The geology and mineralisation of the Carina Iron Deposit, central Yilgarn Craton, Western Australia

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The Carina iron ore deposit is 105 km northeast of Southern Cross, WA. The area designated the Yilgarn Iron Ore Project (YIOP) comprises five prospects along an east–southeast trending greenstone belt that extends from the Helena-Aurora Ranges in the northwest to the Yendilberrin Hills in the southeast, over a strike length of approximately 40 km. The YIOP project encompasses the previously identified iron deposits of Bungalbin, Bungalbin East and Mt Walton. The Carina deposit was discovered in May 2007. The Carina deposit is located within and parallel to the structurally complex northwest trending Mount Dimer Shear Zone. The volcano-sedimentary Archaean greenstone sequence consists of ultramafic and mafic lavas and flows with interbedded sedimentary rocks dominated by chert and banded iron formation (BIF). Supergene enrichment processes formed a goethite ore body replacement of BIF sequences within a doubly plunging synclinal fold structure. Mineralised outcrops dominated by goethite form a low ridge 1500 m long, up to 90 m wide and drilled to over 200 m in depth. In the vicinity of the Carina deposit, iron occurrences have been identified over at least a 12 km strike length. The current exploration in the area began in 2006. Target generation in the area used existing state geological survey maps and regional magnetic survey data to focus on BIF occurrences associated with major structures. Early field investigations resulted in the identification of a large outcrop of predominantly goethite mineralisation at Carina. Detailed geological and structural mapping was completed, followed by close-spaced reverse circulation and diamond drilling. The mineralisation is predominantly goethite with specular and coarse platy hematite localised along structures that cut the goethite mineralisation. Mineralised zones are moderately vuggy and larger cavities occur in proximity to fault zones that transect the ore body. There is a capping by a thin veneer of canga or ferricrete up to 9 m thick. By July 2010, 184 reverse circulation and 11 diamond drill holes (seven surface holes, four tails) were completed. The current JORC-compliant resource estimate is based on assays from 170 RC and 11 diamond drill holes and using a 55% Fe cut-off is quoted as an Inferred Resource of 26·7 Mt at 58·9% Fe, 1·2% Al_2O_3, 3·2% SiO_2, 0.11% P, 0·08% S, and 9·5 % LOI. Mining is planned to commence in early July 2011.

Keywords: Carina, Goethite, Specular haematite, Iron mineralisation, Polaris Metals Pty Ltd, Yilgarn Craton

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Location and access

The Carina iron ore deposit is part of Polaris Metals' Yilgarn Iron Ore Project (YIOP) which is located approximately 110 km northeast of Southern Cross in the Central Goldfields of Western Australia (Fig. 1). The project area is comprised of five prospects (Fig. 1) and is covered by the Bungalbin 1 : 100 000 and Jackson 1 : 250 000 map sheets. Access is via the Great Eastern Highway and then various unsealed but substantial roads and station tracks.

Exploration and discovery history

Early exploration

In 1957 the Geological Survey of Western Australia conducted geological reconnaissance of a greenstone belt extending from Jackson in the Yilgarn goldfield to Ryans Find in the Coolgardie goldfield (Sofoulis, 1960). Gold was the primary focus of the geological reconnaissance but occurrences of iron mineralisation were also documented.

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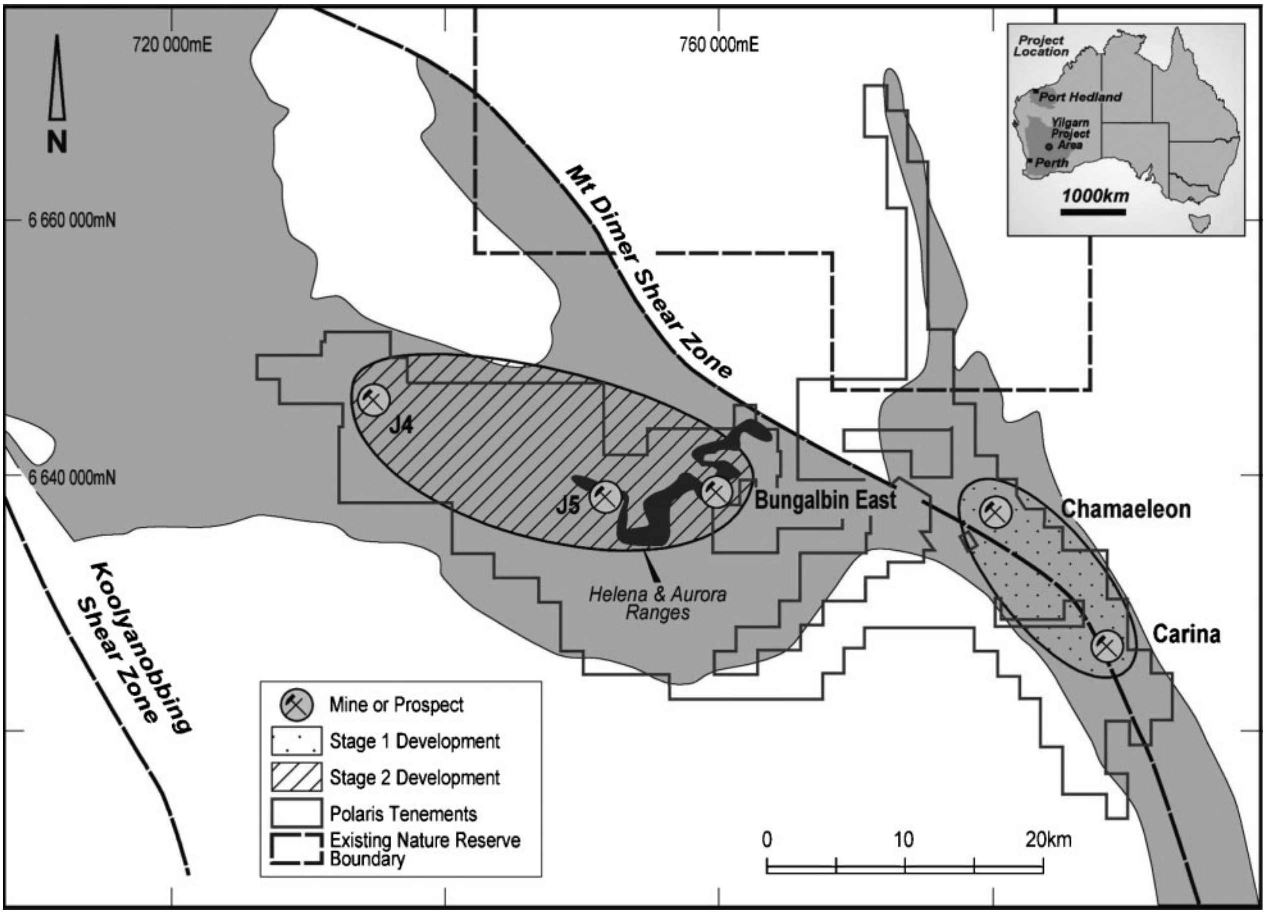


1 Location map of the Carina Iron Deposit and other Polaris projects in the YIOP area

Estimates of tonnage potential were made for four of these areas, calculated on outcrop area and height above the surrounding plain level. A low tonnage zone of mineralisation was identified in the Mt Walton area. Sofoulis (1960) refers to a zone of high grade iron mineralisation estimated from surface outcrop at (non-JORC compliant) 2·5 Mt at 60·06%Fe, as the Mt Walton ore body. Mapping from the period indicates the iron mineralisation identified at the Mt Walton ore body is located in the area now referred to as the Carina deposit.

Commencing in the 1960s and continuing until the early 1970s, BHP explored for and assessed the iron ore potential of the region. BHP's exploration in the Marda-Diemals greenstone belt and Mt Dimer Shear Zone focused on the prominent ranges, particularly the Helena and Aurora Ranges 30 km to the northwest of Carina. In the Helena-Aurora Ranges, drilling in the Bungalbin East and Bungalbin Central area confirmed the presence of significant iron mineralisation and identified numerous zones with a combined 60–70 Mt iron ore potential in enriched hematite ores overlying primary magnetite banded iron formation (BIF).

Banded iron formation and chert horizons are common within the Mt Dimer Shear Zone, a south easterly continuation of the Marda-Diemals greenstone belt that varies from 8 to 17 km in width and trends approximately 300–330°. Between the Helena-Aurora Ranges (Bungalbin) and Mt Walton the ranges become subdued and are represented by a low line of hills named the Yendilberrin Hills, of which Mt Walton is the highest feature. No exploration work appears to have been conducted by BHP in the Mt Walton area during this period.

Around this time, the vast iron resources of the Pilbara region were also identified and exploration focus for iron shifted to the Pilbara. Exploration for iron in the Bungalbin area ceased.

There was limited exploration for nickel by the Societe Le Nickel from 1970 to 1973. Carpentaria Exploration Company (a subsidiary of MIM Holdings Ltd) explored the area for base metals from 1976 to 1977, also without success.

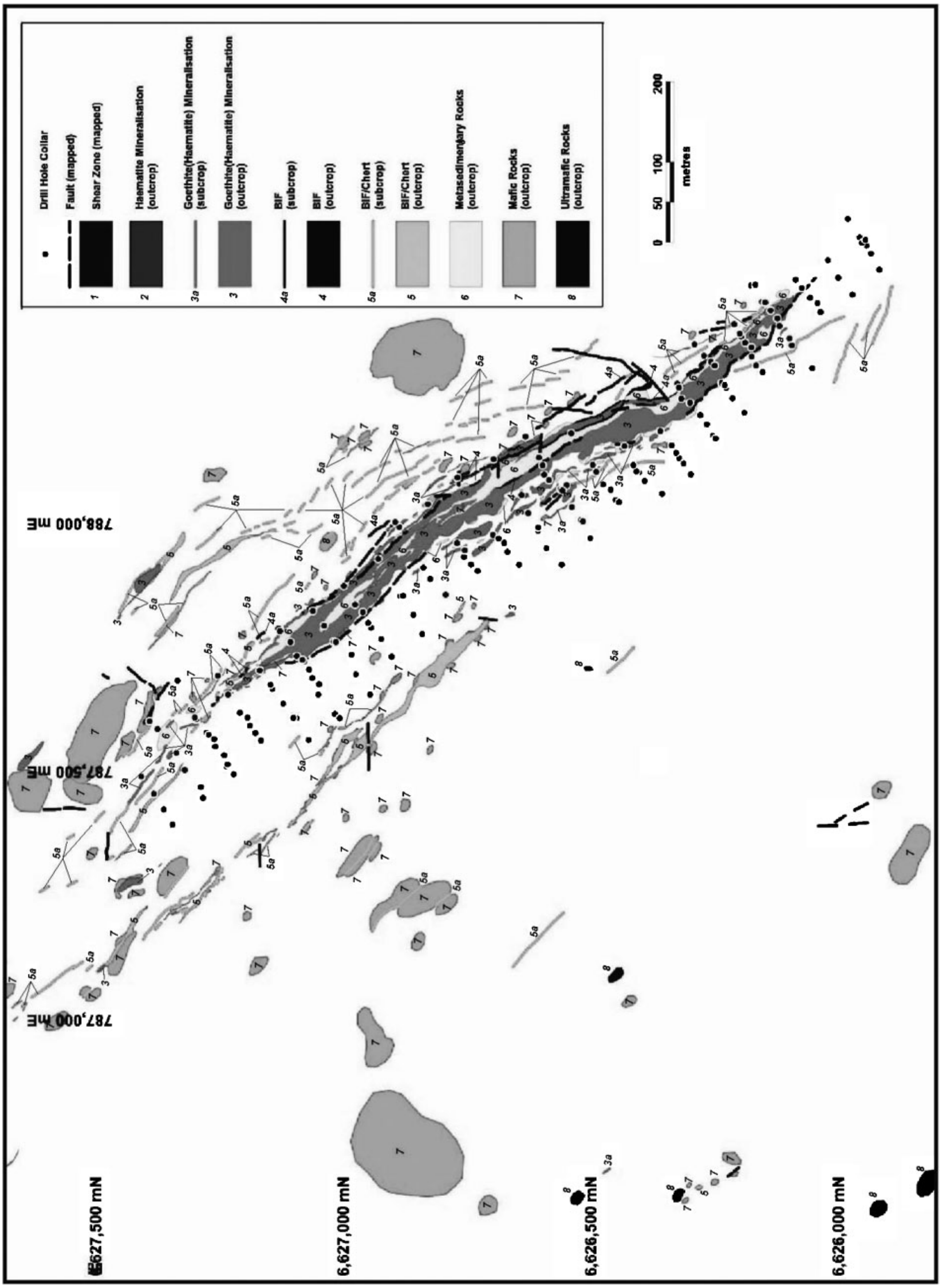
Western Mining Corporation commenced regional exploration for gold deposits in the late 1980s across the Marda-Diemals greenstone belt after identifying the belt as being under explored and prospective for gold mineralisation. The Western Mining Corporation exploration program led to the discovery and subsequent exploitation of the Mt Dimer gold deposit in an area where no historical workings existed.

Subsequent exploration for gold in the Bungalbin area to the north of Carina and proximal to the Bungalbin East iron deposits was conducted by Forrestania Gold NL intermittently from 1987 to 1992. Forrestania withdrew without success, concluding the area did not possess the potential to host significant gold deposits.

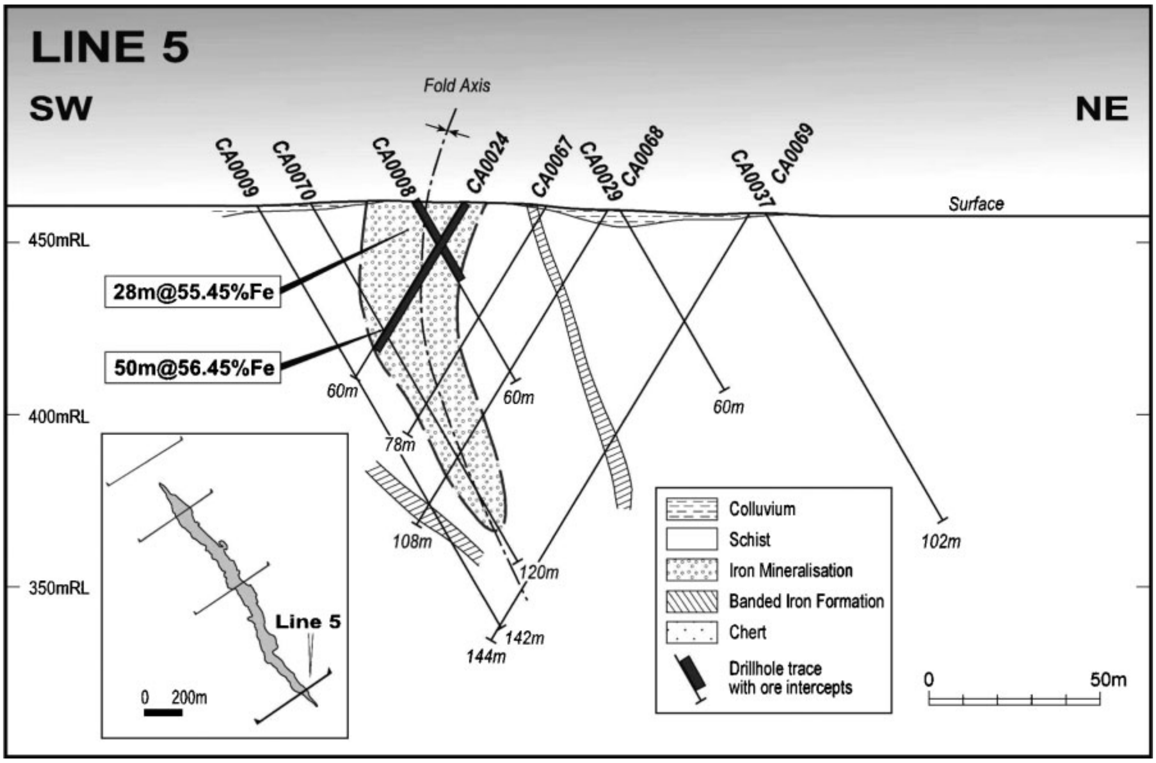
Exploration since 2006

In July 2006, following a 30 year hiatus, exploration for iron recommenced in the area, and the Carina area was one of the first explored.

Desktop target generation was completed prior to commencing field reconnaissance and geological mapping



2 Detailed surface geology fact map of the Carina Iron Deposit. Drill hole locations are also shown



3 Schematic simplified geology section of Drill Line 5. Geology, drilling and interpretation

programmes. Given the structural complexity of the BIFs and their proximity to major structures (Mt Dimer Shear Zone) and folds (the thrust repeated Bungalbin Syncline), all mapped BIF and magnetic anomalies interpreted as BIF were targeted for assessment. More than 150 km strike of BIF and magnetic anomalies had been mapped by Geological Survey of Western Australia within the licence areas.

In early May 2007, the Carina Iron Deposit was discovered during geological reconnaissance and rock chip sampling of the Yendilberrin Hills. In contrast to the prominent ridges and hills that were the main targets of previous iron exploration, the main ridge at Carina is subdued, rising only 10–15 m above the surrounding alluvial plain.

Vegetation in the area is typical of the Eastern Goldfields, with open eucalypt woodland across alluvial channels and plains, and thick mallee and acacia bushland over areas of thinner soils and outcropping BIF and greenstone.

After initial discovery of the goethite-hematite Carina outcrop, the surface was mapped and systematically sampled. A total of 43 samples were collected, returning average assay of 59%Fe, 1·1%Al_2O_3, 3·29%SiO_2, 0·14%P and 9·23%LOI.

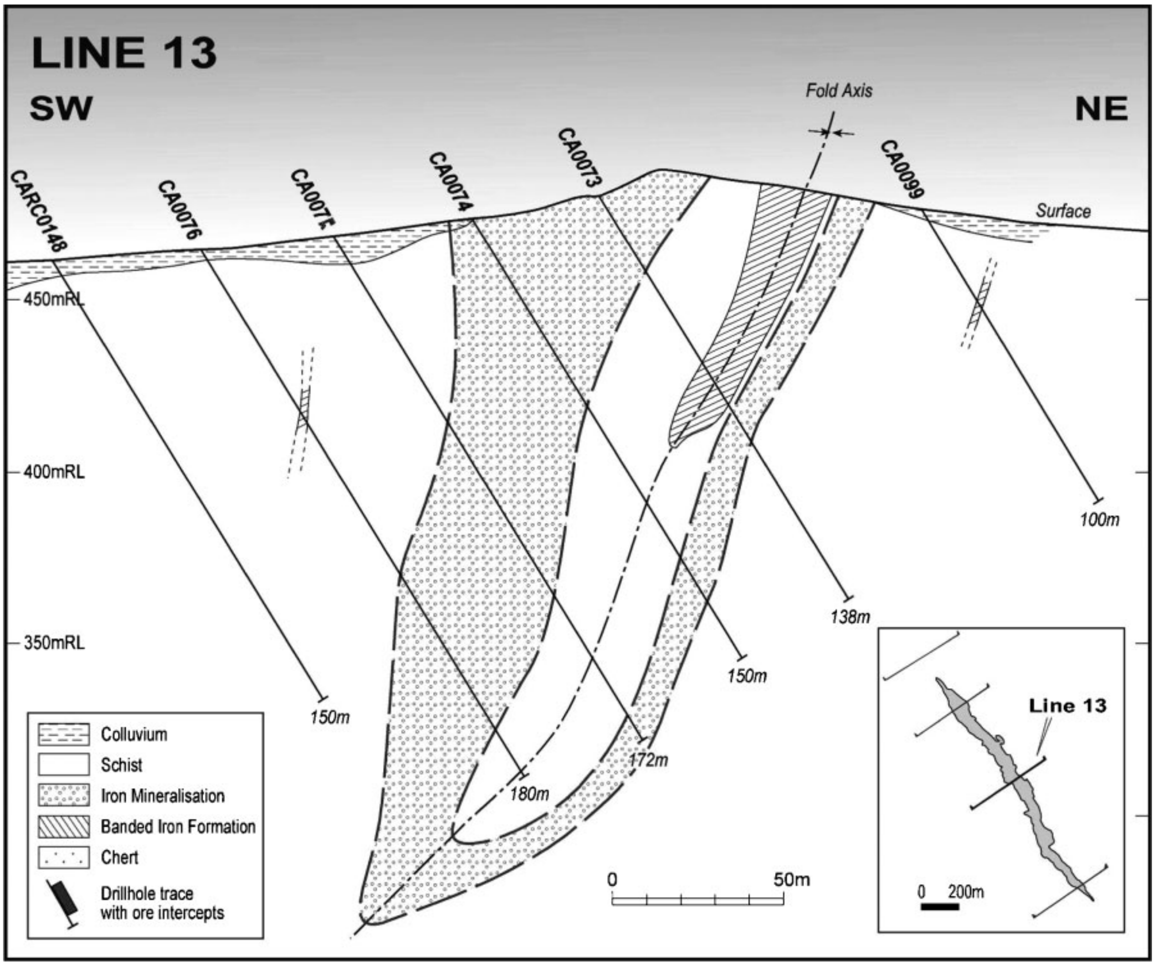
An initial drilling programme of 13 RC drill holes was conducted in 2007 on a nominal line spacing of 160 m. Encouraging results (including a best intercept of 110 m at 58·59%Fe from 2 m depth) were obtained, confirming the depth continuity of outcropping iron mineralisation. Four holes returned intersections of greater than 50 m length exceeding 58%Fe (55%Fe cut-off) and mineralised intersections appeared continuous between holes and drill lines. Seven holes intersected ore grade mineralisation (>55%Fe). From the results an initial Inferred Mineral Resource was estimated of 15·6 Mt grading 57·7%Fe, 1·7%Al_2O_3, 3·8%SiO_2, and 0·12%P (Abbott, written comm. 2007). The Carina deposit is regarded as having been discovered following assessment of results at the completion of the first drill programme.

Regional geology

The deposit lies within the Marda-Diemals Greenstone Belt which is the largest greenstone belt in the Southern Cross Terrane. The lithostratigraphy of this greenstone belt is based on detailed geological mapping, various facing indicators (such as pillow lava structures in basalt and cross bedding in quartzite) and an understanding of the regional structure and geochronological data (Chin and Smith, 1983).

In the Bungalbin-Marda area, the lithostratigraphy of the lower greenstone succession is exposed in the well defined Bungalbin Syncline and in mineral exploration drill holes. The succession can be subdivided into broad sequences:

- a poorly exposed basal ultramafic overlies granitoid basement and is stratigraphically overlain by interleaved mafic and granitoid rocks. The majority of the lower sequence consists of a thick unit of dominantly tholeiitic basalt; however, the lower part contains foliated high-Mg basalt and basaltic schist intercalated with thin units of ultramafic rock. The upper part contains BIF and chert beds, and is locally intruded by feldspar porphyry (Chen and Wyche, 2003)
- the middle sequence is dominantly sedimentary, and consists of a major BIF and chert unit that forms prominent ridges up to 300 m above the surrounding plains. In the Bungalbin Hill area, BIF is dominant in the south whereas chert with intercalated lenticular quartzite layers is dominant in the north. The finely laminated BIF and chert dips steeply to the north and northwest. Cross bedding in the quartzite indicates a



4 Schematic simplified geology section of Drill Line 13. Geology, drilling and interpretation

consistent younging direction towards the core of the Bungalbin Syncline. The Mount Jackson area to the west is mainly composed of BIF and jaspilite (Chin and Smith, 1983)

- the upper sequence is best preserved in a large-scale anticline within the northeast limb of the Bungalbin Syncline. It consists of six units that are intercalated with, and overlain by BIF and chert layers.

Extensive BIF ridges form prominent hills and ranges, the most pronounced of which occur in the Helena-Aurora Range that hosts the Bungalbin East, Bungalbin and several smaller iron deposits. Other iron deposits have been discovered farther to the northwest of Bungalbin along the continuation of the Marda-Diemals greenstone belt to the Marda area. Economic mineralisation at the Windarling East deposit, 50 km to the northwest of Bungalbin is presently being mined by Cliffs Asia Pacific Iron Ore Pty Ltd (formerly Portman Mining). The deposits are all derived from the surface enrichment of primary BIF lithotypes.

Carina Iron Deposit

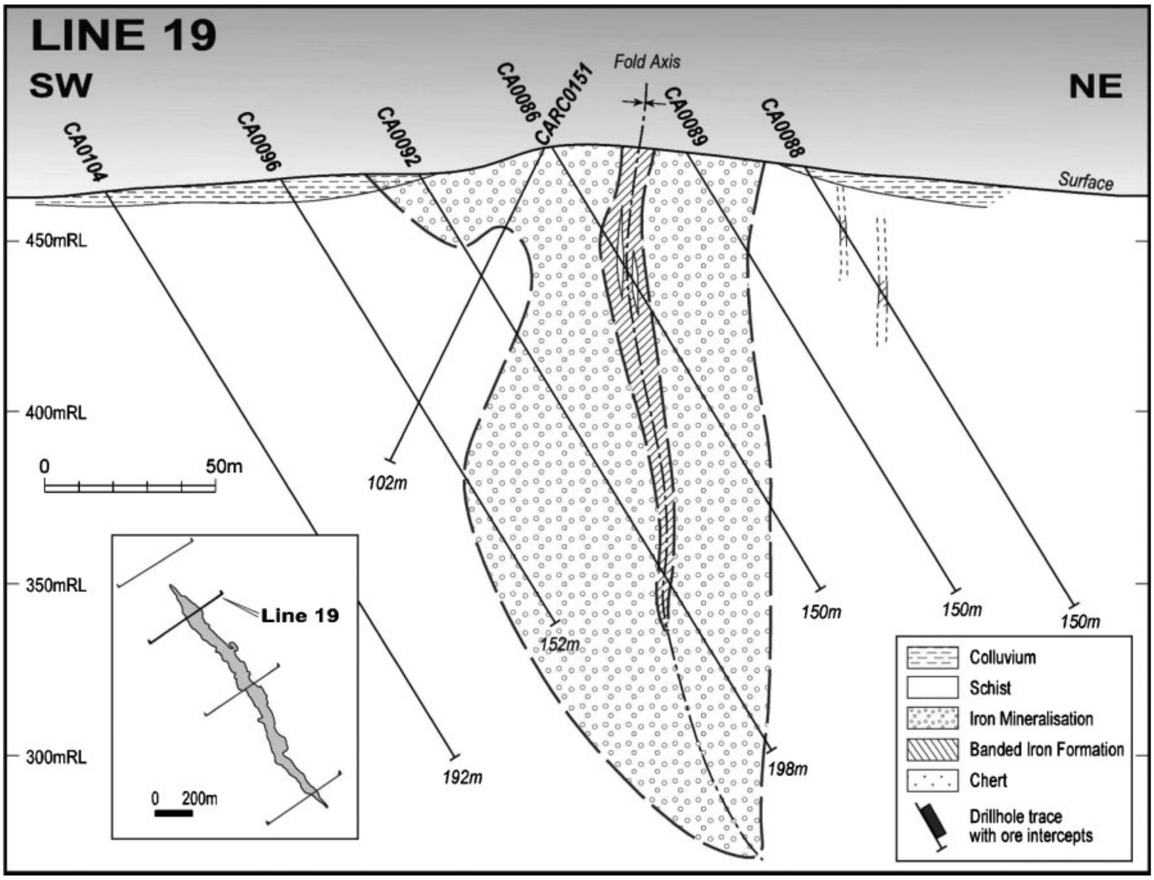
Geology

The Carina Iron Deposit is located within the sinistral Mount Dimer Shear Zone (Fig. 1). The general northwest-trending Archaean stratigraphy is a volcano-sedimentary package composed of an ultramafic sequence (komatiitic basalts, peridotite and alteration-derived talc-chlorite schists) passing into mafic lavas and flows (high Mg-basalts and vesicular basalts) interbedded with thin horizons of chert and BIF. Chert and BIF with intercalated siltstone and very fine-grained sandstone overlie the volcanic rocks.

The deposit is comprised of a steeply west-dipping zone of goethite and minor hematite mineralisation over a strike length of 1500 m and up to a maximum width of 90 m and drill depth of approximately 225 m. The mineralisation represents supergene enrichment of a siderite ($\pm$ankerite)-magnetite-pyrite parent BIF.

The deposit is goethite-rich with subordinate hematite mineralisation and occupies a doubly plunging, overturned syncline that is west dipping. Figure 2 illustrates the surface geology of the deposit area. The trend of this syncline is northwest and is sub-parallel to the Mount Dimer Shear Zone. Evidence supporting this overturned synclinal structure and interpretation is based on data from geological mapping (notably vergence mapping) and is supported by drilling as mineralised intersections close out at depth. Vertical holes drilled though the deepest portions of the mineralised zones have intersected mafic schists beneath the supergene iron mineralisation at the interpreted fold closure position. Parental BIF has not been intersected in drilling at depth beneath, or transitional to supergene mineralised zones. Preserved bedding features in oriented diamond drill core show bedding-to-core orientation changes consistent with drilling through a folded structure.

Similar stratigraphy is mapped on both sides of a ridge which forms along the western limb and parallel to



5 Schematic simplified geology section of Drill Line 19. Geology, drilling and interpretation

the axis of the syncline. A complex history with multiple phases of deformation is evident from structural mapping. Dip measurements, fold vergences of S- and Z-folds, and bedding cleavage relationships indicate the double plunging nature of the synclinal structure, which is therefore, in the absence of fault repetitions and juxtaposition, a rootless structure. M-fold patterns plunging approximately 30°N are observed about the southern fold closures in the outcropping mineralisation. Figures 3–6 illustrate the geometry of the deposit through a series of four interpretative sections.

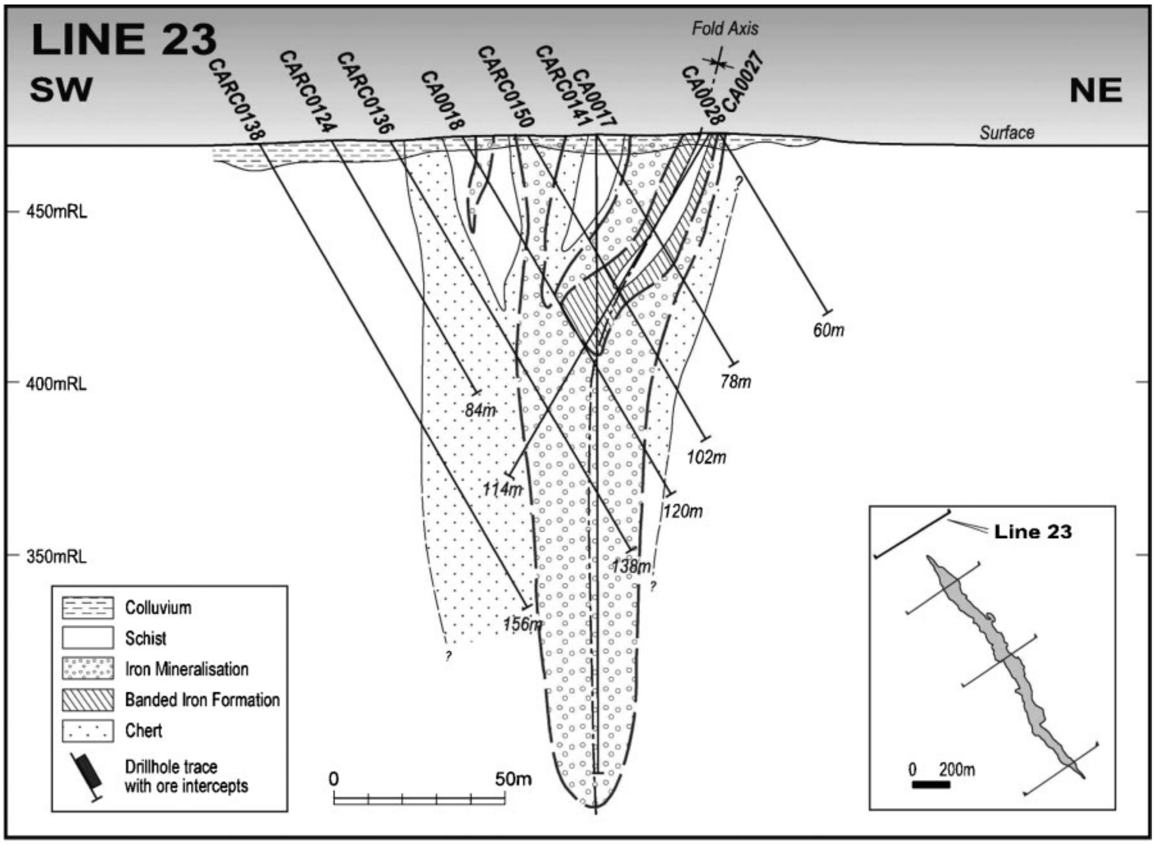
Both limbs dip steeply (70–85°) west though the western limb can dip steeply towards the east. The syncline is asymmetrical, and the western limb is consistently wider, steeper and more structurally deformed. Drilling indicated the maximum depth of fold closure occurs at approximately 225 m true depth and was intersected in the vertical drill hole CADD0001. The open parasitic fold structures plunge either 50° southwest (true bearing), 70° north or 70° east. Minor remobilisation of hematite along fracture cleavage in these orientations is found.

Brecciation, evidence of fluid interaction, pyrite replacement (alteration) and hypogene hematite (coarse platy hematite and specular hematite) are evident throughout the deposit.

The core of the syncline contains pallid to mottled saprolitic clays that occupy the fold hinge. As a result of the intense weathering to greater than 200 m in the synclinal structure, identification of primary lithology is extremely difficult. Residual chert fragments and powdery siliceous sand (the product of weathering chert) indicate the core is in part sedimentary. Adjacent very fine grained textures preserved in saprolite are interpreted to have originally been pelitic sedimentary rocks composed of siltstone to very fine-grained sandstone. Iron, magnesium and titanium levels from assays indicate mafic volcanic may have been interbedded within sedimentary rocks above the goethite replaced BIF in what is now the core of the syncline.

The overturned syncline has been refolded by latter events such that the deposit is refolded under itself in section. Interpretation of structural mapping data indicates the presence of recumbent, isoclinal and reclined folds at various scales. Faulting occurs at some fold closures.

Possible bounding faults along the western fold limb and internal faults parallel to the fold axis appear to have been pathways for fluid movement. Locally, intersections of faulting parallel to the strike of mineralisation and cross faulting are accompanied by intense brecciation. Zones of intense pyrite alteration are frequently associated with these structures. The northern end of the deposit is abruptly terminated by a northwest trending fault with south block down sense of movement. Against this fault, the ore body thickens and swells on the south side and dramatically thins on the north side. This observation is also found in the chert marker units particularly about the fold closures with the northeast trending faults. Zones of specular hematite are found within the goethite-dominant mineralised sequence along minor northeast and east trending faults that transect and locally offset the deposit.



6 Schematic simplified geology section of Drill Line 23. Geology, drilling and interpretation

Mineralisation is predominantly goethite (80%) with localised zones of earthy hematite to several metres in thickness. Earthy (ochrous) goethite and hematite also partially fill vughs and form bands along remnant bedding planes. Carbonate (ankerite-siderite) and less commonly quartz are sometimes present as drusy linings in vughs and infilling thin fractures.

A significant proportion of the iron mineralisation appears to lie stratigraphically above cherts that are best preserved in the over-thickened western limb of the fold structure. Cherts are present on the eastern limb; however, attenuation and faulting have reduced them to a series of discontinuous bodies.

It is unclear how much silica has been removed in the processes of supergene enrichment of the parent lithotype. Based on assay comparisons between BIF at depth and goethite mineralisation, silica content is significantly reduced in areas of goethite mineralisation. Interpretation of geochemical data from zones of mineralisation and proximal BIF and chert indicates that significant amounts of silica (25–35%) have been removed during the iron enrichment process. In the north of the deposit, cherts and BIF become more commonly intercalated throughout mineralised zones. The absence of transitional weathered or unweathered BIF at depth makes this quantification difficult.

Two orientations of shearing and faulting have locally offset the mineralisation. Shearing related to the regional trend (325°) occurs along the western side of the deposit along and proximal to the contact with mafic to ultramafic schists.

Intensely pyritic zones occur along the south western margin of the ore body and in some places are in sharp contact with supergene goethite zones. Reaction fronts are present and pyritised zones observed in diamond drill core appear to preserve textural features similar to those that are present in the oxide mineralisation. Zones of massive pyrite over 15 m true thickness, assaying up to 53% sulphur have been intersected along the south-east margin of the deposit between mafic schist and goethite mineralisation. Rarely, within the supergene goethite mineralisation, zones of massive pyrite up to 6 m wide have been intersected. Friable saccharoidal pyrite derived from these pyrite zones has been locally dispersed within vughs developed in goethite mineralisation proximal to the sulphide zones.

One explanation for the locally massive pyrite zones is that shear and fault zones that were active during regional deformation provided conduits for highly reduced fluids. Reaction occurred where these fluids came into contact with the precursor lithotypes to supergene iron mineralisation, interpreted from petrological samples from adjacent zones unaffected by pyrite alteration and faulting or shearing to have been dominated by carbonate iron formation. Pyrite zones have been intersected in a very limited number of drill holes, making interpretation of the trend and extent difficult. Further work to define the origin and extent of the zones is underway. Studies to date indicate the area affected by pyritisation is volumetrically insignificant and is confined to the deeper sections of the ore body.

Northeast trending structures also cut the iron mineralisation. Unlike the regional shears, these structures are not associated with sulphide alteration. Zones of coarse specular hematite (up to 2 cm plates) are spatially associated with these structures. Zones containing abundant specular hematite are host to the highest grade mineralisation intersected in the project area (61·0–66·0%Fe).

A thin 1–15 m layer of transported reworked canga or ferricrete developed at the surface during the Tertiary-Quaternary Periods peripheral to the outcropping ridge line and areas of higher relief. The ferricrete and canga is typically of sub-economic iron grade and ranges from 25% to 40%Fe, associated with highly variable Al (1–15%) and Si (1·5–60%), especially where clay rich zones and chert fragments have been incorporated into the surface deposits. Calcrete cement is also locally common. Collectively this material is referred to as 'hardpan'.

Carina posses many attributes of Algoma-type iron deposits as described by Gross (1980). Key factors include:

- host rocks of Archaean age
- primary BIF deposited in a volcano-sedimentary setting
- significant strong deformation and variable metamorphism of host rocks
- sulphide zones are common in host rock sequences
- mineralisation has developed through supergene enrichment of BIF-lithotype as evidenced by laminated textures of primary lithotypes preserved in supergene ores.

Carina can therefore be described as an Algoma-type iron deposit.

Petrography

Fifteen samples were submitted for petrographic analysis from diamond drill hole CADD001. Preliminary results indicate that the parent rock type as carbonate (siderite$\pm$ankerite)-hematite-magnetite BIF. Goethite typically comprises greater than 80%, and in many cases greater than 90% of the mineralisation (Teale, written comm. 2009). The average grade for the deposit of 58·6%Fe confirms this observation.

Goethite occurs primarily as earthy masses and colloform bands with botryoidal surfaces. X-ray diffraction studies show the goethite does not contain significant Al_2O_3. Earthy goethite forms as a replacement of banded and bedded lithotypes, interpreted to have been carbonate iron formation. Colloform banded and botryoidal goethite nucleates on brecciated fragments and pseudomorphed magnetite grains and partially to completely infill cavities and fractures. Goethite moulds over siderite preserve original siderite crystal forms (Teale, written comm. 2009).

Hematite occurs as earthy ochrous masses, ochrous bands alternating with colloform goethite, and botryoidal concretions within vugs and cavities. Hematite also occurs as acicular grains (specularite), to coarse platy masses with plates up to 4 cm across. Relict magnetite has not been observed in goethitic ores at the Carina deposit, and magnetite has only been observed in fresh, non-oxidised siderite iron formation obtained from outside the deposit boundary. Magnetite appears to have been martitised, and some examples are preserved well into the replacement 'supergene' iron mineralisation. The hematite is eventually replaced by goethite, but hematite rims are occasionally preserved (Teale, written comm. 2009).

Analysis by X-ray diffraction show that the iron mineralisation comprised of goethite, hematite and platy hematite constitutes 95–97% of the sample with quartz, siderite, and rare ankerite gangue comprising the remainder of the rock mass (by wt-%).

Ore genesis

The Carina Iron Deposit is believed to have formed though the surface oxidation of silica- and alumina-poor, carbonate-rich, BIF lithotypes. Oxidation and leaching during the wet tropical Early Tertiary was aggressive, due to the reactivity of the original carbonate (-pyrite) mineralogy within the protolith BIF. Oxidation led to the development of a high grade supergene ore body, in which primary bedded and banded features are preserved (evidenced mainly in diamond drill core). No zones transitional from supergene oxide replacement mineralisation to unoxidised primary BIF at depth have as yet been located. This is principally due to the deposit being a doubly plunging syncline that is therefore rootless; oxidation and replacement of precursor lithotypes to mineralisation within the syncline has been total and drilling has effectively defined the maximum depth to which mineralisation will be found in the Carina deposit.

Current resource

The resource at July 2009 stood at 26·7 Mt grading 58·9%Fe, 1·2%Al_2O_3, 3·7%SiO_2, 0·11%P, 0·08%S, and 9·5%LOI (Abbott, written comm. 2009). Results are shown in Table 1. The deposit has been defined through total of 195 drill holes for a total of 23 677 m of combined RC and diamond drilling. Table 2 details the drilling breakdown. The resource is based on assays from 170 RC and 11 diamond drill holes and the quoted resource figure uses a 55%Fe cut-off.

The resource was estimated using Ordinary Kriging with model blocks of 10 m (east) by 40 m (north) by 5 m

Table 2 Summary of drilling at Carina

Drilling type	Hole count	Total metres
RC	184	22 005
Diamond (surface)	7	1081
Diamond (tail)	4	591
Total drilling	195	23 677

Table 1 Carina Inferred Resource Estimate July 2009 (Abbott, written comm. 2009)

Cut-off Fe%	Million tonnes	Fe%	Al_2O_3%	SiO_2%	P%	S%	MgO%	MnO%	LOI%
50	27·4	58·7	1·3	3·4	0·11	0·08	0·14	0·21	9·4
51	27·3	58·8	1·3	3·3	0;.11	0·08	0·14	0·21	9·4
52	27·3	58·8	1·2	3·3	0·11	0·08	0·14	0·21	9·4
53	27·2	58·8	1·2	3·3	0·11	0·08	0·14	0·20	9·4
54	27·0	58·9	1·2	3·2	0·11	0·08	0·14	0·20	9·5
55	26·7	58·9	1·2	3·2	0·11	0·08	0·14	0·20	9·5
56	26·2	59·0	1·1	3·1	0·11	0·08	0·14	0·19	9·5
57	24·3	59·2	1·1	3·0	0·11	0·08	0·13	0·19	9·4
58	21·6	59·4	1·0	2·9	0·10	0·08	0·13	0·18	9·4

(RL). The estimate was constrained to a mineralised wireframe interpreted from geological logging and iron assay results. The estimated resource extends from outcrop to a maximum depth of approximately 220 m over a strike length of approximately 1·6 km. Dry bulk densities of 2·9 and 3·4 t/bcm were used for the hard pan and supergene mineralisation respectively. Metallurgical studies indicate a measured dry bulk density of 3·45 t/bcm for supergene goethite-dominant mineralisation. Localised areas of coarse platy hematite yield dry bulk densities of 3·71.

Exploration potential

In 2008, aeromagnetic/radiometric (8911 line km) and heli-EM (874 line km) surveys were flown. These regional surveys were flown to aid in the target definition along the Carina trend by investigating the iron mineralisation at Carina for a footprint that can be applied along the Carina trend. Data suggest that the supergene goethite mineralisation has a negative magnetic response relative to other lithotypes in the host greenstone belt sequence. Magnetic highs are caused by two dominant lithological types; primary magnetite-bearing BIF and altered ultramafic and high Mg mafics where magnetite has resulted from the breakdown of olivine to talc and magnetite. A gravity survey (2883 stations) was also completed on a regional 400×50 m grid with infill of 200×20 m and 80×20 m over the ore body.

Magnetic response at Carina is a function of high magnetite content in altered ultramafic and high-Mg mafic rocks that bound the Carina deposit. As the overall form is a syncline with a deepest closure of 225 m, and all parental BIF has been replaced by supergene goethite mineralisation, the structure and deposit is rootless and therefore no primary magnetic BIF remains to produce a positive magnetic response. As the parent units are located within the Mt Dimer Shear Zone and have undergone significant deformation, it is most likely that stratigraphic continuations and fold repetitions have been significantly displaced or truncated by shearing and faulting within the shear zone. This makes recognition of potential fold repetitions or fault offsets difficult and stratigraphic correlation with outcropping BIF ridges in the area very difficult.

Numerous prominent BIF ridges have previously been explored for iron ore however, the success of Polaris has been in the identification of new targets that possess significant resources, but which have subtle surface expressions. The Carina Extended and Chamaeleon prospects located approximately 1·5 km and 11 km north–west of Carina respectively and display similar low relief. Best intercept to date from Carina Extended is 56 m grading 60·3%Fe in drill hole CXRC0029 and from Chamaeleon is 46 m grading 58·3%Fe in drill hole CH0039. Geological and geochemical interpretation of the mineralisation northwest of Carina is at an early stage as the zone is more structurally complex than Carina.

Acknowledgement

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References

Chen, S. F. and Wyche, S. 2003. Bungalbin, Western Australia – 1 : 100 000 geological series, Geological Survey of Western Australia, Explanatory Notes, 27.

Chin, R. J. and Smith, R. A. 1983. Jackson, Western Australia – 1 : 250 000 geological series, Geological Survey of Western Australia, Explanatory Notes, 30.

Gross, G. A. 1980. A classification of iron-formations based on depositional environments, *Can. Mineral.*, **18**, 215–222.

Sofoulis, J. 1960. Report on a geological reconnaissance of a greenstone belt extending from Jackson in the Yilgarn goldfield to Ryans Find in the Coolgardie goldfield. Appendix: Report on iron ore deposits, Bungalbin-Mt Walton areas, Geological Survey Bulletin 114, GSWA, 21–43.

Abbot, J. 2009. Updated Resource Estimate for the Carina Iron Ore Deposit. Hellman & Schofield Pty Ltd.

Abbott, J. 2008. Interim Resource Estimation and Review of Sampling data for the Carina Iron Ore Deposit, Western Australia. Hellman and Schofield Pty Ltd.

Teale, G S. 2009. A Petrological, Mineragraphic and X-ray Diffraction Investigation of a Suite of Samples from the Carina Iron Project, Western Australia. Teal and Associates, unpublished consulting report for Polaris Metals.