

Using new-generation geological maps of the Pilbara to guide mineral exploration

by

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All field mapping required for the new 1:100 000 and 1:250 000 Geological Series maps of the Pilbara granite–greenstone terranes was completed in 2003. Since the North Pilbara Craton Project commenced in 1995, 22 first-edition 1:100 000 maps and three new (second- and third-edition) 1:250 000 maps have been released. By 2005, 31 new 1:100 000 maps and seven new 1:250 000 maps, plus a number of special terrane maps, will be available (Fig. 1). This has been one of the Geological Survey of Western Australia's (GSWA) largest ever mapping projects, and was a collaborative project with the Australian Geological Survey Organisation (AGSO, now Geoscience Australia). The Australian Geological Survey Organisation made a major contribution to new regional airborne geophysical surveys, while concentrating its fieldwork on mineralization studies. A separate, but complementary GSWA project reviewed all known mineral occurrences in the region. Over 75 000 km² of mainly highly prospective Archaean granite–greenstone terranes now have up-to-date geological and mineralization data to guide future mineral exploration.

Previous mapping

First- and second-edition 1:250 000-scale maps of the Pilbara Craton, produced between 1956 and 1982, were seriously outdated by the early 1990s. These maps were compiled from reconnaissance geological mapping using 1:40 000 to 1:80 000 aerial photography, mostly of very poor quality by today's standards. Fieldwork and map compilation were undertaken without the assistance of Landsat images or orthophotography, without aeromagnetic and radiometric data, with little or no geochronology or geochemistry, and without access to a Global Positioning System (GPS). Field mapping was rapid (averaging about 60 km² per day), but the processes involved in manual drafting and setting up for printing were time consuming, with the result that coloured maps were rarely published within 5 years. For economies of scale, the maps were printed in large numbers (typically about 2000), and thereafter any changes involved expensive reprinting.

New-generation maps

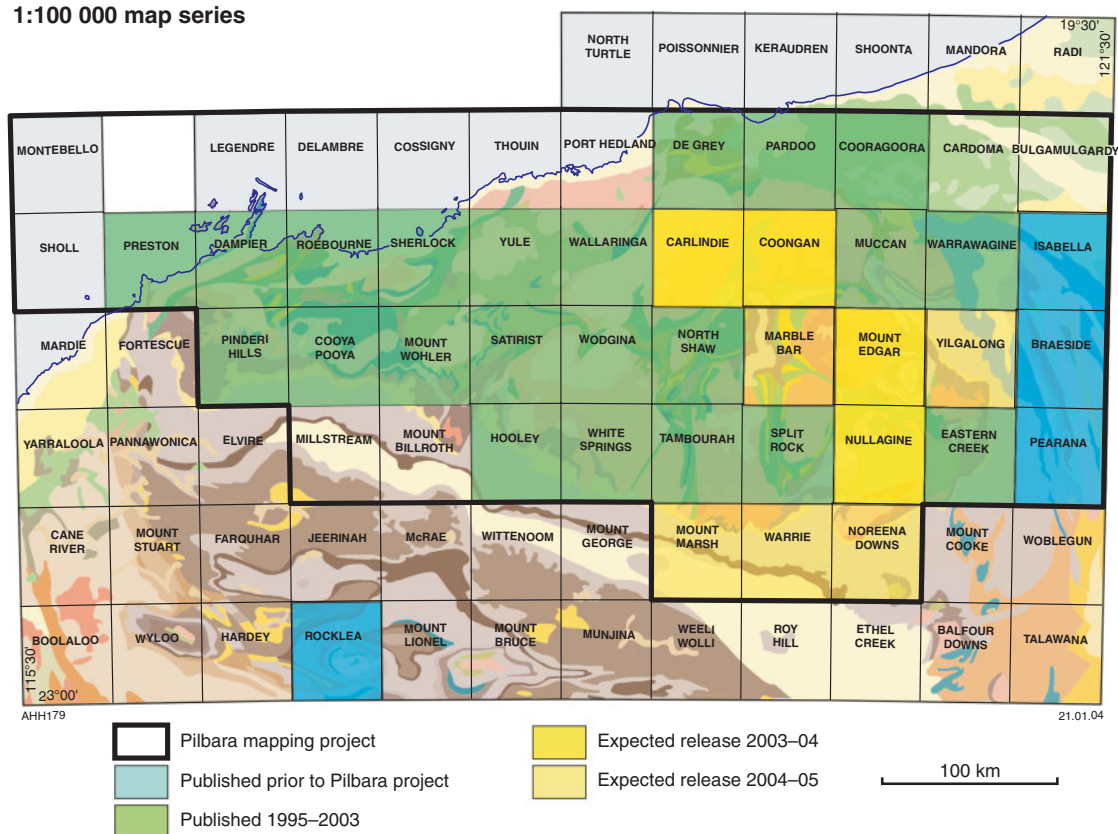
Today, new mapping techniques have vastly increased the range and amount of geoscience data collected, and substantially improved data quality (e.g. by accurate positioning using GPS). Today's mappers use 1:25 000-scale colour aerial photography for navigation and geological interpretation, and are assisted by Landsat, aeromagnetic, and radiometric data. Precise geochronology (e.g. U–Pb zircon dating by sensitive high-resolution ion microprobe: SHRIMP) constrains stratigraphic correlations and the timing of geological events, and geochemistry is available for petrogenetic interpretations. Map production involves either scanning of geologists' compilations or direct digital on-screen map compilation, and is more rapid than the manual drafting of the past. Coloured maps (plotted in small batches as required) can now be released within 12 months of field mapping.

Guide to mineral exploration

The new detailed geological mapping of the northern Pilbara has not only provided industry with better geological maps to assist mineral exploration programs, but has greatly improved our understanding of the region's crustal evolution, including its history of metallogenic events. Geological models have evolved during the mapping, with recent reviews describing the regional geology and tectonic evolution of the granite–greenstones (Van Kranendonk et al., 2002) and the timing of mineralizing events (Huston et al., 2002). The models provide interpretations that can be applied to: (a) explain the distribution of known mineral deposits, and (b) suggest additional areas to explore.

The potential of the new mapping to guide future exploration is illustrated by the recognition of a 200 km-long zone of sanukitoid (high-Mg diorite) and mafic–ultramafic intrusions in the Mallina Basin (Smithies and Champion, 1999). The maps (e.g. Smithies and Hickman, 2003) show that these 2.95 Ga intrusions were emplaced along a major east-northeasterly trending zone of faulting

1:100 000 map series



1:250 000 map series, and terrane maps

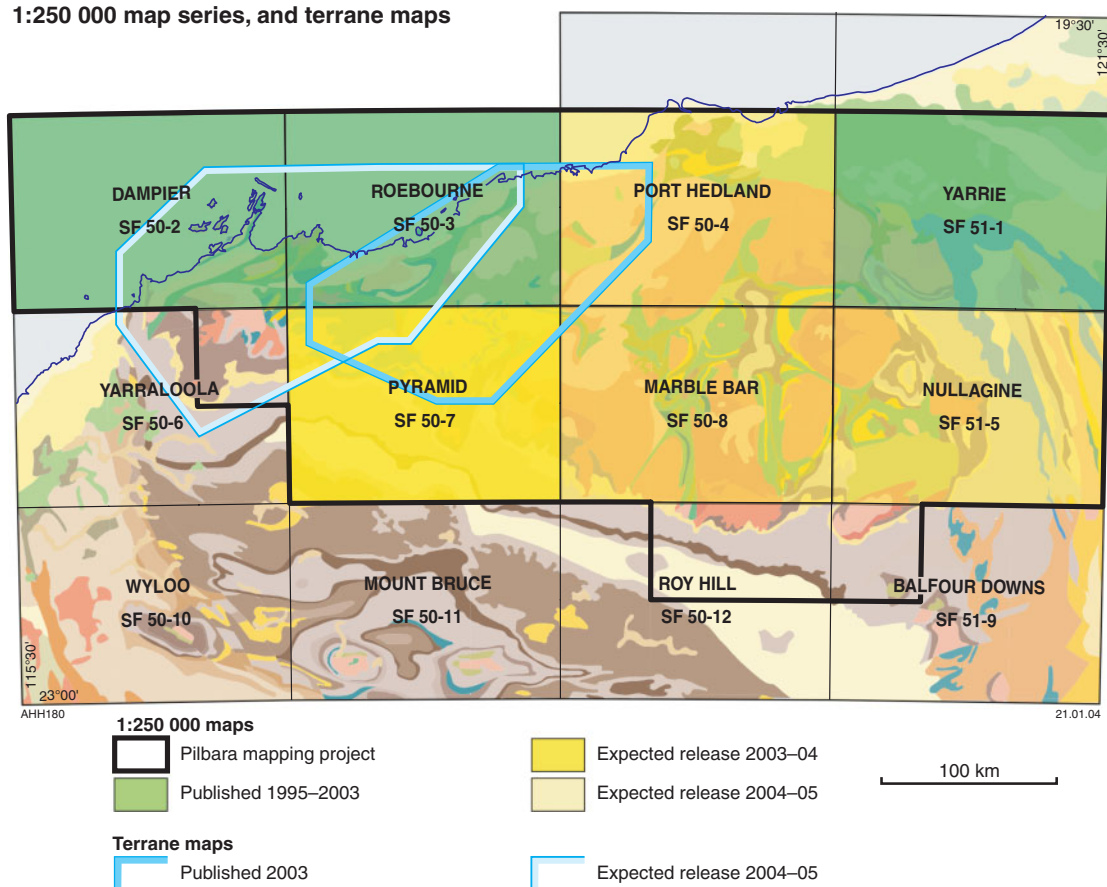


Figure 1. Publications generated by the North Pilbara Craton Project

(principally the Tabbatabba Shear Zone in the east-northeast and the Wohler Shear Zone in the west-southwest), and to a lesser extent on splays from this zone (e.g. Mallina Shear Zone, and probably also the almost entirely concealed Jones River Fault). The recent discoveries of platinum group element (PGE), nickel–copper, and gold mineralization at Indee, along only 10 km of this 200 km zone, support comparisons with sanukitoid-related mineralization in the Wabigoon Subprovince of Ontario, which includes the Lac des Iles mine (published resources: 159 Mt at 1.55 g/t palladium). This suggests that much of the Mallina Basin should now be regarded as prospective for PGE and nickel–copper mineralization, in addition to potential for further discoveries of gold mineralization (Smithies and Champion, 1999).

The new mapping has provided geological bases for GSWA Reports (map and CD format) on mineralization in the west Pilbara (Ruddock, 1999) and east Pilbara (Ferguson and Ruddock, 2001), and contributed to understanding the structural, lithological, and stratigraphic controls on many of these deposits. Completion of the field mapping, and precise zircon U–Pb geochronology from about 200 sites, has now established an ‘event stratigraphy’ for the granite–greenstones of the northern Pilbara, and this correlates with the known periods of mineralization (Van Kranendonk et al., 2004). Compilation of all the new geological data into a seamless database will be the next phase of the Pilbara project, and this will take several years.

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