The Miitel and Wannaway nickel sulfide deposits, Widgiemooltha Dome, Kambalda

by

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Introduction

The Widgiemooltha Dome is located some 40 to 70 km by road southwest of Kambalda (Fig. 1). Soon after the discovery of nickel at Kambalda in January 1966, the mafic–ultramafic stratigraphy surrounding the granitoid centre of the Widgiemooltha Dome was recognized as being similar to the Kambalda host stratigraphy (Fig. 2), and this area became the focus of an intense exploration effort that lasted through to the mid-1970s. The then-major global mining houses were actively involved in this area, and a number of small but significant discoveries were made. In the southern and western part of the Dome, a joint venture between Anaconda Australia and CRA Exploration discovered Redross and Wannaway. At the northern end, a joint venture between BHP Minerals and Inco discovered the Mount Edwards ('26N') deposit. Further north, but in the same stratigraphic succession, Selection Trust (Seltrust) discovered a number of orebodies, of which the Spargoville 5D was the most significant. Each of these explorers also located other significant occurrences, and many are still the focus of ongoing evaluation today.

Unfortunately, the collapse of the nickel price in the early 1970s meant that many of the discoveries were not brought into production at the time. Those that were developed (Redross and Seltrust) struggled economically, before closing prematurely in the prolonged low price environment. Shafts were also sunk at Wannaway and Mount Edwards, but production plans were shelved. By the early 1980s, Western Mining Corporation (WMC) had gained control of most of the prospective leaseholdings in the Widgiemooltha area, and these were consolidated into the Kambalda operation.

Largely because of low nickel prices, all nickel mines in the Widgiemooltha area were closed by 1999. At this point, WMC embarked on a progressive sell-off of its nickel assets in the Widgiemooltha and Kambalda areas. The Miitel–Mariners–Redross block on the eastern side of the Widgiemooltha Dome was purchased by Mincor Resources in February 2001, and production commenced from the Miitel mine in the following month. Production has continued ever since, at the rate of 18 000 t of ore per month. In mid-2001, Mincor also purchased the Wannaway block (on the western side of the Widgiemooltha Dome), and commenced production in October 2001, at a rate ramping up to15 000 t of ore per month.

Assisted by the strong nickel price, Mincor has, since mid-2003, implemented development plans for three new ventures in the area:

- an access decline to the North Miitel orebody;
- commencement of a decline into the remaining orebody at Redross;
- dewatering and rehabilitation of the Mariners mine.

All three developments will be in production by the end of 2004.

Mincor also maintains an aggressive exploration program on its leaseholdings in the Widgiemooltha area

The total cumulative production to date of all nickel mines in the Widgiemooltha Dome area is listed in Table 1.

Miitel orebody

The Miitel nickel deposit is located on the eastern side of the Widgiemooltha Dome, about 55 km by road southwest of Kambalda (Figs 1 and 2). The deposit was discovered by WMC Resources in the early 1990s, as a result of following up low-grade occurrences (about 0.5–1.0% Ni) in drilling from the late 1960s and early 1970s, carried out by Anaconda–CRA, the original nickel explorers in this area. The deposit was purchased by Mincor Resources, and brought into production in March 2001. Production to end of June 2004 is 697 000 t at 3.95% Ni. A further 370 000 t at 3.00% remains in ore reserves at Miitel, and 465 000 t at 2.65% at North Miitel, along the northern extension of the same ore channel. The deposit is open to the north and south, and further significant additions are expected. Currently, mineralization is known over a plunge length of 2300 m.

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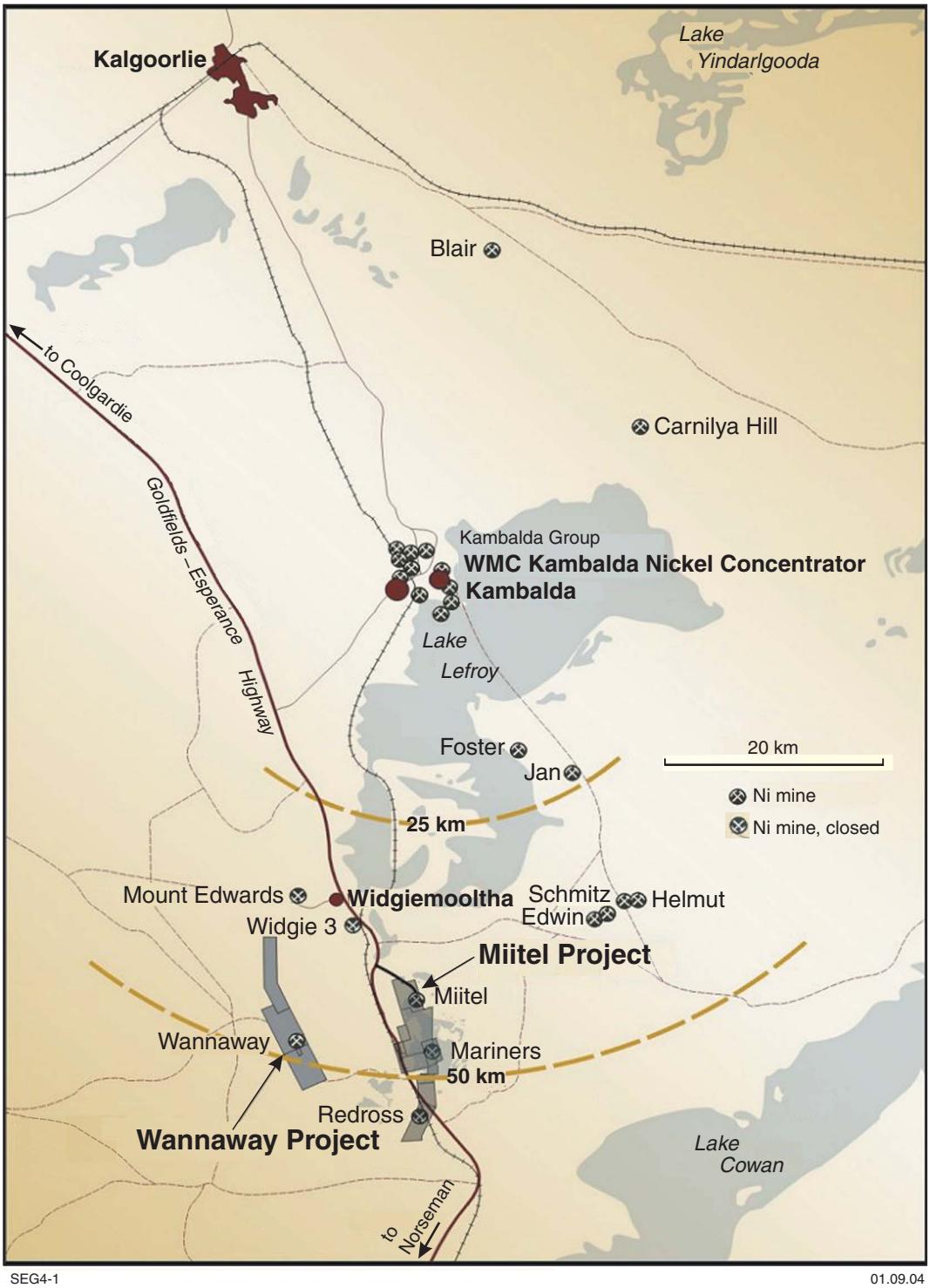

Figure 1. Location of Miitel and Wannaway nickel deposits

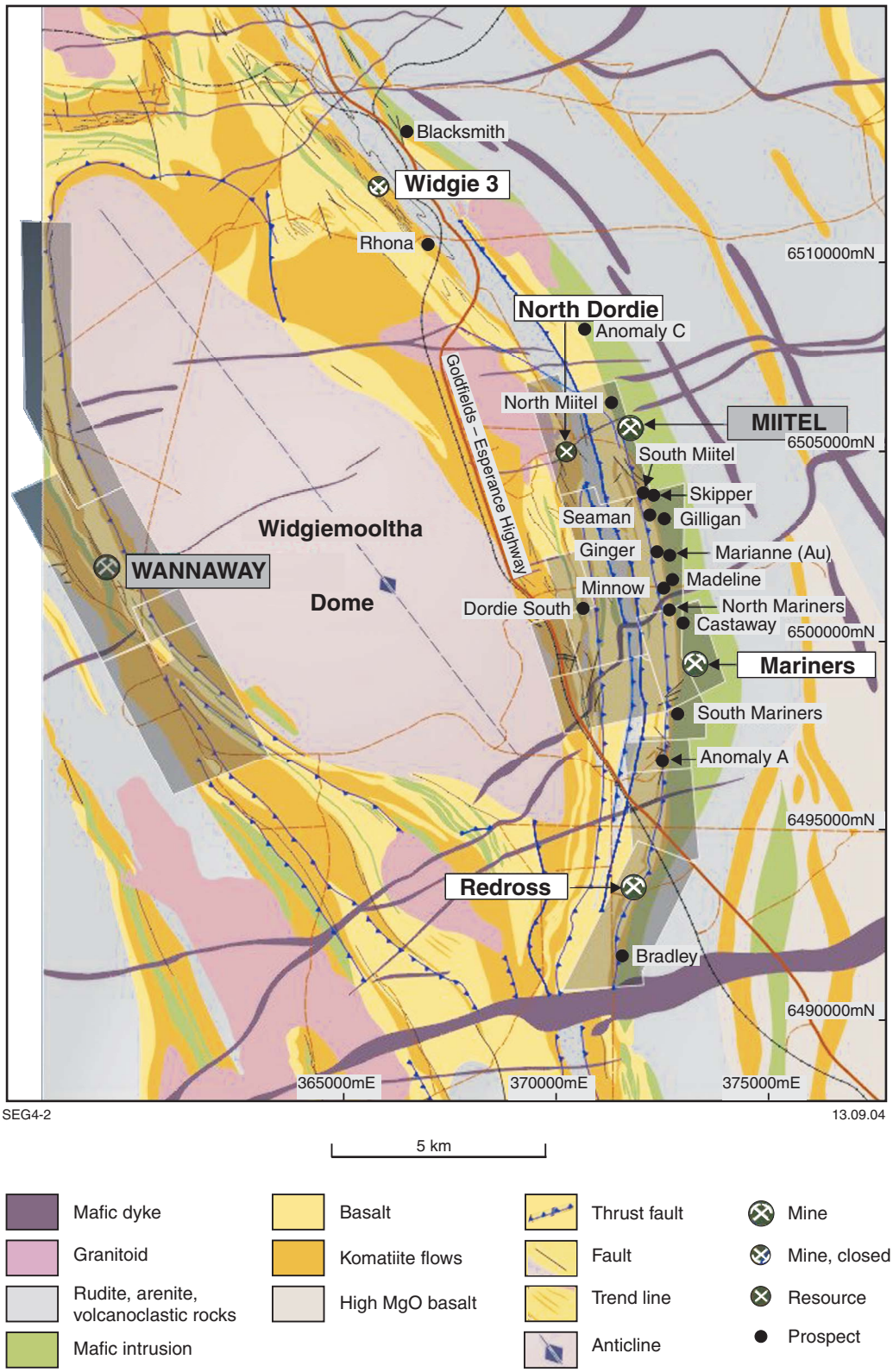

Figure 2. General geology of the Widgiemooltha Dome

Table 1. Total cumulative production to June 2004 of all nickel mines in the Widgiemooltha Dome area

Mine	*Years*	*Company and extraction method*	*Tonnes and nickel grade*	*Current status*
Redross	1971–78 1989	(Anaconda–CRA, underground) (WMC, openpit)	438 000 t @ 3.25% 97 600 t @ 2.43%	Being brought into production by Mincor Resources
Wannaway	1984–98 2001–04	(WMC, underground) (Mincor, underground)	646 600 t @ 2.30% 397 000 t @ 3.25%	Still in production by Mincor Resources
Mariners	1991–98	(WMC, underground)	1 114 700 t @ 2.53%	Being brought into production by Mincor Resources
Miitel	2001–04	(Mincor underground)	697 000 t @ 3.95%	Still in production by Mincor Resources
Mount Edwards	1981–95	(WMC, underground)	954 600 t @ 2.72%	Being evaluated by Titan Resources
Widgie 3	1988–91	(WMC, openpit)	82 600 t @ 2.17%	Being evaluated by Titan Resources
132 North	1991–92	(WMC, openpit)	32 200 t @ 3.54%	Being evaluated by Titan Resources
Spargoville 5D	1975–80	(Seltrust, underground)	600 000 t @ 2.50% (estimate only)	Being evaluated by Breakaway Resources
Spargoville 1A	1992–93	(Amalg, underground)	64 000 t @ 2.10% (estimate only)	Being evaluated by Breakaway Resources
Spargoville 5A	1997–98	(Amalg, openpit)	20 000 t @ 2.50% (estimate only)	Being evaluated by Breakaway Resources
Total mined to date:			**5.144 Mt @ 2.85%**	

Miitel is a typical Kambalda-style komatiite-hosted deposit. It has a north-northwesterly–south-southwesterly strike, and dips at 70–85° to the east (Figs 3 and 4), in keeping with its position on the eastern flank of the Widgiemooltha Dome. A recent geological description is given by Cairns et al. (2003). Significant features are summarized below.

- The deposit sits on the stratigraphically underlying basalt contact, and exhibits a typical 'trough'-type channel structure, substantially modified by later structural deformation. The ore environment (the structurally modified channel) plunges flatly to the north (at the northern end), and flatly to the south at the southern end.
- Visually, the underlying basalt does not appear to be particularly strongly deformed relative to other orebody environments. Paradoxically, however, strongly ptygmatic quartz veins are present in some areas of the basalt, just below the contact.
- Five structural events have been defined. A late-stage arsenic mineralization event has resulted in vein structures, interpreted to be associated with D_4.
- Broadly, high grade mineralization occurs in the central 'channel' position, with lower grade mineralization on the upper and lower 'flank' positions. However, in detail, the picture is far more complex, as a result of superimposed structure. Towards the southern end, the mineralization occurs in a series of pods that are ellipsoidal in long-section.
- The ore profile is typical of Kambalda-type deposits, with massive sulfide (12–13% Ni) at the base, overlain by matrix mineralization (5–7% Ni), which is then overlain by disseminated sulfides (0.5–1.5% Ni) in talc–magnesite host. The higher-than-average grade for the Miitel deposit is a result of the relatively high tenor (nickel content of 100% sulfide equivalent), the overall thickness of the profile (averaging 1.5–2.0 m), and the relatively high proportion of massive sulfide in the total ore profile. All sulfide ores are pyrrhotite–pentlandite, with minor pyrite and chalcopyrite. There is some metre- to 10 m-scale remobilization of massive sulfide, resulting in a massive-sulfide-only profile in attenuated basalt–basalt 'pinchout' positions.
- Sedimentary rocks are essentially absent from the mine environment.
- Overlying ultramafic units are very high in Mg (reflecting the original olivine-rich cumulate), and are entirely altered to a talc–magnesite assemblage, with no serpentinite minerals recorded. Flow margins are observed, but original textures, such as cumulate and spinifex textures, appear to have been largely destroyed.

Wannaway orebody

The Wannaway nickel deposit is situated on the western side of the Widgiemooltha Dome, about 60 km southwest of Kambalda. Wannaway was discovered in 1970 by Anaconda–CRA, as a result of follow-up of a soil geochemistry anomaly. Although an exploration shaft was sunk at the time, and metallurgical bulk samples taken, the deposit was not brought into production until 1984, after it had been purchased by WMC. Between 1984 and 1998, 647 000 t at 2.3% Ni was mined. Towards the end of this period, WMC geologists located an adjacent ore position, known as the N02 orebody, just south of the mined orebody (designated the N01).

Mincor purchased the Wannaway property from WMC in mid-2001, and brought the N02 orebody into production in October of that year. Total production from this period to June 2004 is 397 000 t at 3.25% Ni. Remaining tonnages are largely lower grade material in the lower areas of both the N01 and N02 orebodies, and total about 150 000 t at 2.1% Ni. Exploration of the mine environment is continuing, however, and there are promising signs of further extensions.

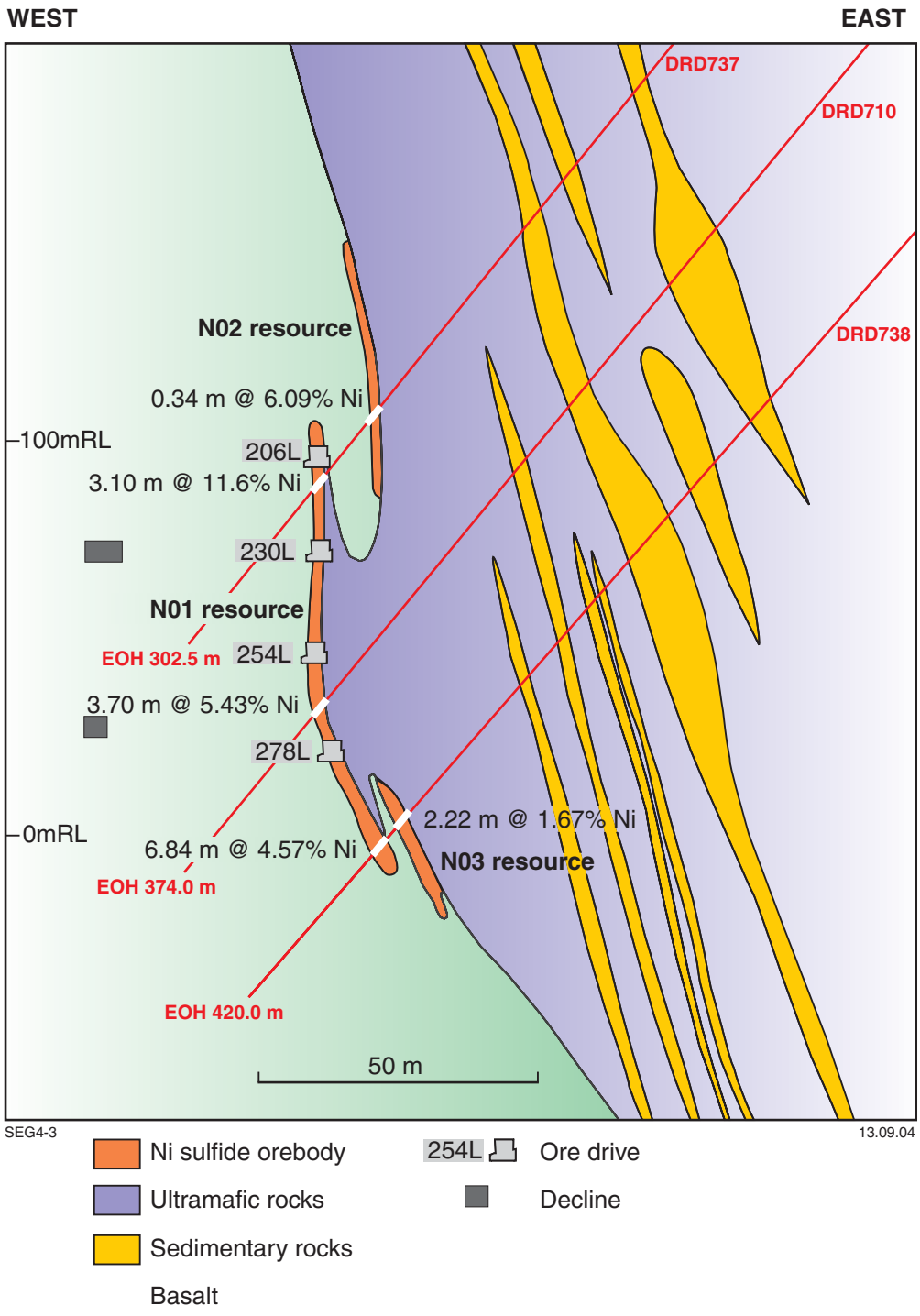

Figure 3. Cross section of the Miitel nickel deposit at 6505050N

Geologically, Wannaway has some unusual features and is less typical of a Kambalda-style deposit. A recent description is given by Daddow et al. (2003), and the geological features of Wannaway are summarized below.

- The orebody consists of two subparallel oreshoots (designated the N01 and N02 shoots; Fig. 5), which dip to the west at 60°, strike northerly, and plunge at 70° to the north-northwest.
- The upper part of the orebody sits above the basalt contact, with a small thickness (?2–10 m) of ultramafic rock sandwiched between the ore zone and the contact. In this area, sedimentary rocks sit on the contact. However, most of the orebody (approximately the lower three-quarters) directly abuts the underlying basalt contact, with no sedimentary units present.
- The orebody does not have a defined 'trough' or channel structure in the underlying basalt. This is very

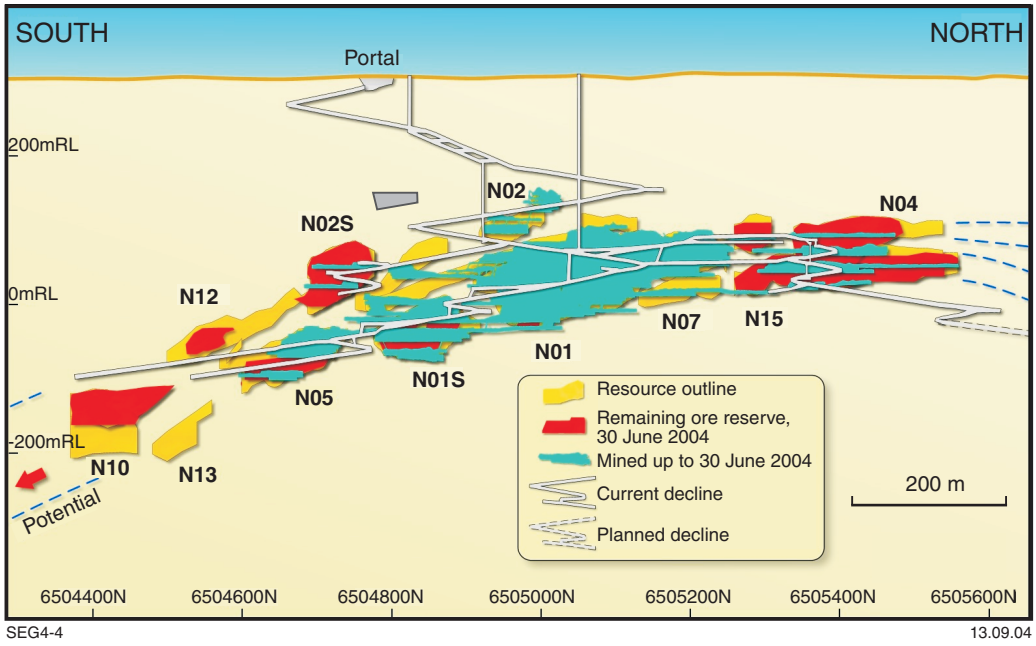

Figure 4. Long section of the Miitel nickel deposit showing distribution of ore

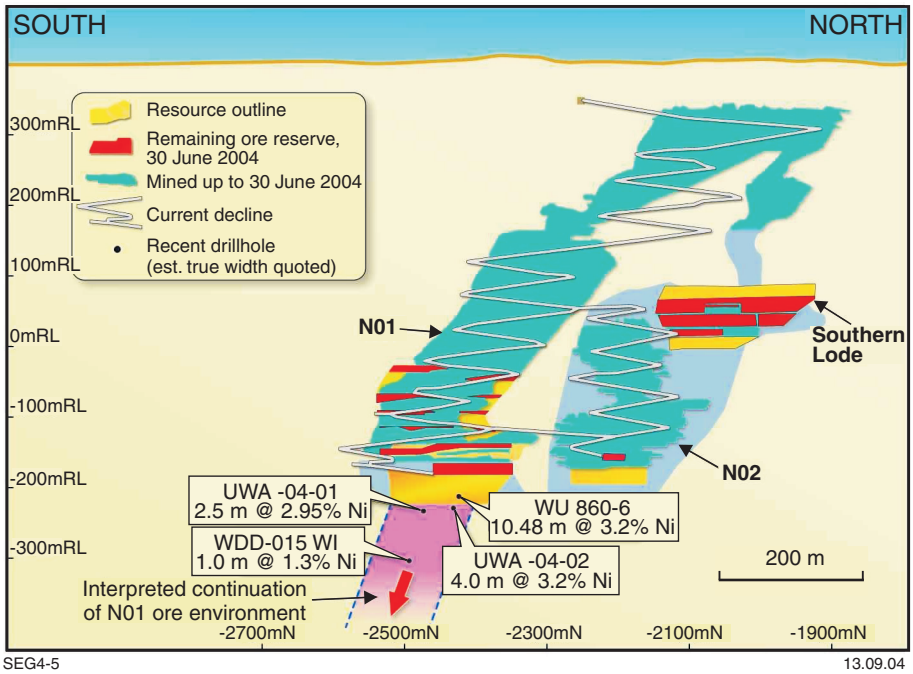

Figure 5. Long section of the Wannaway nickel deposit (local mine grid)

unusual for orebodies of the Kambalda district. At Wannaway, the basalt contact exhibits a broadly curviplanar morphology, with only minor small-scale 'pinchout'-type structures.

- The underlying basalt is strongly pillowed (at least in the upper 20 m). Pillows are invariably strongly deformed, exhibiting elongation and stretching from structural deformation (whereas for the Kambalda Dome orebodies, pillows in the basalt generally appear undeformed).
- The overlying ultramafic unit is a black serpentinite, with essentially no talc–magnesite alteration. This is unique in the Kambalda area, where ore-environment ultramafic rocks are always strongly or completely altered to talc–magnesite (with only remnant serpentinite areas). Relict cumulate textures are preserved in the Wannaway serpentinite.
- The lower margins of both the N01 and N02 oreshoots are characterized by interaction with sedimentary units along the basalt contact. Here, the massive sulfide and matrix sulfide ore types become progressively lower in tenor (as low as 4% Ni), as the pentlandite content decreases. Concurrently, the true sedimentary rock (usually a typical Archaean laminated black sulfidic 'shale') contains a high proportion of nickel — commonly up to 1–2%. In places, discrete zones of massive sulfide and matrix sulfide are interlayered with sedimentary units. However, the detailed relationships are highly variable and inconsistent. In some areas, the magmatic sulfides overlie the sedimentary units, whereas in others, the sulfides underlie these units and are in direct contact with basalt. Elsewhere, sulfides are enclosed by sedimentary rocks.
- The N01 and N02 oreshoots have different characteristics. The N01 oreshoot has a lower tenor (8–10% Ni), and only a very thin component of massive sulfide in its ore profile. Much of this ore zone is a relatively narrow width of matrix ore, leading to an overall low mined grade of 2.30% Ni, even using narrow-vein mining techniques. The N02 oreshoot has a relatively high tenor of 12–13% Ni, and a higher proportion of massive sulfide, giving the higher average mined grade of 3.25% Ni.
- Massive sulfide in the N02 oreshoot has apparently undergone significant local remobilization. Within this orebody, there are two relatively small (25 m × 50 m in long section) 'pods' of massive sulfide, where the thickness is up to 8 m. This is interpreted as local structural thickening associated with reverse movement.

The Wannaway orebody is interpreted an endmember representative of the Kambalda-style deposit. Low-angle reverse structural movement is interpreted to have thrust the upper part of the orebody off the contact, while also juxtaposing the lower sedimentary unit with the lower margin of the orebody.

Acknowledgements

The author acknowledges the work of all geological personnel who have documented the geology of these orebodies over the years. This description is published with the permission of Mincor Resources NL.

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