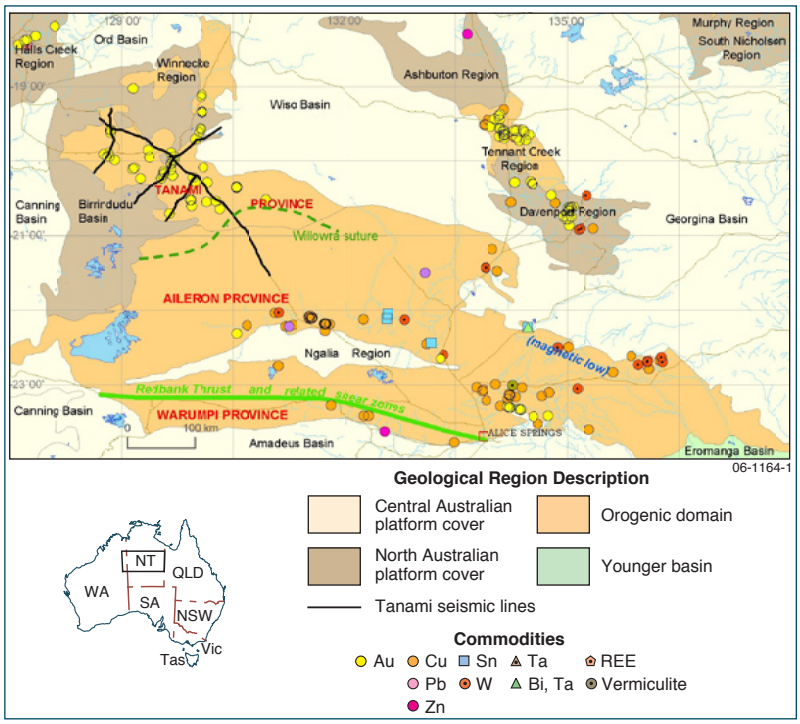


Figure 1. Map showing the North Australia-Tanami Project area.

For Geoscience Australia, a major focus in the project has been the collection of new geochronological data, including data to constrain the age and correlation of supracrustal volcanic and sedimentary units, felsic and mafic intrusive bodies, and mineral deposits. This program, which involved collaboration with the NTGS, the Australian National University and Curtin University, increased the geochronological database for the Arunta, Tanami and Tennant regions by over 300 dates. These regions now have well over 500 dates, making the North Australian Craton one of the best studied Proterozoic provinces in the world. These data will serve as a cornerstone for future synthesis studies and provide a basis for developing exploration models.

Another significant result was the correlation of the Lander 'package' of turbiditic sedimentary rocks with the Tanami Group, the major host for gold in the Tanami

gold province. The correlation suggests that potential for lode-gold mineralisation extends south into the poorly exposed western and northern Arunta. This potential has been confirmed by Tanami Gold's recent success at the Tekapo prospect, which returned an intersection of 16 metres grading 3.4 g/t Au.

"major conclusions of this study, include the identification of a major suture between the Tanami and Aileron provinces"

New models for Tanami gold

A second major focus of the project has been the refinement of geology, geochronology, geochemistry and controls on lode-gold mineralisation in the Tanami region. This program, which involved close collaboration with the NTGS and GSWA, extended regional geological mapping to include studies on the fluid history, geochemistry, structure and ore controls of lode-gold deposits. This has led to descriptive models for deposits in The Granites, Dead Bullock Soak and Tanami goldfields and holistic models of structural, stratigraphic and geochemical controls on gold mineralisation. The results have been published in *NTGS Report 17* and in an upcoming *Mineralium Deposita* special issue on the Tanami gold province.

Our geological, geochronological and geochemical studies of the Tanami region have been followed up by the acquisition of 720 kilometres of land seismic data (figure 1) to establish the architecture of this major Proterozoic gold province. Two major conclusions of this study, to be described in more detail in the next issue of *AusGeo News*, include the identification of a major suture between the Tanami and Aileron provinces and the recognition that mineral deposits in the region are associated with major crust penetrating shear zones and/or anticlinal stacks (figure 2). The suture, which corresponds spatially to the Willowra gravity ridge, has a classic crocodile form and juxtaposes Aileron province crust with a characteristic north-dipping structural grain against Tanami crust to the north and west. As rocks of the correlated Tanami–Lander package blanket this suture, collision of the Tanami and Aileron crust is interpreted to have happened prior to ~1840 Ma.

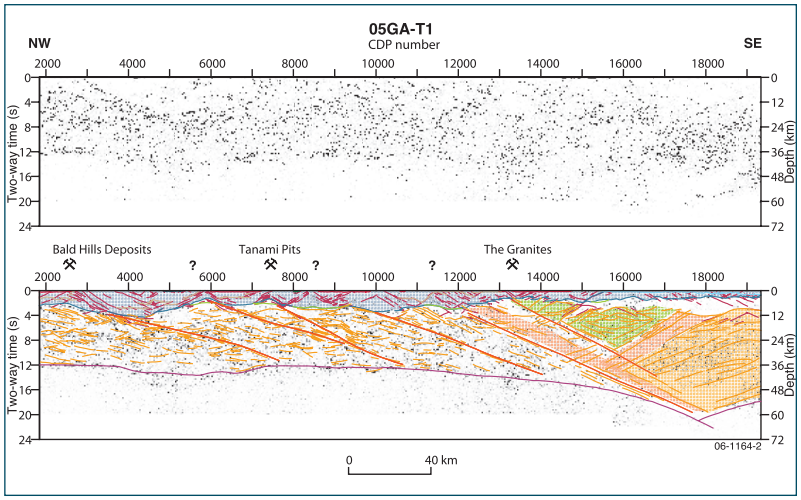


Figure 2. Seismic data and interpretation of line 05GA-T1, Tanami region, northwestern Australia.

Firmer dates for Tennant magmatism

Outside the Tanami region, the project undertook work in the Tennant and Arunta regions (figure 1). In the Tennant region, dating of felsic magmatic rocks, including granites and porphyries, has indicated that the Tennant magmatic event was restricted in time to between 1850 and 1845 Ma. This result, although consistent with previous results of Compston (1995), indicates a much tighter constraint on the age of granite emplacement.

Recalculation of Ar–Ar isotopic dating results for ore-related muscovite from Compston and McDougall (1994) to account for updates to standards and decay constants yielded ages between 1850 and 1845 Ma. This suggests that gold–copper–bismuth (Au–Cu–Bi) mineralisation at Tennant Creek coincided with felsic magmatism of the Tennant magmatic event (figure 3).

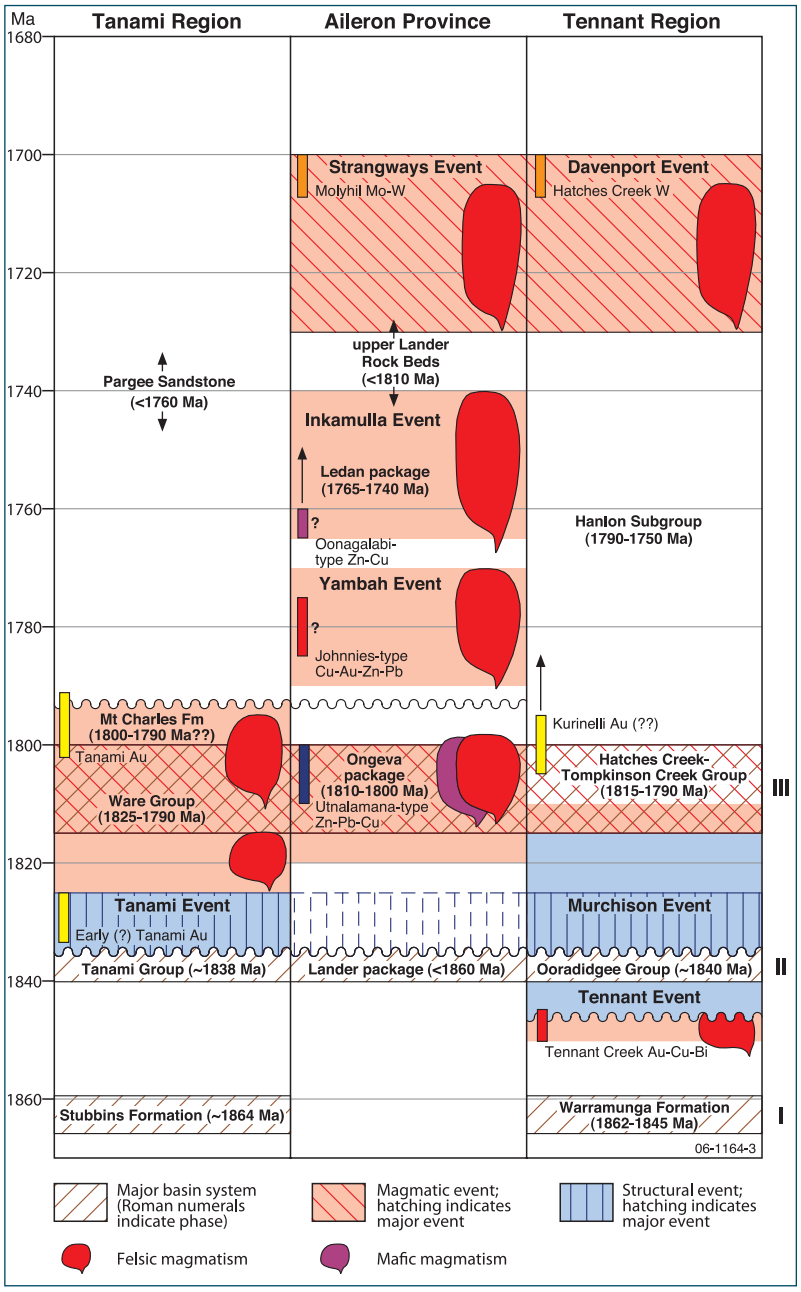


Figure 3. Space-time diagram showing basin forming, magnetic, structural and mineralising events in the Tanami, Arunta and Tennant regions between 1870 and 1680 Ma.

Arunta region potential

One of the first studies undertaken as part of the North Australia Project was an assessment of the Arunta region for mafic–ultramafic orthomagmatic nickel – copper – platinum group elements (Ni–Cu–PGE) mineralisation. Initial results suggested that the western Arunta has moderate potential for Voisey's Bay-type basal Ni–Cu segregations, whereas the eastern Arunta has moderate potential for Merensky Reef-type strataform PGE-bearing sulphide layers. Associated geochronological studies suggest that the mafic–ultramafic bodies were emplaced during three major periods: 1811–1803 Ma (during the Stafford Event), 1787–1774 Ma (during the Yambah Event) and 1639–1633 Ma (during the Liebig Event). Forward modelling of potential field data indicates that many of the ultramafic–mafic intrusions are under relatively shallow cover.

To establish the origin and potential of small base metal ± gold deposits in the Strangways Ranges of the eastern Arunta, NTGS and Geoscience Australia undertook a systematic program of mapping and sampling the deposits. Based on those studies, it was concluded that, as previously interpreted by Warren and Shaw (1985), many of the deposits were volcanic-hosted massive sulphide deposits that formed within 1810–1801 Ma volcaniclastic rocks that were deposited during the Stafford igneous event. However, several prospects associated with massive ironstone bodies, including Johnnie's Reward and possibly some of the Jervois deposits, were interpreted as iron oxide – Cu – Au deposits formed during the Yambah igneous event at 1795–1780 Ma. In addition, the Oonagalabi Cu–Zn prospect was interpreted as a carbonate-replacement deposit formed during an Inkamullah igneous event at 1760–1740 Ma.

Results synthesised for North Australia Craton

The final aspect of the project was to synthesise individual

results into an overall understanding of the geologic and metallogenic development of the North Australia Craton. The results of this synthesis are presented in figure 3. Between ~1865 and ~1800 Ma, the Tanami–Tennant–Arunta region was characterised by the development of three basin systems at ~1865–1860 Ma, 1840–1835 Ma and 1815–1800 Ma. Although the earliest basin system appears to be restricted to the Tanami and Tennant regions, the two later basin phases are present in all regions. Sedimentary rocks deposited during the second phase are most widespread, making up large parts of all regions.

"These deposits produced over 5 million ounces of gold"

All thermotectonic events—with the possible exception of the Liebig event—in the Tanami, Tennant and Arunta regions are associated with significant mineralisation. Iron oxide – copper – gold deposits in the Tennant Creek and Rover goldfields are associated with the Tennant igneous event at 1850–1845 Ma. These deposits produced over 5 million ounces of gold in addition to significant copper, bismuth and selenium. Their high grade and polymetallic character make them attractive exploration targets, particularly in the Rover field, which until recently had not been actively explored for several decades.

The major mineralising event in the Tanami region occurred at the end of the Stafford event at 1803–1791 Ma. This lode-gold event produced a global gold resource of over 12 million troy ounces, and is currently interpreted to relate to the shift from convergence along the northwest margin of the North Australia Craton to convergence along the southern margin. It is likely that small discoveries in the north and west Arunta (Tekapo, Dodger and Falchion–Sabre) are associated with this event, and recent dating of deposits (Rasmussen et al 2006) in the Pine Creek region to the north indicates similar (within error) but slightly younger ages (~1780 Ma).

Results published

The North Australia and Tanami projects have generated extended datasets that provide a better understanding of the geological evolution and mineral systems of the North Australia Craton. A compilation of these new data and results has been published as Geoscience Australia Record 2006–17 (available on CD-ROM), while GIS datasets for the Tanami – north Arunta, Tennant and south Arunta regions are available on DVD. All products are available from the Geoscience Australia Sales Centre on Freecall 1800 800 173 (within Australia) or +61 2 6249 9966 (email mapsales@ga.gov.au).

For more information

phone Bruce Goleby
+61 2 6249 9404
email bruce.goleby@ga.gov.au
or
phone David Huston
+61 2 6249 9577
email david.huston@ga.gov.au

Related articles and websites

Evolution and metallogenesis of the North Australian Craton conference abstracts
North Australia Project results and products
www.ga.gov.au/minerals/research/regional/nap/NAP_results_products.jsp

link

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