

# West Pilbara mineralization mapping, Western Australia

by

I. Ruddock

The west Pilbara project includes the area of four 1:250 000 sheets: DAMPIER, ROEBOURNE, PYRAMID, and YARRALOOA. The area is one of the cornerstones of the State's economy and future prosperity, with major contributions from the North West Shelf Gas Project at Burrup Peninsula, the Robe River iron ore mines, and the iron ore export facilities at Dampier and Cape Lambert. The purpose of the west Pilbara project is to promote the area's mineral exploration potential by providing industry with a data package comprising a report, a map, and digital spatial indexes for exploration activities and all known mineral occurrences.

Geologically, the west Pilbara includes the Pilbara Craton, except in the southwest where it includes the northern edges of the Ashburton Basin and the onshore Carnarvon Basin. The region contains a broad range of mineral commodities which include iron ore, nickel, base metals, gold, silver, platinum-group elements, titanium, vanadium, antimony, tin, and beryl. There is a long mining history going back to the 1870s, and the gold discovery at Mallina Homestead in 1888 sparked a gold rush that spread through the whole Pilbara. Copper mining at Whim Creek also started at about that time, and during the 1890s there were numerous other discoveries of gold and copper which were developed as small mines.

Mining activity waned in the early part of the 20th century, but this changed dramatically in the west Pilbara when the iron ore export embargo was lifted in the early 1960s, and there was a surge in iron ore exploration in the Robe River area where large resources of pisolitic iron were delineated. During the 'nickel boom' of the late 1960s and early 1970s, the area from Dampier to Whim Creek was a major focus for nickel-copper and copper-zinc exploration and several discoveries were made. Nickel deposits were located at Mount Sholl, Ruth Well, Radio Hill, and Sherlock Bay; copper-zinc resources were outlined at the old mining areas of Whundo and Mons Cupri (the base metal deposit at Salt Creek was discovered later, in 1977). Vanadium-titanium deposits were also outlined in the mid- to late 1960s at Ball Balla and Don Well. In the mid-1980s the west Pilbara became

a focus for platinum-group element exploration in layered mafic intrusions, and a deposit was discovered at Munni Munni. In 1987 a small but very rich silver deposit was also found at Elizabeth Hill, just north of Munni Munni.

Although mineral exploration in the area has fallen behind some other parts of the State since the late 1980s, there has been a recent revival in nickel exploration in layered intrusions of the west Pilbara following the discovery of the huge Voisey's Bay deposit in Labrador (in 1994) and a revival of regional gold exploration for turbidite-hosted vein-gold deposits following new discoveries in the Mallina Basin in 1997.

New mine developments include the reopening of the Radio Hill nickel mine in April 1998 and plans to open a new silver mine at Elizabeth Hill. In addition, there are plans to restart copper mining at Whim Creek and Mons Cupri, and in late 1998 it was announced that the vanadium deposits at Balla Balla may be developed using new metallurgical techniques.

Four hundred and thirty-five mineral occurrences have been identified in the present study and most of them are in the greenstone sequences and layered mafic intrusions of the Archaean North Pilbara granite-greenstone terrane; in the south, most of the occurrences are pisolitic iron ore deposits in Cainozoic palaeochannels in the Robe and Fortescue valleys. The mineral occurrences have been categorized into seven styles of mineralization:

- Orthomagmatic mafic and ultramafic
- Stratiform sedimentary and volcanic
- Vein and hydrothermal
- Stratabound (clastic hosted)
- Disseminated and stockwork in felsic plutons
- Pegmatitic
- Sedimentary — alluvial

The main styles targeted for exploration in the area (apart from iron ore) have been the first three listed above.

Orthomagmatic mineralization occurrences are in the layered mafic-ultramafic intrusions, where the main commodities are:

- Nickel-copper (Radio Hill, Sholl, Sherlock)
- Vanadium-titanium (Sherlock and Andover)
- Platinum-group elements (Munni Munni and Radio Hill)
- Chromium (Munni Munni and Sherlock)

A few nickel occurrences are also developed in komatiite-high-Mg basalt sequences (Ruth Well).

Stratiform sedimentary and volcanic (volcanic massive sulfide) occurrences of copper-zinc (lead and silver) are located in two main areas of greenstones: the Whim Creek belt in the east and the Sholl belt in the west. Another area with volcanic massive sulfide (VMS) potential is at Shepherd Well in the far west. More recently, VMS potential has been highlighted in the Hamersley Basin, in felsic volcanic units of the Fortescue Group, as a result of GSWA mapping on the PINDERI HILLS 1:100 000 sheet.

Nearly all vein and hydrothermal gold occurs in the granite-greenstone sequences. The most significant occurrences are hosted by metasedimentary rocks in the east in the Mallina Basin. These are known as 'turbidite-hosted gold' occurrences, similar to the Ballarat-Bendigo area in Victoria, the Hodgkinson Basin in northeast Queensland, and several other major gold producing areas around the world. The main structural controls on mineralization in the Mallina Basin are the east-northeasterly trending Mallina Shear and Sholl Shear, and splays from these.

In the west, vein gold is hosted by mafic and ultramafic volcanic rocks, and the main structural control

on mineralization is the east-northeasterly trending Sholl Shear and splays from this.

The west Pilbara project also includes the completion of a spatial index for all mineral-exploration activities contained in WAMEX reports that are available to the public on open file. Exploration intensity in prospective zones can be demonstrated using a selection of themes; for example, the distribution of geochemical grid surveys, ground EM and IP surveys, and drilling. For the west Pilbara, the distribution of these three types of exploration activities shows that there are gaps in the data over many areas. The reason for these gaps is due to two factors:

- a) the areas were not considered worthy of further investigation beyond initial regional geochemical surveys and airborne geophysical surveys (most likely due to the limitations of older surveys), or
- b) the data are actually in WAMEX reports but these are not yet on open file.

The west Pilbara must still be considered as one of the most prospective underexplored parts of the State for a large range of commodities in a variety of mineralization styles. Many areas have been highlighted during past exploration as being prospective for base metal sulfides, nickel-copper sulfides, platinum-group elements, and gold, but they have yet to be fully tested by the latest geochemical and geophysical methods used in industry, and be assessed in the light of new geological concepts arising from the Survey's current 1:100 000-scale mapping program and the airborne geophysical surveys undertaken by AGSO as part of the National Geoscience Mapping Accord.