Open File Envelope No. 12,781

EL 3048 / 3999 / 5245

PONDOOMA / IRONSTONE HUT

FINAL REPORT AT LICENCE FULL SURRENDER, FOR THE PERIOD 3/12/2002 TO 24/9/2015

Submitted by
Centrex Metals Ltd
2015

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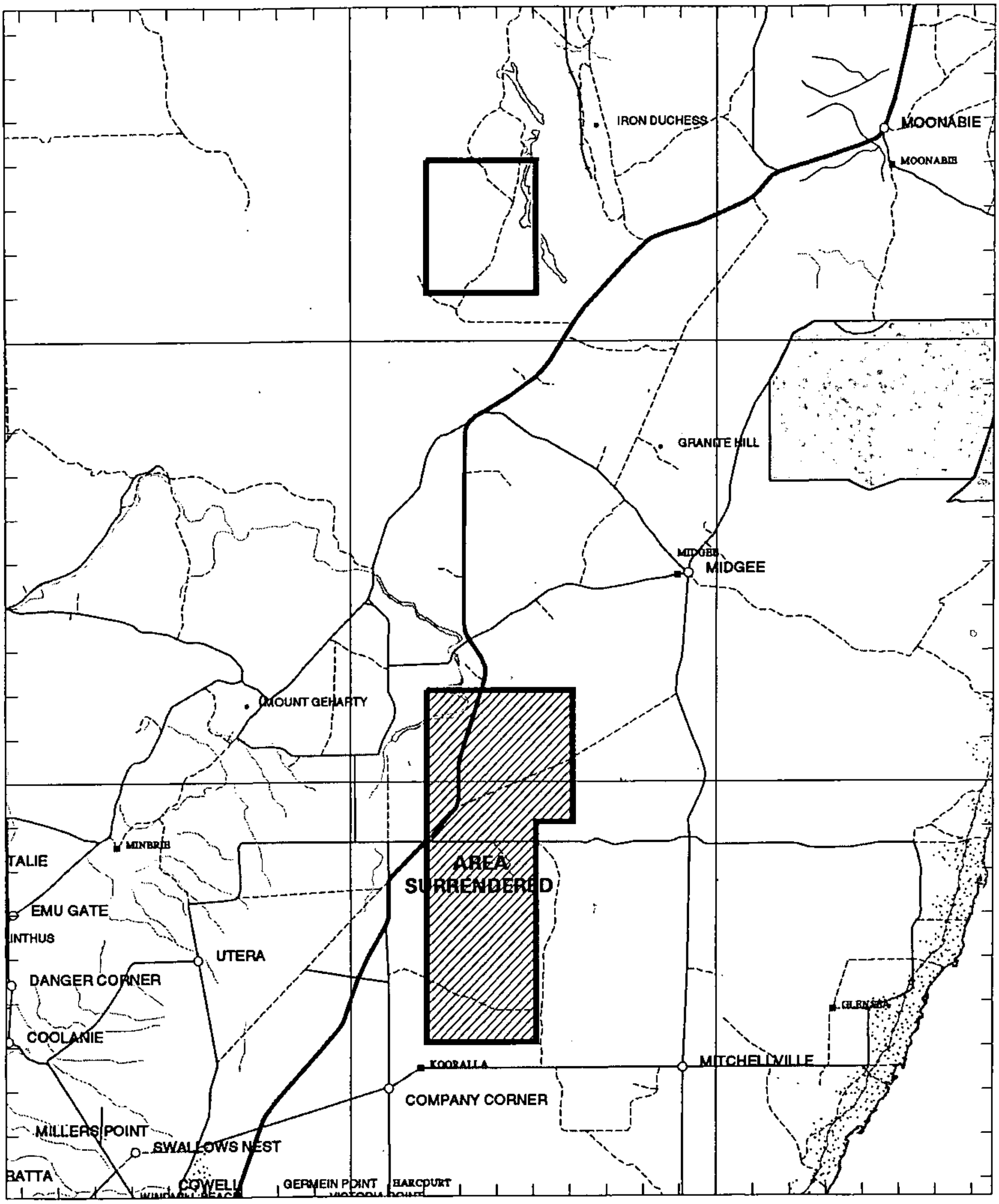
Government of South Australia
Department of State Development

SCHEDULE A



EXPIRED

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LICENCE GRANTED IN : DATUM AGD66

GDA
GEOCENTRIC DATUM OF AUSTRALIA

APPLICANT : **SOUTH AUSTRALIAN IRON ORE GROUP PTY LTD**

FILE REF : **107/02** TYPE : **MINERAL ONLY** AREA : **26** km² (approx.)

1:250000 MAPSHEETS : **WHYALLA**

LOCALITY : **PONDOOMA AREA - Approximately 60 km southwest of Whyalla**

DATE GRANTED : **03-Dec-2002** DATE EXPIRED : **02-Dec-~~2004~~** 2005 EL NO : **3048**

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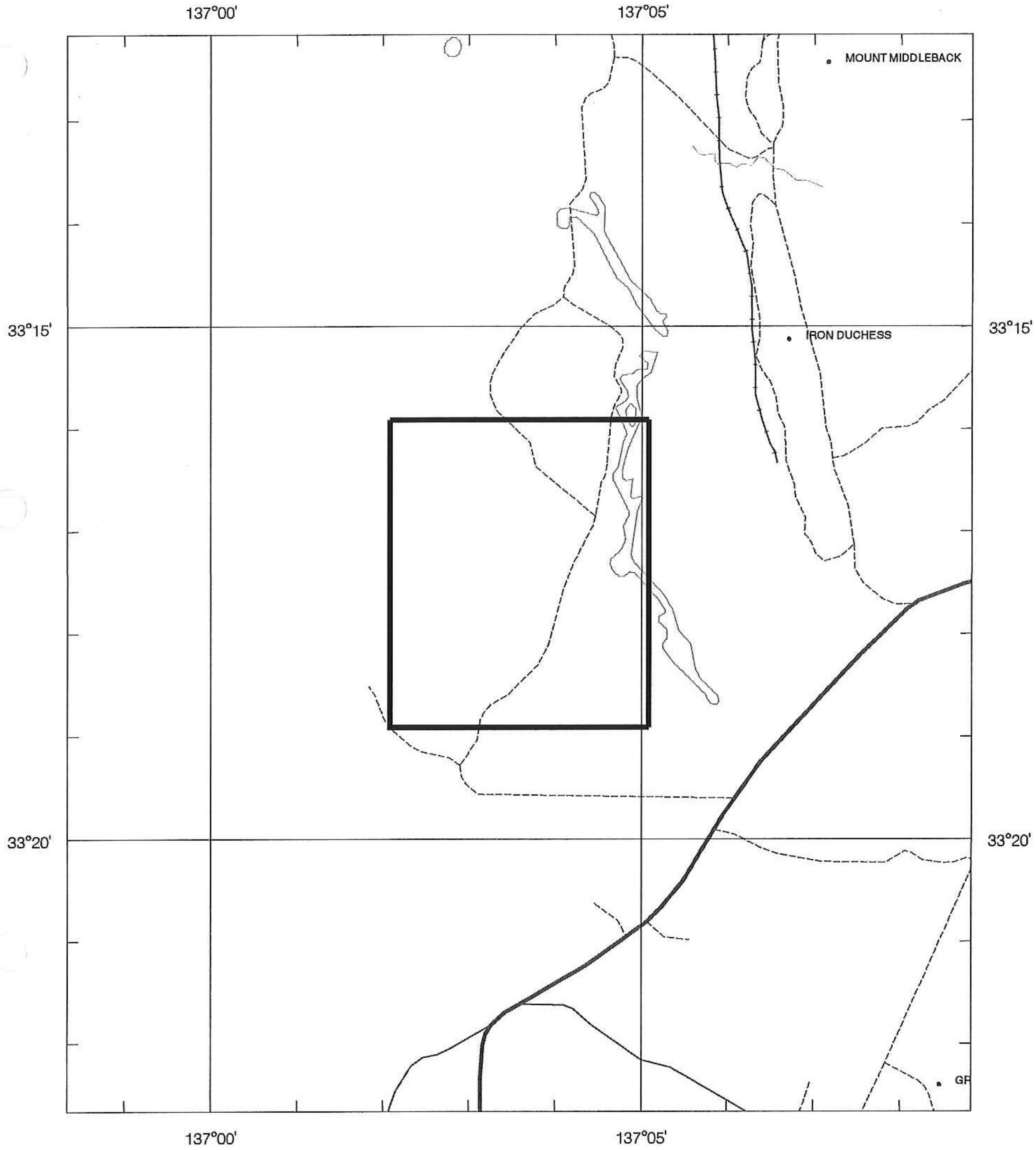

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LICENCE GRANTED IN : DATUM AGD66

GDA GEOCENTRIC DATUM OF AUSTRALIA

APPLICANT : **SOUTH AUSTRALIAN IRON ORE GROUP PTY LTD**

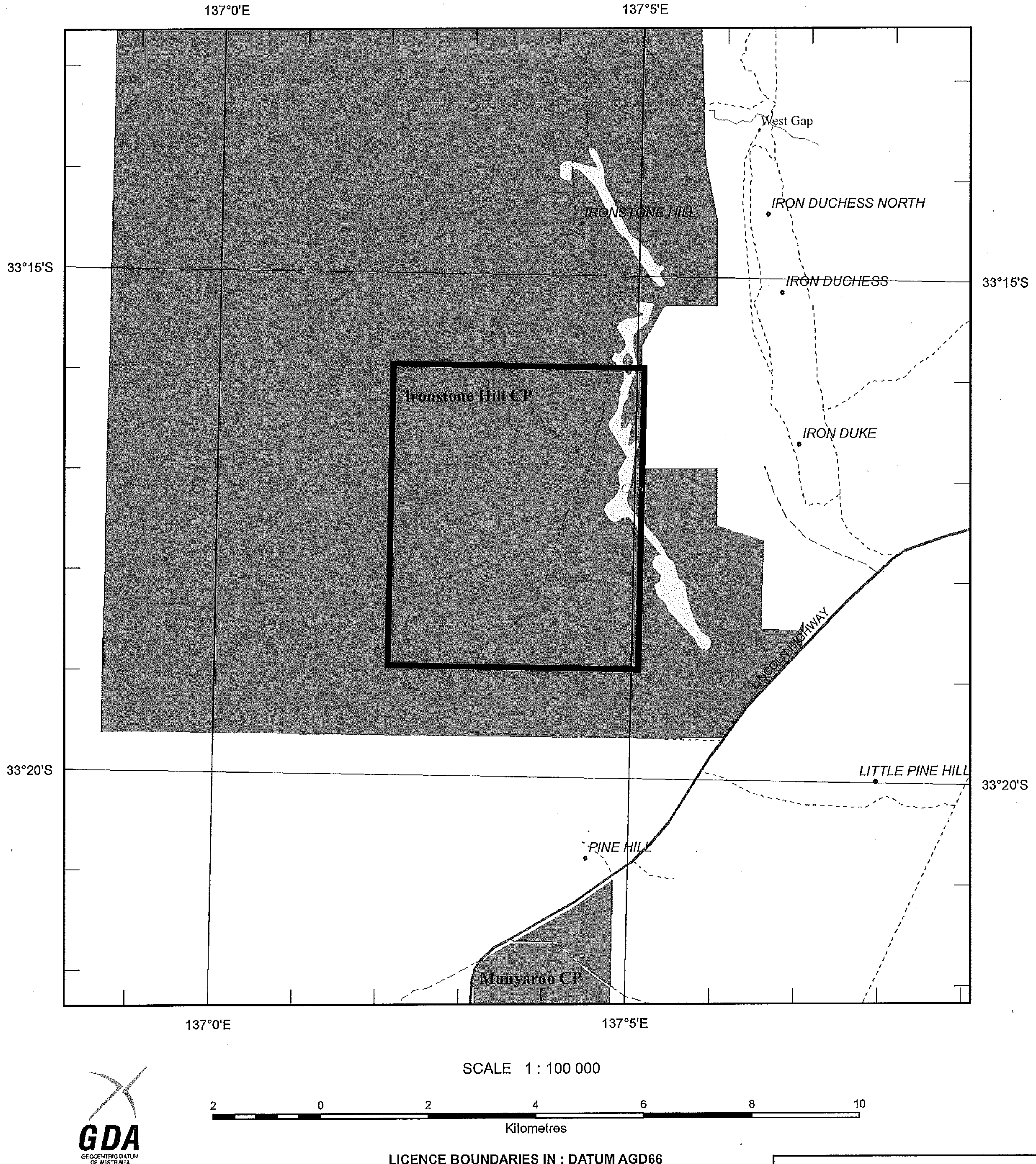
FILE REF : **533/07** TYPE : **MINERAL ONLY** AREA : **26** km² (approx.)

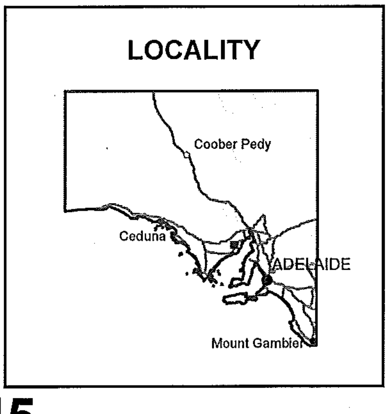
1:250000 MAPSHEETS : **WHYALLA**

LOCALITY : **PONDOOMA AREA - Approximately 60 km southwest of Whyalla**

DATE GRANTED : **12-Dec-2007** DATE EXPIRED : **11-Dec-2008** EL NO : **3999**

SCHEDULE A





APPLICANT : **SOUTH AUSTRALIAN IRON ORE GROUP PTY LTD**

FILE REF : **2012/00312** TYPE : **MINERAL ONLY**

AREA : **26** sq km (approx)

1 : 250 000 MAPSHEETS : **WHYALLA**

LOCALITY : **PONDOOMA AREA -**
Approximately 60 km southwest of Whyalla

DATE GRANTED: **12-Dec-2012** DATE EXPIRED: **11-Dec-2014** EL NO: **5245**

CENTREX METALS LIMITED

Final Annual Technical Report

EL5245 Ironstone Hut

Tenement numbers: EL5245 Ironstone Hut (from 12/12/2012)

Formerly EL3999 (12/12/2007 – 11/12/2012)

Formerly the northern portion of EL3048 Pondooma (3/12/2002 – 2/12/2007)

Reporting period: 3 December 2002 to 30 June 2015 (surrendered in full)
Licence was amended in the Mining Register on 24 September 2015

Tenement holder: Centrex Metals Limited

Operator: Centrex Metals Limited *(Lincoln Minerals Limited)*

Author: Fraser Farrell

Date: July 2015

1:250000 map sheet: SI5308 WHYALLA

1:100000 map sheet: 6331 MIDDLEBACK

All coordinates in this report are expressed in Geodetic Datum of Australia 1994, zone 53H, unless stated otherwise.

On 26 August 2010 this tenement area was included within a Conservation Park proclaimed under the *National Parks and Wildlife Act 1972.* Consequently this report may be placed on Open File.

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Contents

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1 SUMMARY OF ACTIVITIES

EL5245 Ironstone Hut, formerly EL3048 (northern part) and then EL3999, was one of a contiguous group of five tenements (EL5245, EL5335, EL4571, EL5170 & EL4451) collectively referred to as the *Western Middlebacks Tenements* by Centrex Metals. In recent years they have been reported within Centrex's "Northern Areas Amalgamated Expenditure Agreement" annual reports. The statutory six monthly summary reports have been individually submitted for all five tenements throughout their lives. Annual reports from earlier years of tenure were also individually submitted and some have subsequently been released to Open File by the SA Director of Mines.

The focus of Centrex's exploration was iron ores. From 8 July 2005 *Lincoln Minerals Limited* acquired rights to all nonferrous minerals within the tenement.

Centrex initially held tenure of EL5245 Ironstone Hut – then EL3048 Pondooma – as part of the SAIOG (South Australia Iron Ore Group) joint venture with Portman Iron Ore Ltd. Centrex acquired 100% of SAIOG and its tenements in September 2003. EL3048 Pondooma had two portions. The larger southern portion was surrendered in December 2007, and the northern portion was retained as EL3999 Ironstone Hut and renewed as EL5245 Ironstone Hut. The tenement's area has remained at 26 square kilometres since becoming EL3999.

A ground gravity survey was done in 2003 for SAIOG by Haines Surveys, comprising 750 stations at 50m intervals on east-west lines 200m and 400m apart. A short description is given in Section 2.3 and full details & data are available as Open File Envelope 10220.

Reprocessing of government and Open File aeromagnetic data was done in 2005 for the entire portfolio of Centrex tenements to identify iron ore targets. Data spacing and quality were variable which led to some uncertainty in drill target selections. In February 2007 an airborne magnetic, radiometric & digital terrain survey was flown for 420 line kilometres within EL5245 at line spacing of 100m flown at 50m height. This survey covered all five Western Middlebacks Tenements and expenses & data were shared between Centrex and Lincoln Minerals. Full details of the 2005 reprocessing and the 2007 survey, and the survey's data, are available from Open File Envelope 11449.

Mapping and outcrop sampling of EL5245 occurred during 2009-2010 as part of a larger mapping project for the entire Western Middlebacks Tenements. Follow-up PACE geochronology (published in PIRSA Report Book 2011/00003 and discussed in Section 2.5 below) revealed some rocks were >3000Ma.

No mechanical drilling has been done by Centrex or Lincoln Minerals (or SAIOG) within EL5245. During the mapping project a hand powered post hole digger was used to bore holes into lakebeds and regolith to ascertain thicknesses of potential detrital iron ores. These holes were backfilled immediately after their contents & subsurface layering had been examined.

The *Ironstone Hill Conservation Park* was proclaimed by the Government of South Australia on 26 August 2010. The Park includes all of EL5245 and practically all of neighbouring tenement EL5335 Ironstone Hill. The proclamations and a map of the Conservation Park are in Section 3 of this report.

Centrex's exploration licence for EL5245 Ironstone Hut was due for renewal on11 December 2015, but the tenement is being surrendered in full as of 30 July 2015.

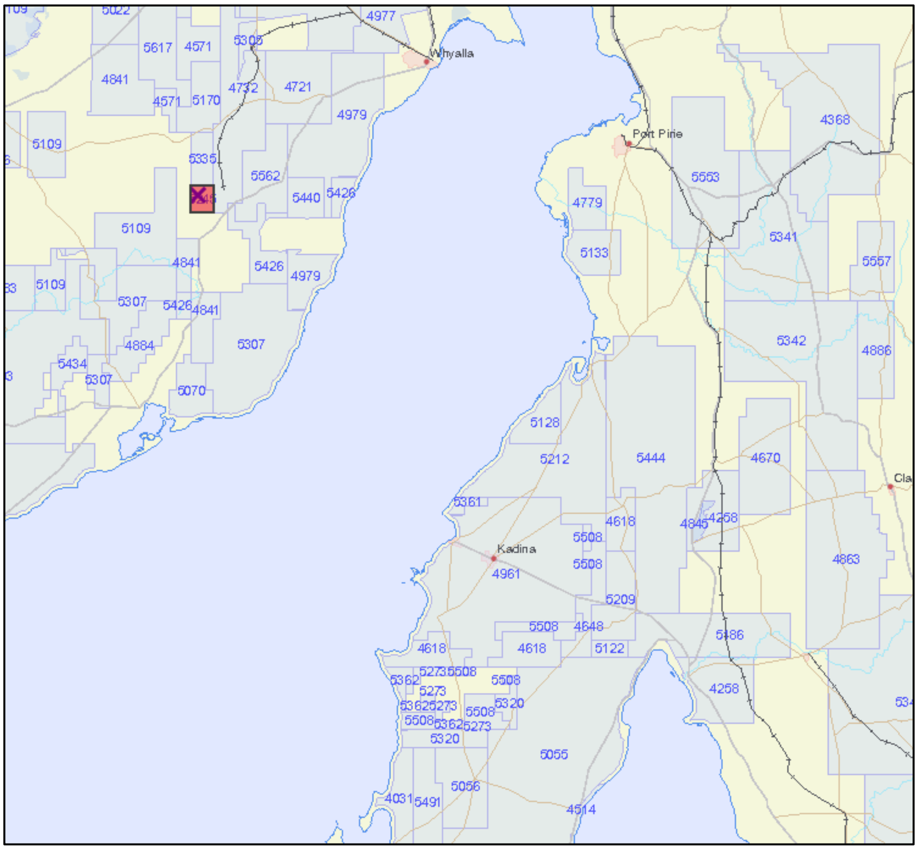


Figure 1: Location of EL5245 (in red, from SARIG).

2 EXPLORATION COMPLETED

2.1 INTRODUCTION & HISTORY

EL5245 covers 26 square kilometres immediately west of the southern Middleback Ranges and Arrium's open cut Iron Duke mine, which is itself midway between the city of Whyalla (population 23000) and the town of Cowell (population 800) on the eastern Eyre Peninsula. The mine's magnetite processing plant tailings dams begin a short distance east of the EL5245 boundary. Arrium is the mining successor to OneSteel, who themselves succeeded BHP as the owners of the many iron ore deposits along the Middleback Ranges.

The topography within EL5245 is generally flat to gently sloping; but some short steep slopes, gullies and small escarpments exist near the salt lakes along the eastern side of the tenement. The salt lakes are remnants of an ancient drainage channel now disrupted by Pliocene block faulting & subsequent sedimentary runoff. Rainfall onto the lakes was observed to drain towards the south. Hand borings into the lakebeds with a post hole digger found weathered bedrock (usually mylonite) <1m deep. A skin of pebbles, gravel & grit covers large parts of the lakebeds.

The landscape is deeply weathered, and developed widespread & abundant calcrete, before it was partly covered during the Pleistocene by numerous linear sand dunes up to 15m high. Outcrops of non-calcrete rocks are sparse.

Figure 2: An example of how easy it is to miss outcrops in the scrub. A white Toyota Landcruiser Ute is parked only 20 metres away, directly in front of the camera, on the tenement's main access track.

Winter rainfall is low but generally consistent from year to year. Summer rainfall is highly variable and dominated by thunderstorm events. Daytime summer temperatures often exceed 40°C and winter nights are usually frosty.

Vegetation within EL5245 is dominated by spinifex grass (on the sand dunes), a samphires + calandrinias + native boxthorn community (around the salt lakes), and dense mallee-melaleuca scrub (almost everywhere else). In many places the foliage canopy is almost unbroken and visibility at ground level is reduced to less than 30m. Old bushfire scars provide opportunities for many other plant species, such as sandalwood or oilbush, to locally flourish. No reliable correlation was discovered between any plant species and their underlying rock types; although spinifex showed a preference for sand dunes and non-calcrete rubble, and pale grey lichen grows on almost all calcrete surfaces.

The endangered Sandhill Dunnart *(Sminthopsis psammophila)* has been reported from EL5245 by various biological surveys. None of these mouse-sized marsupials were found by Centrex but occasional burrows of appropriate diameter were seen in the sandy areas during the 2009-2010 mapping. Several endangered Malleefowls *(Leipoa ocellata)* and their nest mounds were seen during the mapping. Common birds in EL5245 include crows, magpies, falcons, ring-neck parrots, various honeyeaters & finches together with occasional emus & budgerigars. Bluetongue and shingleback lizards are the most commonly seen reptiles; probably because they are large and slow moving. Many unidentified species of small lizards – and (fortunately) snakes – were quick to flee or hide when approached. Feral goats, foxes & rabbits were all being exterminated from the area of EL5245 as part of the management of the *Ironstone Hill Conservation Park.*

Bulletin 33 of the Geological Survey of South Australia (1954) contains the first comprehensive investigations of rocks around the Middleback Ranges including within EL5245. It also summarises many earlier investigations and internal reports by the Geological Survey and by BHP on the iron ores in the region. Unfortunately a lot of BHP's extensive searching for iron ores away from the Middleback Ranges was devalued by poor reporting of their sampling locations. The grid system(s) and benchmark(s) used have no known correlation to any published geodetic datum; and some sample location descriptions are so vague it is not even clear which *hill* a sample came from.

Many exploration companies who have subsequently held tenements containing EL5245 did only desktop reviews of earlier work. Others who had large tenements worked only on locations outside of EL5245. Exceptions include:

- The Shell Company of Australia targeted Cu-Pb-Zn during 1983-1985 in their EL1116, and their reports in Open File Envelope 6284 include summaries of earlier work by BHP and other companies. Their "Profile line 31" included several RAB holes along the main access track just west of Ironstone Hill's BIF outcrop (in Centrex's neighbouring EL5335). Shell were surprised to find only highly weathered "granitic bedrock" in these holes. "Profile line 31" is interpreted by Centrex to have drilled into a major shear zone, probably mylonitic.
- Acacia Resources describe rock chip sampling and assaying for Cu-Pb-Zn in 1994, from the relinquished southern part of their EL1831, in Open File Envelope 8894. No significant base metals were found.
- Helix Resources collected reconnaissance calcrete samples in 2001-2002 from their tenement EL2789, targeting potential gold and IOCG mineralisation around the large Charleston Granite batholith to the south of EL5245. Results are described in Open File Envelope 9873.

Overgrown remains of some old drill sites & tracks were discovered in the tenement during the 2009-2010 mapping. These are not mentioned in open literature so are presumed to date from the regional drilling campaigns by BHP soon after the publication of Bulletin 33.

2.2 GEOLOGY

A geology map of EL5245 is in Section 3.2 of this report. Major rock types for all five of the Western Middlebacks tenements are described below; with tenement-specific notes added.

2.2.1 MAPPING & SAMPLING IN 2009-2010

Access to EL5245 by Centrex via the Iron Duke Mine site was not permitted. The exploration licence conditions confined all vehicles to the existing track into EL5245 from the Whyalla-Kimba Road. This restriction together with the sand hills and dense vegetation resulted in all mapping traverses being done on foot.

EL5245 was geologically mapped as part of a larger mapping project covering all five of Centrex's Western Middlebacks tenements. The mapping strategy included:

- Trying to find and identify all rocks previously mapped by company and government geologists.
- Traversing all known aeromagnetic anomalies, with larger anomalies traversed by multiple paths on foot. Some anomalies matched mafic rocks or gneisses rather than iron ores. Some outcrops of iron ore had no associated anomaly because they happened to be located between flight lines.
- Traversing "no outcrop" areas to find unmapped rocks. Many new outcrops and subcrops were discovered this way, especially in places concealed from overhead view by dense foliage. However the dense vegetation and sand drifts guarantees that some outcrops will still have been missed.
- Taking advantage of the runoff from rare heavy rainfalls, which revealed the sources of otherwise imperceptible slopes and their rock fragments. Some of these slopes were capped by unmapped outcrops.
- Mapping existing vehicle tracks, vermin fences & gates with a view to possible future drill rig access.
- Sampling any outcrops of iron ore for assay.

Soon after mapping began it was realised that all previous geology maps showing EL5245 had placed too much faith in photo interpretation. Some "outcrops" didn't exist at all, some were just mixtures of calcrete & iron stained regolith, some were "identified" as a totally wrong rock type, and some were misplaced by up to 300m (thus might be a different outcrop). Some company maps on Open File had simply been redrawn from earlier maps including their errors. Photo interpretation is good for identifying the sand dunes and lake beds in EL5245 but is useless for reliably identifying outcrops and their rock type(s). The only guaranteed method of finding and correctly identifying rocks in EL5245 is to encounter them at ground level in person.

Numerous hand specimens were collected to assist with outcrop correlations across all five tenements. Outcrops of BIFs and other potential iron ores were sampled for assay, including assay sampling traverses across larger outcrops. Sample locations and assay results for EL5245 are listed in Section 4.

While mapping was in progress the *Department of Primary Industries & Resources SA* (PIRSA, as it was then known) instigated a PACE-funded collaborative geochronology program. Centrex's proposal to date rocks from the region was successful, so sampling was expanded to include samples (up to 50kg) of rocks thought to be stratigraphically significant. Geochronology results are discussed below.

Samples were also collected in 2010 by PIRSA geologists, and by Goodwin for her 2010 Honours Thesis.

2.2.2 CAINOZOIC

Nearly all the mapped region is covered by a **regolith** composed of clays, sands, grits, minor bedrock fragments, and occasional gravely paleochannels. Cursory observations suggest various fluvial, alluvial, aeolian, and in-situ rock weathering sources for the regolith; plus significant leaching and reworking of earlier unconsolidated materials. Some of these may be of pre-Cainozoic origin (for example, reworked Permian tillites). The regolith also contains abundant calcrete deposits which are discussed below. Sand dunes cover parts of the regolith and numerous small salt lakes are incised into it. Drilling near the mapped region has encountered up to 60 metres of regolith on top of weathered bedrocks. **Hematite pebbles** were noted to be weathering out of alluvium in many places along the eastern sides of EL5245 & EL5335 to form an erosional lag. Only trace to minor amounts of hematite pebbles were found within fresh alluvium, sometimes in discrete bands suggesting flood events. These buried hematite pebbles were greatly outweighed by calcrete nodules and/or rock fragments in the alluvium; consequently no assays were done. Significant accumulations of BIF & hematitic talus are exposed on the flanks of the nearby Middleback Ranges.

White to pale red **sand dunes** were not specifically mapped but are found throughout EL5245, EL5335, and the southern parts of EL4571 & EL5170. They form broad ridges up to 15 metres high, oriented ESE-WNW, and fixed in place by dense growths of spinifex and low mallee. The same sands can also be found piled against the sides of the steeper hills and ridges, where they have filled void spaces within the rock rubble. The dunes appear to be mixtures of locally derived materials and white sands from elsewhere. Demarcations between these sands and the underlying regolith often show sudden changes of slope, sand colour, grit & clay content, and vegetation. Consequently these dunes can be mapped reliably by photo interpretation.

Salt lakes fill most of the discontinuous chain of depressions in the low terrain along the eastern side of EL5245 & EL5335 and in the southern part of EL5170. These depressions were probably a Cainozoic river channel that has been disrupted by block faulting, decreasing rainfall, mobile sand dunes, and modern alluvial sedimentation from the rejuvenated Middleback Ranges. Topographic contours show this channel as a ~4km wide ~40m deep gap cutting through the higher ground along the Whyalla-Kimba Road. Many of the lakes exhibit actively eroding western shorelines, and accumulations of wind-blown gypsum & silt on their eastern and southern sides. The lakebeds near Iron Duke Mine are partly covered by a skin of pebbles, gravel & grit of weathered rock and BIF. Post hole digger borings found weathered mylonite less than one metre below these lake beds, and very low concentrations of BIF fragments within the lakebed muds and within the surrounding regoliths. The skin of pebbles, therefore, represents the erosional residue from a total volume of material much larger than today's lake basins. After rain the waters in these lakes can be seen to drain southwards.

Calcrete wasn't mapped because it is a ubiquitous part of the regolith. Calcrete occurs in a variety of forms ranging from scattered nodules up to solid sheets of stone. Some of the latter has been broken up by tree roots and by old track works. The calcrete layer closely follows the modern regolith surface, so it is likely that any calcrete exposed at the surface gets slowly dissolved by rainfall and then re-precipitated below the soil. Calcrete obscures many of the outcrops of other rocks – sometimes so much that they were only discovered by breaking open the “calcrete”.

Outcrops mapped as **silcrete** consist of amorphous massive silica, with colours ranging from grey to dull white but frequently stained red/yellow/tan by ferricretes. Occasionally silcrete outcrops contain thin horizontal layers of well-rounded milky quartz pebbles, minor weathered rock fragments, and well-rounded grits. One such occurrence near the SE corner of EL5335 has thickened to fill a Cainozoic paleochannel. The only other textural features seen in silcrete outcrops are intergrowths and interbeddings with ferricrete, some minor voids, and cementation of older rocks.

Ferricrete consists of tough, massive, dark brown to black limonite + hematite, with minor amounts of silica and rock fragments (including older ferricretes). Small irregular voids and cavities are common, but some have been partly or totally filled by hematite. A few outcrops of vaguely layered earthy-looking limonite-rich rock, also mapped as ferricrete, are probably laterite.

Blends and intergrowths of silcrete and ferricrete are common at outcrop scales. Exposures containing between ~1/4 and ~3/4 silcrete with ferricrete were mapped as silcrete+ferricrete. No correlation was found between ferricrete and potential iron source rocks, or any adjacent rock compositions. Ferricrete (and silcrete) fragments are also common within the regolith, and upon its surface as erosional lags. Ferruginous intervals intercepted in the regolith by historic drilling are probably subsurface ferricretes or laterites.

Silcrete & ferricrete both formed during the wetter climates of the early-mid Cainozoic. Generally (but not always) their outcrops are found capping modern topographic highs and occasionally they are overlain or impregnated by calcrete.

Figure 3: Sieving +6.4mm fragments from the regolith. Most of the oversize is calcrete or barren rock.

Figure 4: Detrital milky quartz gravel cemented by silcrete.

Figure 5: A typical ferricrete.

Figure 6: Probably a laterite, but was mapped as ferricrete.

2.2.3 NEOPROTEROZOIC

Gairdner Dolerite dykes have been postulated to exist in the tenement by some previous explorers; and there are several occurrences of dolerite/amphibolite rubble & outcrops. None of these can be confidently identified as Gairdner Dolerite without more detailed investigations.

2.2.4 MESOPROTEROZOIC

Previous mappings have depicted a large area of **Charleston Granite** in EL5245 but this appears to be another error of photo / geophysical interpretation. The only outcrops which *might* be Charleston Granite were two small dykes, found by the access track in the northeast of EL5245, which appear to be a finer-grained version of this distinctive granite. Other outcrops previously "mapped" are definitely not Charleston Granite.

Figure 7: The possible Charleston Granite dyke (left), and the actual Charleston Granite (right) exposed by a Lincoln Highway road cutting.

2.2.5 PALEOPROTEROZOIC (KIMBAN OROGENY)

This section describes rocks formed by the Kimban Orogeny. Recognisable rocks that were altered by the Kimban Orogeny are described later.

The Kimban Orogeny featured multiple episodes of intense folding, syntectonic intrusions, and regional metamorphism to amphibolite-granulite grade during the period ~1850Ma to ~1700Ma. It affected the entire eastern Eyre Peninsula and culminated with the development or re-activation of major shear zones. One of the largest of these is the Kalinjala Shear Zone (a.k.a Kalinjala Mylonite Zone), which has been traced for hundreds of kilometres from the Lake Gairdner region south-eastwards down to EL5245, and then south-westwards to Port Neill, Port Lincoln and beyond.

The abrupt change in magnetic textures bordering the west side of the mapped area marks the inferred trace of the Kalinjala Shear Zone. There is almost no outcrop on the trace itself but outcrops that are several hundred metres away show intense deformation. The magnetic intensity map also shows other faults splaying off the bend in this crustal-scale dextral shear. A deep crustal seismic survey by Geoscience Australia in 2008 revealed the Shear Zone near Iron Knob as an east-dipping crustal-scale discontinuity, with several near-vertical splays into the overlying rocks.

Another abrupt magnetic change occurs along the eastern side of the mapped area, where the typical low-intensity “moat” surrounds the very magnetic Middleback Ranges. The BIFs in the Middlebacks define a refolded sheath fold that plunges deep into the earth. East of the Middlebacks “moat” the magnetic complexity abruptly reappears.

Therefore it is reasonable to interpret the mapped basement outcrops as a collection of deeply eroded nappes or crustal blocks separated from each other by splays of the Kalinjala Shear Zone.

2.2.5.1 Various massive quartz bodies

Massive quartz occurs in many places and it has multiple origins. All have been mapped as the same rock in this work. Most common are the massive milky quartz bodies associated with faulting and shear zones, which can all be interpreted as cataclastic melts during the Kimban Orogeny. These bodies can be several hundred metres long but intense fracturing has shattered many of them into swathes of rubble. A second type is the milky quartz segregations found within and alongside pegmatite intrusions. A third type of massive quartz sometimes forms layers interbedded with cherts or cherty BIFs. This type represents either variations in sedimentary deposition, or large-scale chemical segregation during Kimban Orogeny metamorphism.

A fourth type of massive quartz consists of pale grey silica, randomly and intensely veined by multiple generations of milky quartz veins. Hydrothermal vents are known to exhibit similar textures, so this rare type of quartz might have been produced by hot springs arising from the Gawler Ranges Volcanics? The best outcrop of this rock is at the gravity survey “benchmark” near the centre of EL5245. A small outcrop of the same rock was serendipitously found west of EL5335 by the Whyalla-Kimba Road.

Concordant veinlets of milky quartz are a common but minor component of the cherts and magnetite BIFs described below.

Figure 8: Massive quartz/chert near Ironstone Hill in EL5335.

Figure 9: Probable hydrothermal quartz near the centre of EL5245.

2.2.5.2 Mylonites

Mylonites from the Kimban Orogeny are suspected to exist along several crustal block boundaries in the mapped region, and the Kalinjala Shear Zone passes along the western boundary of the tenement. Spectacular exposures of a mylonitic boundary were found straddling the eastern sides of EL5245 & EL5335, where a mylonite zone at least 1km wide and traceable for about 3km along strike has been revealed by lakeside erosion. These outcrops are dominated by felsic and granitic mylonites. Minor volumes of mafic mylonites also occur, as discrete layers or as streaks & blended bands within the felsic mylonites. Some of the mafics may be syntectonic or post-tectonic intrusives. Mylonite layering here has a near-vertical dip and a strike of 20-30 degrees. Intense cleavage has totally shattered some outcrops. Minor faults and open folding disturb the layering & cleavage and suggests some post-mylonitic compression along strike. Post hole digger borings in the adjacent lakebed revealed more of these mylonites beneath a thin blanket of saline mud. Rare rods of siliceous hematite-magnetite within the mylonites may have originated from tectonically ingested BIFs. Flanking the western side of this mylonite zone are poorly exposed, strongly foliated granites and gneisses. Other strongly foliated granitic/gneissic rocks occur near some of the other inferred crustal block boundaries but their associated mylonites are not exposed.

Shear zones through many of the older granite/gneiss outcrops sometimes included mylonitic or cataclastic layers that are only a few metres wide.

Figure 10: Slaty granite (left); and a syntectonic amphibolite intruded into felsic mylonite (right), both in EL5245.

2.2.5.3 Fine-grained pink granite

This Kimban Orogeny granite consists of quartz + potassium feldspar + minor plagioclase ± trace hornblende. The pink colour is pervasive and may be iron staining rather than feldspar. Phenocrysts are absent, unlike the other granites mapped. Crystals are typically no bigger than ~2mm, often much smaller, and often show a preferred orientation or weak foliation. Outcrops, where they exist, consist of nearly featureless pink cobbles and small boulders. Fragments of this rock are a common trace component of the regolith south of the Whyalla-Kimba Road. Most of the outcrops were found south of 6320000n but outcrops and rubble patches are also known from as far north as the centre of EL4451 Stony Hill. A sample of this granite was assayed as sample IH029, and another sample IH088 from EL5335 Ironstone Hill was dated to 1737±5Ma by PACE geochronology.

The fine-grained pink granite intrudes many other rock types including the magnetite BIFs, and is itself intruded by the suspected Charleston Granite dykes in EL5245. It has also been strongly deformed in places by mylonitic shear zones. An outcropping sheared contact with magnetite BIF included a cataclastic melt zone about 10 metres wide.

Figure 11: Fine grained pink granite in outcrop (left), and more typically as patches of pink rubble (right).

2.2.5.5 Metagabbro ("red gabbro")

Figure 12: Metagabbro.

“Red gabbro” is an informal name for a medium-grained hornblende + red feldspar ±minor biotite rock. The red feldspar was assumed to be potassic when mapped but petrology later showed it to be intensely micro-sheared plagioclase. All but two outcrops were found alongside a mafic rock and a granitic/gneissic rock, suggesting that the “red gabbro” is either a contact metamorphic product or a blended melt of both rock types. Exposed contacts may be very irregular at outcrop scales. However the majority of mafic/granitoid boundaries don’t feature any “red gabbro”.

A sample IH089 from EL5335 Ironstone Hill was dated to 1736±4Ma by PACE geochronology.

2.2.6 VARIOUS AMPHIBOLITES & DOLERITES

Most mafic rock mapped in EL5245 consists only of weathered rubble or subcrop, with little or no in-situ outcrops or preserved contacts with neighbouring rock(s). Consequently it's been impossible in most cases to determine the relationship between mafics and their nearby rocks just from field evidence. Even correlating the mafic rocks with each other has been difficult, so it's likely that categories below inadvertently include rocks of multiple ages and origins.

Fine grained amphibolite schist is a very fine grained dark green schistose rock, possibly retrograde metamorphosed from a mafic predecessor. The majority of exposures occur as swathes of flaky-platy rubble because this rock readily breaks when weathered. The hand lens shows only minor tiny flakes of chlorite & biotite in an unresolved groundmass. A sample from neighbouring tenement EL5335 was assayed as IH026.

Porphyritic (“spotty”) amphibolite has abundant medium-to-coarse grained plagioclase in a dark green unresolved groundmass. The plagioclase grainsize is always far larger than the other minerals and it's this contrast that distinguishes it from the next category. The relationship between the two is unclear. A porphyritic amphibolite was assayed as sample IH030.

Amphibolite/dolerite probably includes rocks of multiple origins, but in hand specimen they all appear similar. “Amphibolite” includes all fine-to-medium grained hornblende + plagioclase rocks, and “dolerite” includes all fine-to-medium grained hornblende + plagioclase + pyroxene rocks. Both are sometimes foliated or lineated, but unlike the previous two mafics the entire rock is crystalline in the hand lens. The plagioclase grainsize is similar to the other minerals but weathering emphasises the plagioclase on exposed surfaces. Most dolerites & amphibolites are blended at outcrop scales.

Figure 13: Fine grained amphibolite.

Figure 14: Porphyritic or "spotty" amphibolite rubble.

Figure 15: Amphibolite/dolerite outcrop in a floodway in EL4571.

2.2.7 BIFS AND OTHER "HUTCHISON GROUP" ROCKS

While mapping was in progress these rocks were presumed to be Paleoproterozoic in age and correlative with similar BIF sequences elsewhere on the Eyre Peninsula. Consequently they are shown as such on the geology maps in this report. Ongoing geochronology by the Geological Survey of SA has now shown this "Hutchison Group" consists of three discrete (meta)sedimentary packages of different ages and provenances, one of which is late Archean in age and named Middleback Group. This Archean package is only found east of the Kalinjala Shear Zone and is represented by the rocks of the Middleback Ranges, by the BIFs mapped in these tenements, and by the BIFs found near Cowell.[1] The stratigraphy is *Katunga Dolomite* (oldest) → *Middleback Jaspilite / BIF* → *Cook Gap Schist* (youngest). In the Middleback Ranges the BIF unit has been tectonically repeated to yield a *Lower* and an *Upper Middleback Jaspilite.* The other two packages are only found west of the Kalinjala Shear Zone and have been named Cleve Group and Darke Peak Group. The revised stratigraphy is shown below.

[1] By Centrex Metals within EL4884 Bungalow/Minbrie, and by Rex Minerals within their EL5070.

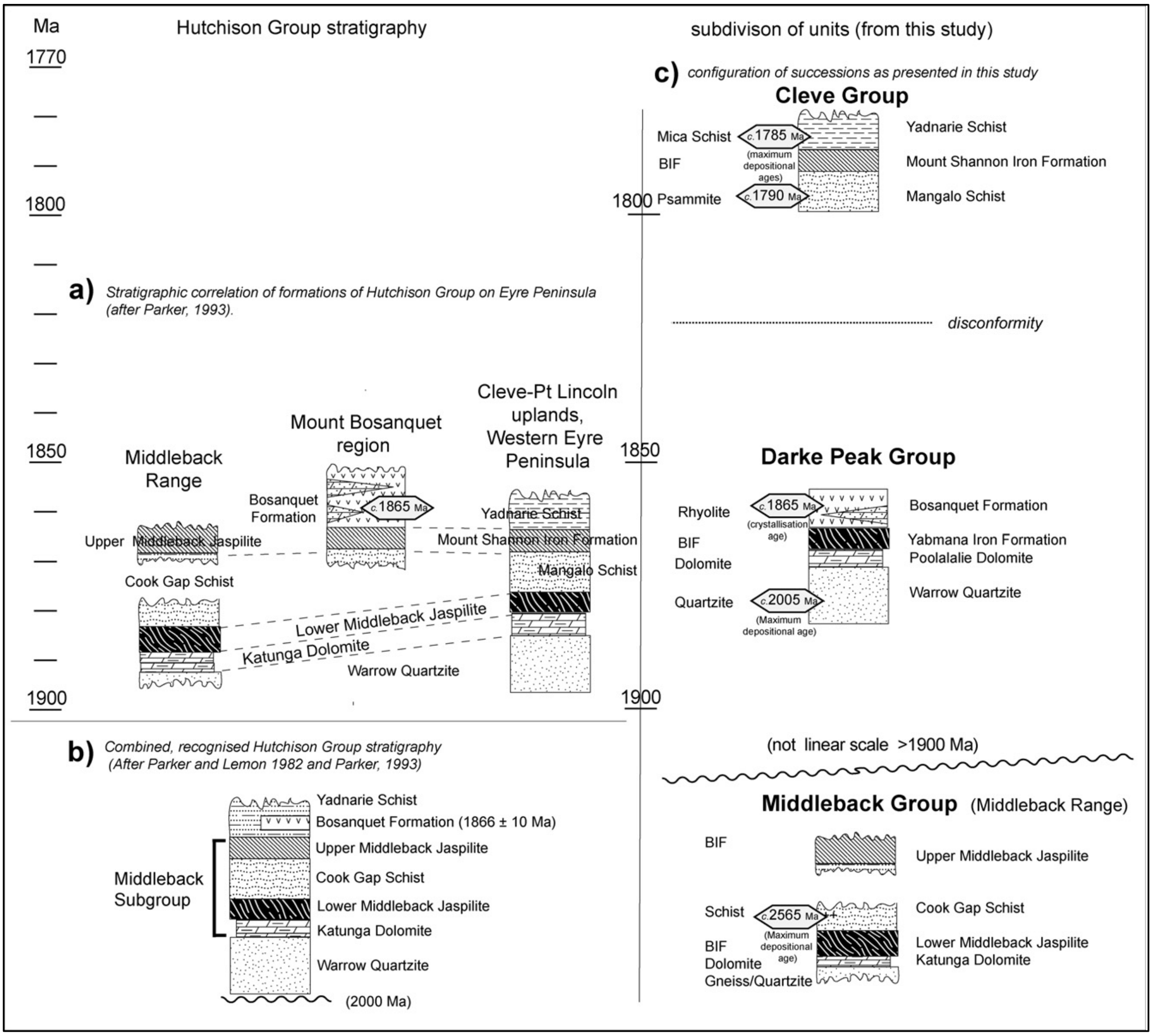


Figure 16: Stratigraphic correlations published by Szpunar et al (2011). The left half shows the traditional "Hutchison Group" correlations. The right half shows the three recently recognised BIF packages.

Fine grained **schists** probably underlie a lot of the mapped region but almost none of it outcrops because it weathers so easily. Fine grained schist fragments alongside BIFs may represent the Cook Gap Schist, part of the Hutchison Group. Other isolated schists are of unknown age.

A **quartz magnetite schist** that outcrops alongside some BIFs is interpreted as sheared BIF, and has been mapped as BIF. The magnetite has been recrystallised into porphyroblasts up to 4mm size.

Two types of magnetite BIF were found. One consists of laminations of elongated crystalline quartz + fibrous anthophyllite/cummingtonite, alternating with laminations of crystalline magnetite + minor quartz. Laminations were each 1-3mm thick with magnetite crystal sizes from about 2mm down to microscopic. The second type contained thinner and less distinct laminae defined by alternating fine-grained quartz and magnetite. Both types of BIF showed gradational contacts with any adjacent cherts, both types were partly silicified & partly altered to hematite/limonite by millennia of exposure, and both types contained countless concordant quartz veinlets whose edges were magnetite enriched. Occasionally the quartz veinlets look like they are “folded”, where they have broken across a BIF lamination or two before resuming concordancy, sometimes in the opposite direction.

All BIF outcrops are surrounded by halos of weathered BIF fragments, and the bigger outcrops were flanked by a BIF + sand talus. This makes the larger BIF outcrops look even bigger on aerial photos and thus some previous mappings have greatly overestimated their size. The largest single outcrop of BIF straddles the boundary of EL5245 and neighbouring EL5335.

The magnetite BIFs were severely folded and compressed by the Kimban Orogeny. Layer-parallel internal shearing within BIFs has produced quartz-magnetite schists with magnetite porphyroblasts up to 4mm size. Many lines of magnetite BIF outcrops are cut by faults crosscutting Kimban Orogeny structures.

Shearing against granitic-gneissic rocks has produced cataclastic melt zones up to 10 metres wide, grading from magnetite BIF --> schistose & silicified BIF --> "magnetite+silica rock" and/or "quartzite" --> quartz+feldspar pegmatite (intermittent pods) --> foliated and/or schistose granite with quartz veins --> granite.

Hematite-altered BIFs occur when magnetite BIFs are shattered by faults or intense folding, allowing groundwater to penetrate the BIF and convert the magnetite into hematite. These outcrops frequently have hematite (and limonite) filling fractures and veins, as well as replacing the original magnetite. The original quartz seems unchanged in outcrops but the anthophyllite has often weathered to clay and limonite. A similar process is at work today in all of the magnetite BIFs, slowly converting magnetite laminae into hematite & limonite.

Thin beds of chert and cherty magnetite BIF occur within many of the magnetite BIF outcrops, but few of these layers are thick enough to map individually. Contacts with BIFs are gradational over 0.2 to 2 metres across strike, or over tens of metres along strike. Cherts probably represent intervals of low iron and/or high silica sedimentation.

Figure 17: Minor folding in magnetite BIF outcrop.

Figure 18: Concordant quartz veining in magnetite BIF.

Figure 19: A rare outcrop of reasonably fresh Cook Gap Schist, in EL4571.

2.2.8 MESOARCHEAN ROCKS

2.2.8.1 Cooyerdoo Granite

The name Cooyerdoo Granite was first used informally by BHP geologists many years ago to describe the large granite outcrops between Iron Baron and Iron Knob mines. Isolated large outcrops of Cooyerdoo Granite near the boundary of EL5170 and EL4571 were described in Bulletin 33 as the "Woolshed Granite", named for a small woolshed that used to exist there in the 1950s. Speculation about the Cooyerdoo Granite's true age continued for decades – frustrated by a lack of visible and un-faulted contacts with other rocks – until late 2008 when its U-Pb zircon age of 3157±2Ma was first announced by Geoscience Australia. Inherited zircons up to ~3310Ma were reported but no younger metamorphic zircons were detected, suggesting that these samples were at a high crustal level during the various orogenies that strongly deformed younger rocks in the region. Zircons from the Cooyerdoo Granite have been inherited by several younger igneous and sedimentary rocks in the region.

Discussions with the geochronologists and the landowners resulted in a 2009 visit to this Cooyerdoo Granite's type locality on the eastern border of Cooyerdoo pastoral lease, plus a visit to the type locality (on the neighbouring Corunna pastoral lease) of the ~3150Ma "unnamed gneissic granite" also found in 2008. At the time these were thought to be correlative with rocks recently discovered by Centrex's mapping. The Corunna rock contains some ~2500Ma metamorphic zircon and was formally defined as a gneissic variant of Cooyerdoo Granite in 2012.

No definite outcrops of Cooyerdoo Granite were found in EL5245 or EL5335, but it may exist there at shallow depths. In EL4571 and the other two tenements Cooyerdoo Granite occurs as light grey pavements and low tors consisting of fresh-looking medium grained plagioclase, a pink to pale brown potassium feldspar, quartz, minor disseminated biotite and occasional hornblende. Feldspar crystals up to 3 times the size of their neighbours are a rare but widespread component. Some outcrops show minor aplitic veining, or a compositional banding of quartz + potassium feldspar alternating with fine-grained disseminated biotite-rich bands. These more gneissic outcrops also tend to weather pinkish, rather than grey, and are sometimes associated with thin mylonitic shear zones.

Contacts with other rocks are rare and obscured by shear zones or by faults. No xenoliths have been found. In its type locality the Cooyerdoo Granite also features lines of foliated dolerite rubble, apparently dykes intruded sometime before ~2500Ma.

Geochemistry indicates a slightly peraluminous calcalkaline I-type granite derived from crustal melting.

Figure 20: Cooyerdoo Granite (left) and its gneissic variant (right). The latter is at the Corunna type location sampled by Geoscience Australia.

Figure 21: Typical outcrop of Cooyerdoo Granite, in EL4571.

2.2.8.2 Gilles Gneiss

Gilles Gneiss is an informal name for a medium-grained granitic gneiss composed of potassium feldspar, plagioclase, quartz, minor biotite & minor hornblende. Biotite & hornblende are sometimes partly altered to chlorite and predominantly occur as fine-grained aggregates <2mm size. The light grey & pink gneissic banding is produced by alternating quartz + potassium feldspar-enriched and plagioclase-enriched zones; often folded or warped at outcrop scale. Some outcrops also feature small tourmaline-rich veins and/or feldspar-rich pegmatites & leucosomes. No xenoliths have been found.

Outcrops of Gilles Gneiss generally occur as clusters of <1m high rounded tors or small pavements. Swathes of medium to fine grained amphibolite-dolerite rubble alongside and around Gilles Gneiss outcrops are very common but the relationship of this mafic rubble to the Gneiss is unclear. Outcrops of the Gneiss occasionally contain thin concordant mafic bodies, consisting of hornblende + plagioclase with minor pyroxene and vein calcite. These un-dated bodies may be remnants of protolith, or sills intruded prior to metamorphism.

The biotite & hornblende aggregates, and the general absence of biotite-enriched banding, helps to distinguish hand specimens of Gilles Gneiss from the otherwise similar-looking gneissic variant of Cooyerdoo Granite. However these aggregates tend to weather easily from outcrop surfaces; and localities have been discovered outside EL5245 where both Gilles Gneiss and Cooyerdoo Granite outcrop near each other.

A small sheared enclave of Gilles Gneiss (within Kimban Orogeny fine-grained pink granite) was assayed as IH027 and dated by PACE geochronology to 3249±4Ma with a metamorphic overprint at 2507±6Ma. Another sample

IH085 from a much larger outcrop in neighbouring EL5335 was dated to 3250±8Ma with a metamorphic overprint at 2507±5Ma. Details are discussed in geochronology below. Geochemistry suggests an origin from fractionated mantle-derived magma. The hill containing the IH085 outcrop (690672e 6320075n GDA94) is fortuitously protected within the *Ironstone Hill Conservation Park* and is considered the type locality for Gilles Gneiss. At time of writing it is South Australia's oldest known rock. Known outcrops extend from the small enclave at IH027 near the southern border of EL5245 to the northern end of Centrex's EL4451 on the Gilles Downs pastoral lease. Its presence within Gilles Downs provides a simple (and alliterative) name for this rock.

Figure 22: Examples of sheared (left) and un-sheared (right) Gilles Gneiss.

Figure 23: Gilles Gneiss in outcrops.

2.2.8.3 Pegmatite-Migmatite Rock

Pegmatite-migmatite rock ("peg-mig") is frequently associated with Gilles Gneiss (and its amphibolite-dolerite swathes) from outcrop scale to locality scale. However preserved contacts with Gilles Gneiss are rare and obscured by shearing. Occasionally "peg-mig" may be found in (apparent) isolation or associated with Cooyerdoo Granite outcrops. "Peg-mig" is rich in feldspar and quartz phenocrysts set in a fine-grained groundmass of quartz and (?)biotite. Weathered surfaces acquire a very rough texture due to selective retention of quartz. Larger outcrops/subcrops may be cut by Kimban Orogeny shear zones.

It is interpreted to be a product of partial melting of Gilles Gneiss, either from the 2507Ma metamorphic event or from the 3157Ma event that produced the Cooyerdoo Granite.

Figure 24: Outcrop of pegmatite-migmatite in EL4571.

2.2.9 MISCELLANEOUS ROCKS

In EL5245 this category features minor pegmatite and aplite veins occurring within other rocks; and various lithological remnants ingested by mylonite zones.

Figure 25: Aplite vein within porphyritic amphibolite.

2.3 GEOPHYSICS

2.3.1 GROUND GRAVITY SURVEY (2003)

A ground gravity survey was done in 2003 by Haines Surveys, comprising 750 stations at 50m intervals on east-west lines 200m and 400m apart. The Bouguer anomaly map from the survey is in Section 3 of this report. SAIOG's field inspection of one good anomaly near the main access track revealed "outcropping granite" so follow-up drilling was cancelled.

The following description of the survey is quoted from the Haines Survey report. The coordinates mentioned are Australian Magnetic Grid 1984, and at the time this tenement was still the northern portion of EL3048 Pondooma.

> *The originally proposed Pondooma survey consisted of 3 rectangular areas with a total of 22 west-east lines (line spacing 200 metres and 400 metres, station spacing 50 metres) coincident with AMG84. Pondooma NW comprised 261 stations in 9 lines bounded by 689600E, 6315100N in the south west and 691000E, 6317300N in the north east with a line spacing of 200 metres north of 6316300N and 400 metres in the south. In the course of the survey infill was requested for an extra 87 stations in 3 lines south of 6316300N giving the entire area a line spacing of 200 metres. Pondooma SW comprised 126 stations in 6 lines (separation of 400 metres) bounded by 690400E, 6311800N in the south west and 691400E, 6313800N in the north east. Pondooma SE comprised 161 stations in 7 lines (separation of 400 metres) bounded by 692100E, 6311800N in the south west and 693200E, 6314200N in the north east. In setting up the survey, 2 additional lines were inadvertently added to the south for 46 unintended stations. In the course of the survey infill was requested for an extra 69 stations in 3 lines in the south of this area providing for a 200 metre line spacing south of 6312200N which included 2 lines south of the originally intended area. Pondooma NW and Pondooma SW were completed as specified and Pondooma SE included 46 unintended stations with the 46 infill stations falling outside the originally specified area being deemed intended.*
>
> *Also specified but overlooked in setting up, 10 stations at 100 metre spacing in 2 tie lines between Pondooma SW and Pondooma SE areas at 6312200N and 6313400N. These stations were omitted.*

The survey used Trimble 4000 GPS receivers to achieve a quoted horizontal & vertical precision of 2cm. Gravity readings were done with a Scintrex CG-3 Autograv meter; for 40 seconds at each station and for 120 seconds at the base station at the beginning & end of each day's field work. Gravity control was established by linking the base station to the Australian Geological Survey Organisation Gravity Base Station Network station 9493.0109 at Whyalla Airport. Data processing by Haines Surveys assumed a country rock density of 2.67 g/cc. Full details & data are available as Open File Envelope 10220.

The survey base station, labelled “Haines Surveys Grav-GPS Base 2003 0402”, was rediscovered on a hill top during the 2009-2010 mapping at (GDA94) 691362e 6314573n. It is shown on the geology map in Section 3 as “benchmark”.

2.3.2 AEROMAGNETIC SURVEYS (2005 & 2007)

Reprocessing of government and Open File aeromagnetic data was done in 2005 for the entire portfolio of Centrex tenements to identify iron ore targets. Data spacing and quality were variable which led to some uncertainty in drill target selections. In February 2007 an airborne magnetic, radiometric & digital terrain survey was flown for 420 line kilometres within EL5245 at a line spacing of 100m flown at 50m height. This survey covered all five Western Middlebacks Tenements and expenses & data were shared between Centrex and Lincoln Minerals. Full details of the 2005 reprocessing and the 2007 survey, and the survey’s data, are available from Open File Envelope 11449.

Maps of Total Magnetic Intensity from the 2007 survey are shown in Section 3.3.

2.4 GEOCHEMISTRY

Centrex collected 10 samples from outcrops in EL5245 using hand tools and submitted them for XRF assay. 8 of these samples were BIFs or other potential iron ores. One of the eight, IH025, was a very elongated hematite + magnetite inclusion, literally a "tectonic rod", from a major mylonite zone, assaying at 65.6% Fe. This was by far the highest Fe assay result. Another of the eight, IH008, is the sole representative of a magnetite BIF outcrop ~170 x ~15 metres in size, about 3.5km southwest of Ironstone Hill summit and assayed at 28.9% Fe.

The remaining samples came from a single magnetite BIF outcrop, ~500 x ~50m in size, straddling the boundary between EL5245 and EL5335 about 4km southwest of Ironstone Hill summit. The nine samples collected across the entire outcrop ranged between 32.2% and 38.1% Fe. Some average assays of the nine samples in % are:

Fe	P	S	SiO_2	Al_2O_3	LOI
35.0	0.043	0.02	48.54	0.18	0.52

The two non-ore samples IH027 and IH030 were assayed to help infer their geological context and to assist in regional correlations with other assayed rocks. Calculated CIPW normative mineralogies are shown below. Mineral percentages are considered indicative not definitive, because Centrex's assay method was designed for iron ores.

Normative mineral wt%	IH027 Gilles Gneiss enclave	IH030 porphyritic amphibolite in mylonite zone	IH026 fine-grained amphibolite (from EL5335)	IH029 fine-grained pink granite (from EL5335)
Quartz	27.0	-	-	29.4
Albite	33.0	22.6	20.1	32.1
Anorthite	8.7	30.0	22.9	1.7
Orthoclase	23.5	8.2	5.3	30.1
Corundum	0.8	-	-	1.0
Diopside	-	17.3	16.8	-
Hypersthene	4.9	4.0	18.4	4.9
Olivine	-	11.9	9.3	-
Ilmenite	0.5	1.6	2.7	0.3
Magnetite	0.4	1.7	2.7	0.5
Apatite	0.1	0.1	0.2	0.1

Individual sample locations and all assay results are listed in Section 4. Samples were also collected & assayed in 2010 by PIRSA geologists, and by Goodwin for her 2010 Honours Thesis. See Section 4.3 and the References for further details.

2.5 GEOCHRONOLOGY

PACE Geochronology project PGC01-05 published geochemistry and U-Pb zircon ages of four rocks from the Western Middlebacks tenements. Three of the samples were collected from neighbouring tenement EL5335 Ironstone Hill but also occur in this tenement.

Rock	Centrex sample	PACE sample	Age
Small Gilles Gneiss enclave within a large body of fine-grained pink granite	IH027	R1721025	magmatic age 3249±4Ma (also metamorphic age 2507±6Ma)
Gilles Gneiss, from its type location (in EL5335)	IH085	R1721026	magmatic age 3250±8Ma (also metamorphic age 2507±5Ma)
Fine-grained pink granite (in EL5335)	IH088	R1721027	magmatic age 1737±5Ma
Metagabbro enclave, on contact between gneiss and amphibolite (in EL5335)	IH089	R1721028	magmatic age 1739±4Ma

At the time of collection IH027 was suspected to be an equivalent of the Cooyerdoo Granite; and was sampled from this small enclave to also investigate the magmatic processes that generated the surrounding fine-grained pink granite. Almost all igneous zircons in IH027 were dated to 3249Ma, and many of them are overgrown by thin rims of 2507Ma metamorphic zircon. There is also a minor population of small 2507Ma zircons. Interestingly there were no zircons produced in this sample by the Sleafordian (2465-2410Ma), Cornian (~1850Ma) or Kimban (1850-1700Ma) Orogenies; even though the surrounding fine-grained pink granite is definitely a Kimban orogeny product that inherited ~2505Ma and ~3150Ma zircons from somewhere (see below). The 3249Ma zircons in IH027 represent the original crystallisation of the rock from a granodioritic magma. The 2507Ma zircons represent a high grade metamorphic episode which probably gave the rock its current gneissic texture, and might represent either an unknown early phase of the Sleaford Orogeny or an entirely separate event.

At the time of collection IH085 was also suspected to be an equivalent of the Cooyerdoo Granite; and was sampled from within a large area of outcrops to minimise any effects from neighbouring younger rocks. Two distinct zircon populations were dated, of 3250Ma zircons overgrown and partly assimilated by 2507Ma zircons and zircon rims. As with IH027 there were no zircons attributable to known younger orogenies. IH027 and IH085 also share mineralogical and geochemical characteristics and are considered to be the same rock; informally named Gilles Gneiss. The ~93Ma difference in age to Cooyerdoo Granite may indicate two distinct episodes of Mesoarchean igneous activity. At time of writing Gilles Gneiss is South Australia's oldest known rock, but the 3300-3500Ma inherited zircons in many of Eyre Peninsula's rocks suggests there is an even older rock awaiting discovery.

The fine-grained pink granite IH088 intrudes many other rock types including the magnetite BIFs, and is itself intruded by the suspected Charleston Granite dykes in EL5245. It has also been strongly deformed in places by mylonitic shear zones. Consequently it was suspected to be a late Kimban orogeny product that might also help constrain the age of major shear zones. IH088 was collected from an outcrop by the main access track that had no strong deformation. The predominant igneous zircon age found was 1737Ma, confirming its Kimban orogeny genesis, but there were also inherited zircons from ~2505Ma and a few inherited zircons up to ~3150Ma. Evidently some of the melt that produced the fine-grained pink granite originated from both the Cooyerdoo Granite and from the Gilles Gneiss (or from rocks of identical ages that have not yet been found).

The metagabbro IH089 is almost always found between gneissic rock and amphibolites; and at the time of collection was thought to be a contact metamorphic product derived from the two neighbouring rocks. If this was true it could be expected to yield zircons (and thus ages) from both of the rocks. The predominant zircon age found was 1739Ma which represents the magmatic age of the neighbouring amphibolite. Inherited grains up to ~3330Ma were probably derived from local melting of the neighbouring gneiss.

2.6 EXPENDITURE

Total expenditures by Centrex Metals for this tenement were:

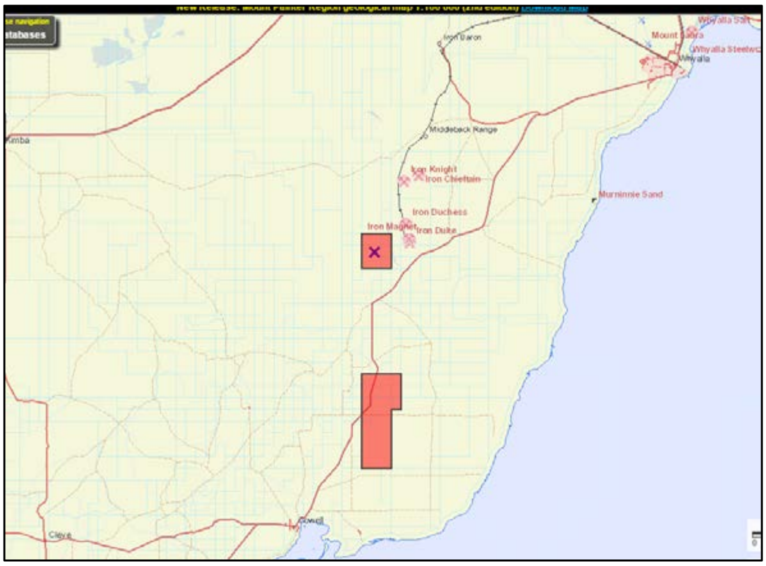
EL3048	03/12/2002 – 02/12/2007	$79706
EL3999	12/12/2007 – 11/12/2012	$98738
EL5245	12/12/2012 – 30/06/2015	$28258
	Total expenditure	$206072

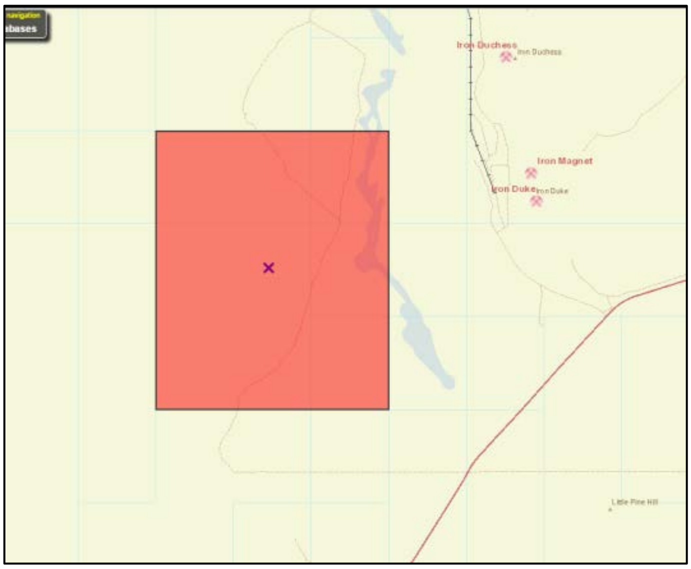
Total expenditures by Lincoln Minerals for this tenement were $7148; primarily on the 2007 aeromagnetic survey shared with Centrex.

3 MAPS, PLANS & IMAGES

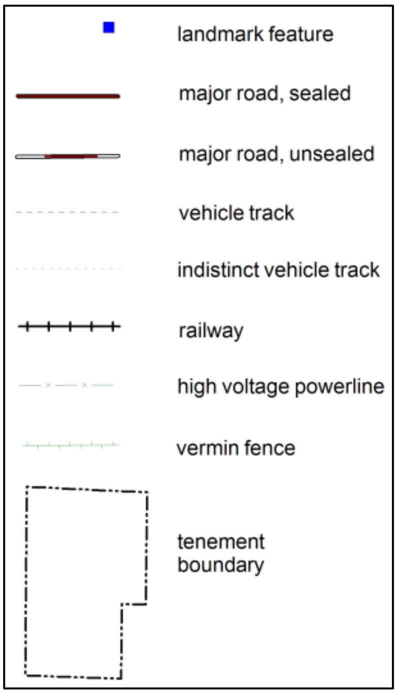
3.1 LOCATION

The first SARIG screenshot below shows the two portions of the original tenement EL3048 between Whyalla and Cowell. The part that became EL3999 and then EL5245 contains the “X”. The second screenshot shows EL3999 / EL5245.





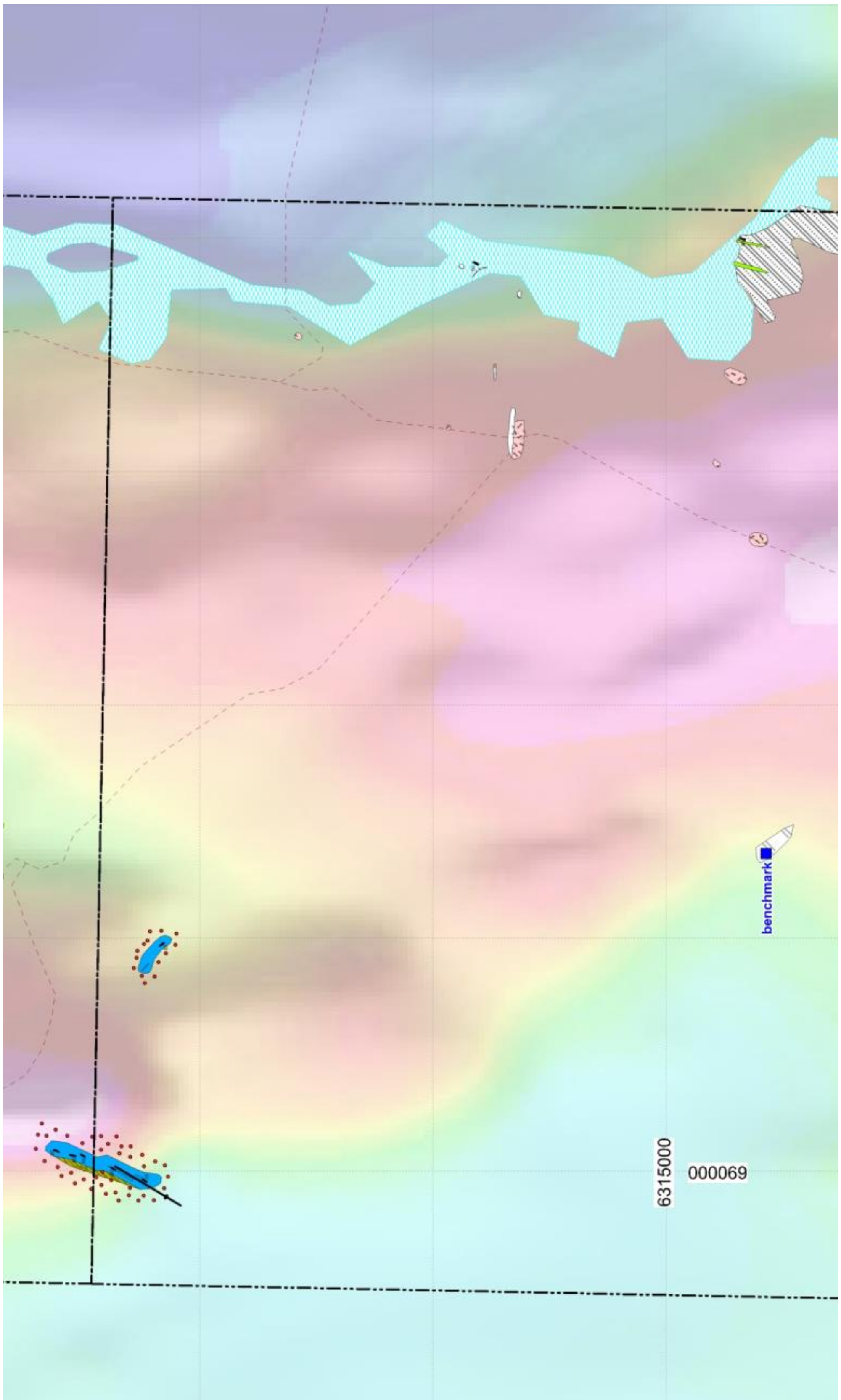
3.2 GEOLOGY & SAMPLE MAPS (2010)

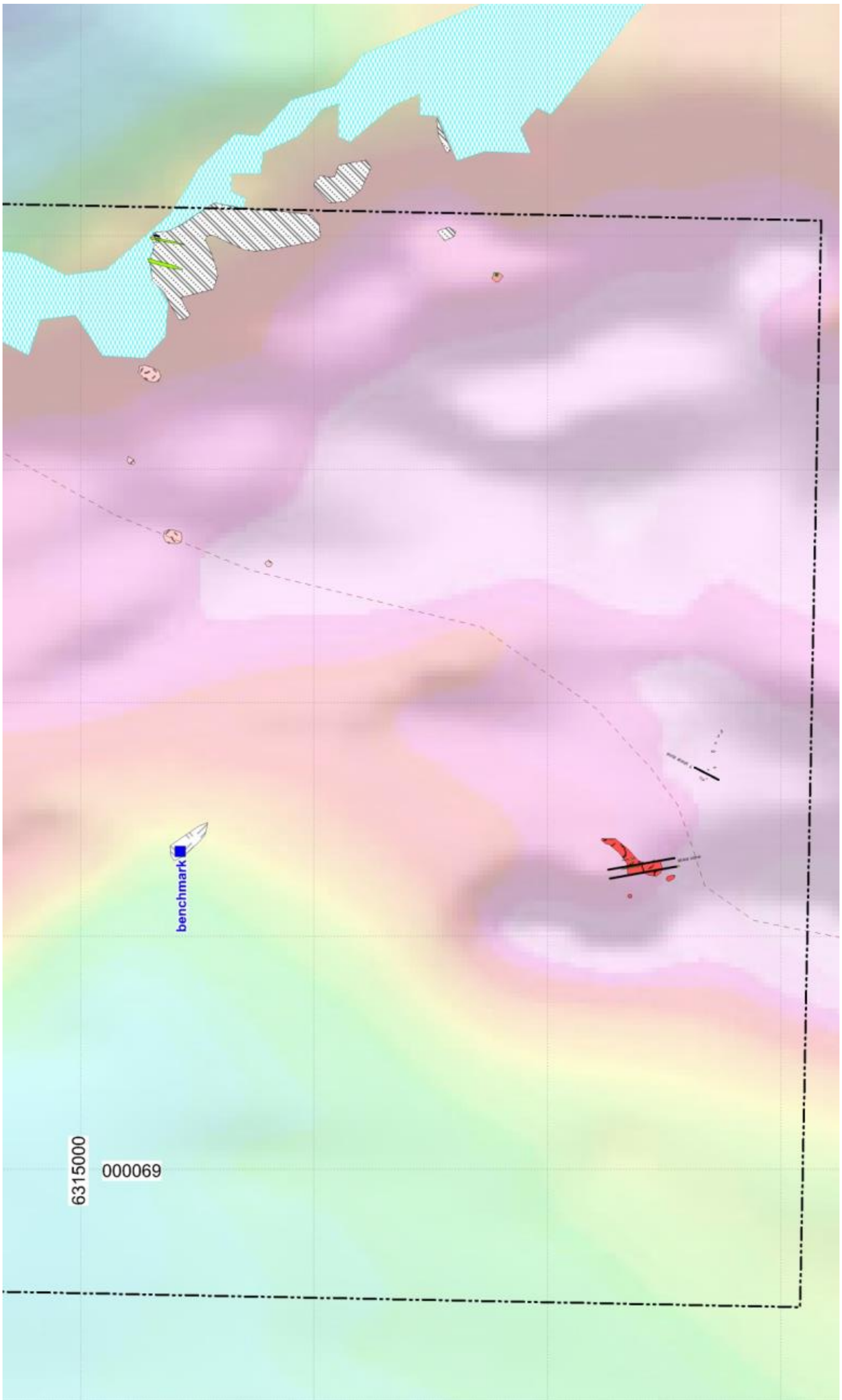


The geology is shown on a background transparency of Total Magnetic Intensity from the 2007 aerial survey. Grid lines are GDA94 and define 1km squares. Sample points have been omitted to better show the actual outcrops. Tenement boundaries are shown as of 2009 when the mapping began. The map legend includes rock types from all five of the Western Middlebacks tenements. Float/rubble is indicated by coloured dots.

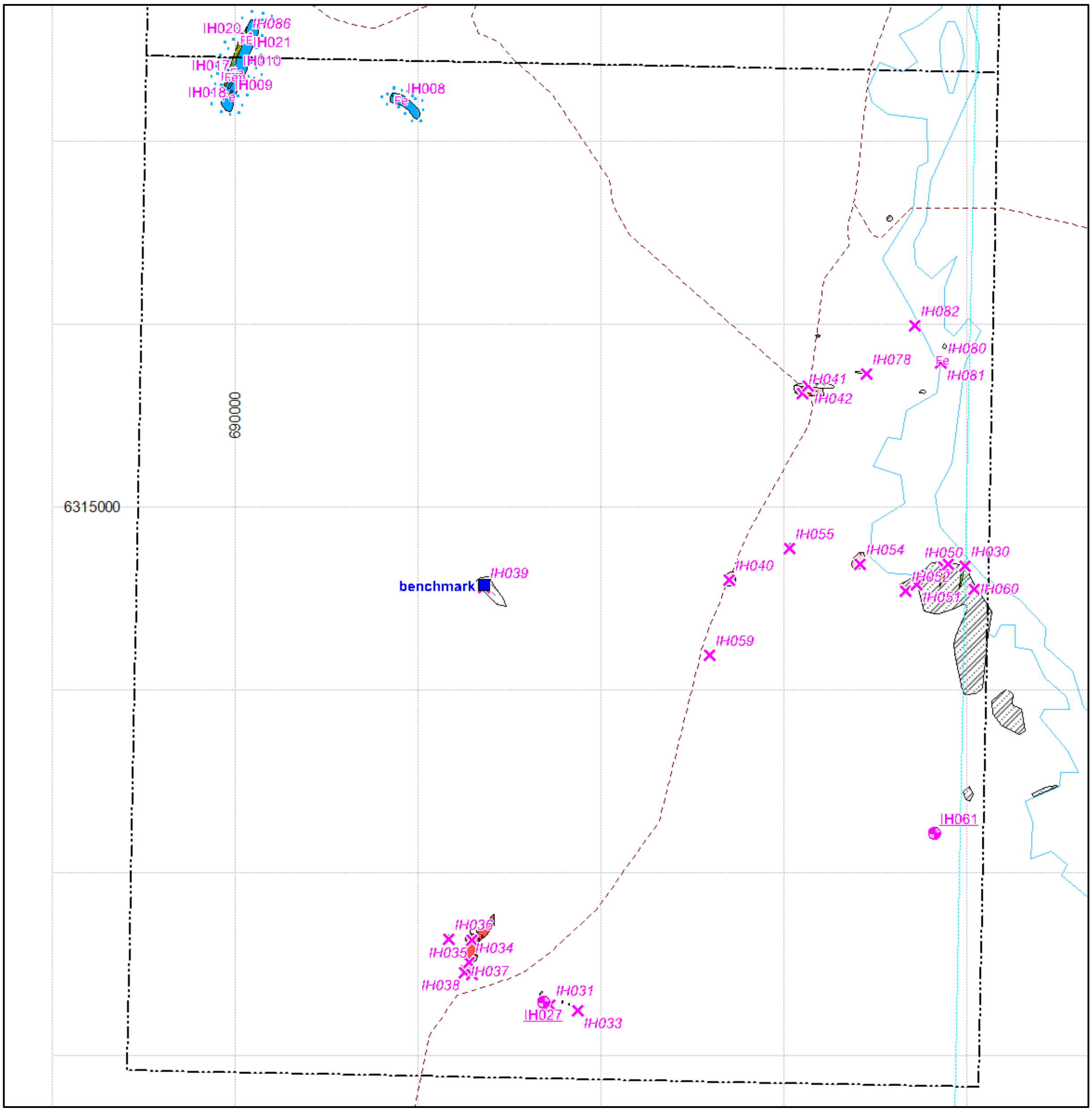
In order to show the map tiles at a larger size they have been rotated so that north is on the left margin.

"Benchmark" is the base station for the 2003 ground gravity survey.


benchmark
6315000
000069

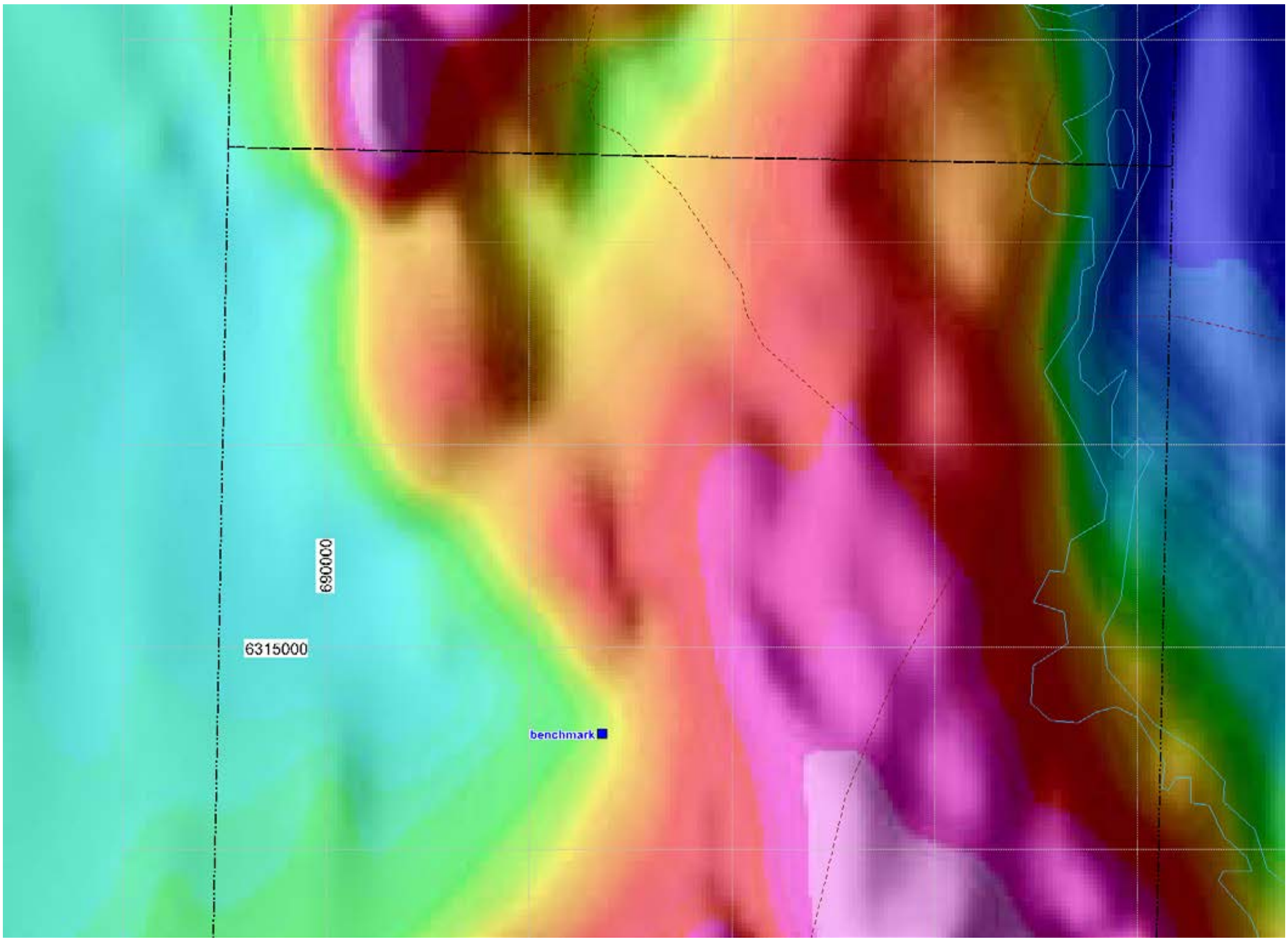

benchmark
6315000
000069

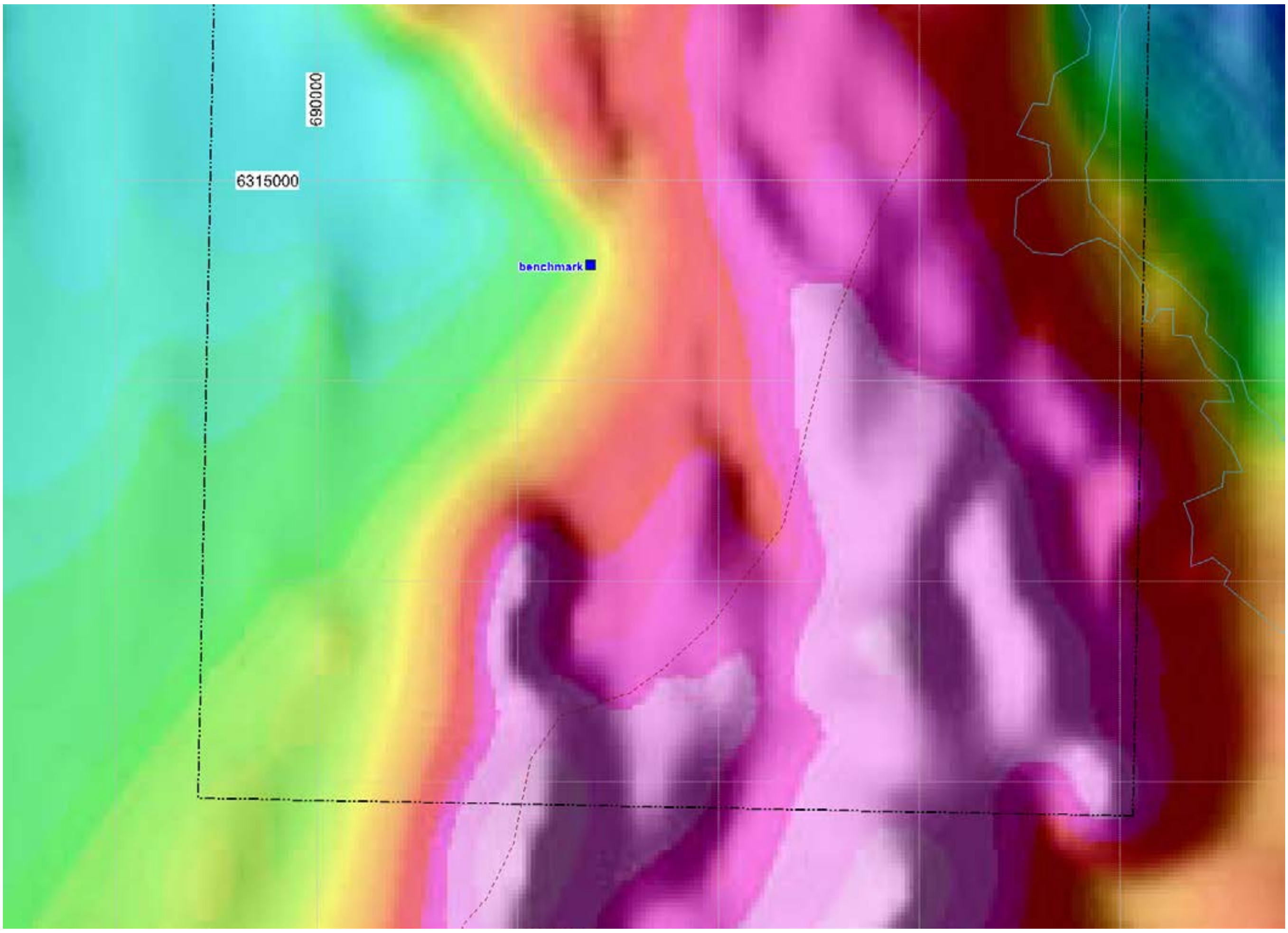
Sample locations are shown on the map below.



3.3 AEROMAGNETIC SURVEYS (2005 & 2007)

Grid lines are GDA94 and define 1km squares. Tenement boundaries are shown as of 2009.




690000
6315000
benchmark

3.4 IRONSTONE HILL CONSERVATION PARK

The two proclamations establishing the new park are below, followed by a map.

Published in *Gazette 26.8.2010 p 4422*

South Australia

National Parks and Wildlife (Ironstone Hill Conservation Park) Proclamation 2010

under section 30(1) of the *National Parks and Wildlife Act 1972*

1—Short title

This proclamation may be cited as the *National Parks and Wildlife (Ironstone Hill Conservation Park) Proclamation 2010.*

2—Commencement

This proclamation comes into operation on the day on which it is made.

3—Constitution of Ironstone Hill Conservation Park

The following Crown land is constituted as a conservation park and assigned the name *Ironstone Hill Conservation Park*:

Allotments 81, 84 and 88 of Deposited Plan 83666, Hundred of Moonabie, County of York;

Section 8, Hundred of Moonabie, County of York.

Made by the Governor

being of the opinion that the Crown land described in clause 3 should be protected and preserved for the purpose of conserving any wildlife and the natural features of the land and with the advice and consent of the Executive Council
on 26 August 2010

MEC10/0038CS

1

South Australia

National Parks and Wildlife (Ironstone Hill Conservation Park—Mining Rights) Proclamation 2010

under section 43 of the *National Parks and Wildlife Act 1972*

Preamble

1 The Crown land described in Schedule 1 is, by another proclamation made on this day, constituted as a conservation park under section 30(1) of the *National Parks and Wildlife Act 1972* and assigned the name *Ironstone Hill Conservation Park*.

2 It is intended that, by this proclamation, certain existing and future rights of entry, prospecting, exploration or mining be preserved in relation to that land.

1—Short title

This proclamation may be cited as the *National Parks and Wildlife (Ironstone Hill Conservation Park—Mining Rights) Proclamation 2010*.

2—Commencement

This proclamation comes into operation on the day on which it is made.

3—Interpretation

In this proclamation—

Environment Minister means the Minister for the time being administering the *National Parks and Wildlife Act 1972*;

Mining Minister means the Minister for the time being administering the *Mining Act 1971* or the Minister for the time being administering the *Petroleum and Geothermal Energy Act 2000*, as the case requires.

4—Existing rights to continue

Subject to clause 6, existing rights of entry, prospecting, exploration or mining under the *Mining Act 1971* or the *Petroleum and Geothermal Energy Act 2000* may continue to be exercised in respect of the land described in Schedule 1.

5—New rights may be acquired

Rights of entry, prospecting, exploration or mining may, with the approval of the Mining Minister and the Environment Minister, be acquired pursuant to the *Mining Act 1971* or the *Petroleum and Geothermal Energy Act 2000* in respect of the land described in Schedule 1 and may, subject to clause 6, be exercised in respect of that land.

6—Conditions for exercise of rights

A person in whom rights of entry, prospecting, exploration or mining are vested pursuant to the *Mining Act 1971* or the *Petroleum and Geothermal Energy Act 2000* (whether those rights were acquired before or after the making of this proclamation) must not exercise those rights in respect of the land described in Schedule 1 unless the person complies with the following conditions:

(a) if work to be carried out in relation to the land in the exercise of those rights is a regulated activity within the meaning of the *Petroleum and Geothermal Energy Act 2000*, the person must ensure that—

(i) the work is not carried out until a statement of environmental objectives in relation to the activity that has been approved under that Act has also been approved by the Environment Minister; and

(ii) the work is carried out in accordance with the statement as so approved;

(b) if work to be carried out in relation to the land in the exercise of rights under the *Mining Act 1971* or the *Petroleum and Geothermal Energy Act 2000* has not previously been authorised (whether by inclusion in an approved statement of environmental objectives referred to in paragraph (a) or otherwise), the person must give at least 3 months notice of the proposed work to the Mining Minister and the Environment Minister and supply each Minister with such information relating to the proposed work as the Minister may require;

(c) if directions are agreed between the Mining Minister and the Environment Minister and given to the person in writing in relation to—

(i) carrying out work in relation to the land in a manner that minimises damage to the land (including the land's vegetation and wildlife) and the environment generally; or

(ii) preserving objects, structures or sites of historical, scientific or cultural interest; or

(iii) rehabilitating the land (including the land's vegetation and wildlife) on completion of the work; or

(iv) (where the work is being carried out in the exercise of rights acquired after the making of this proclamation) prohibiting or restricting access to any specified area of the land that the Ministers believe would suffer significant detriment as a result of carrying out the work,

(being directions that do not reduce or otherwise detract from any requirement in respect of any of those matters contained in an approved statement of environmental objectives referred to in paragraph (a)), the person must comply with those directions in carrying out the work;

(d) if a plan of management is in operation under section 38 of the *National Parks and Wildlife Act 1972* in respect of the land, the person must have regard to the provisions of the plan of management;

(e) in addition to complying with the other requirements of this proclamation, the person—

(i) must take such steps as are reasonably necessary to ensure that objects, structures and sites of historical, scientific or cultural interest and the land's vegetation and wildlife are not unduly affected by any work; and

(ii) must maintain all work areas in a clean and tidy condition; and

(iii) must, on the completion of any work, obliterate or remove all installations and structures (other than installations and structures designated by the Mining Minister and the Environment Minister as suitable for retention) used exclusively for the purposes of that work;

(f) if no direction has been given by the Mining Minister and the Environment Minister under paragraph (c)(iii), the person must (in addition to complying with any approved statement of environmental objectives referred to in paragraph (a)) rehabilitate the land (including its vegetation and wildlife) on completion of any work to the satisfaction of the Environment Minister.

7—Governor may give approvals, directions

If—

(a) the Mining Minister and the Environment Minister cannot agree as to whether—

(i) approval should be granted or refused under clause 5; or

(ii) a direction should be given under clause 6(c); or

(b) the Environment Minister does not approve a statement of environmental objectives under clause 6(a),

the Governor may, with the advice and consent of the Executive Council—

(c) grant or refuse the necessary approval under clause 5; or

(d) give a direction in writing under clause 6(c); or

(e) grant or refuse the necessary approval under clause 6(a).

Schedule 1—Description of land

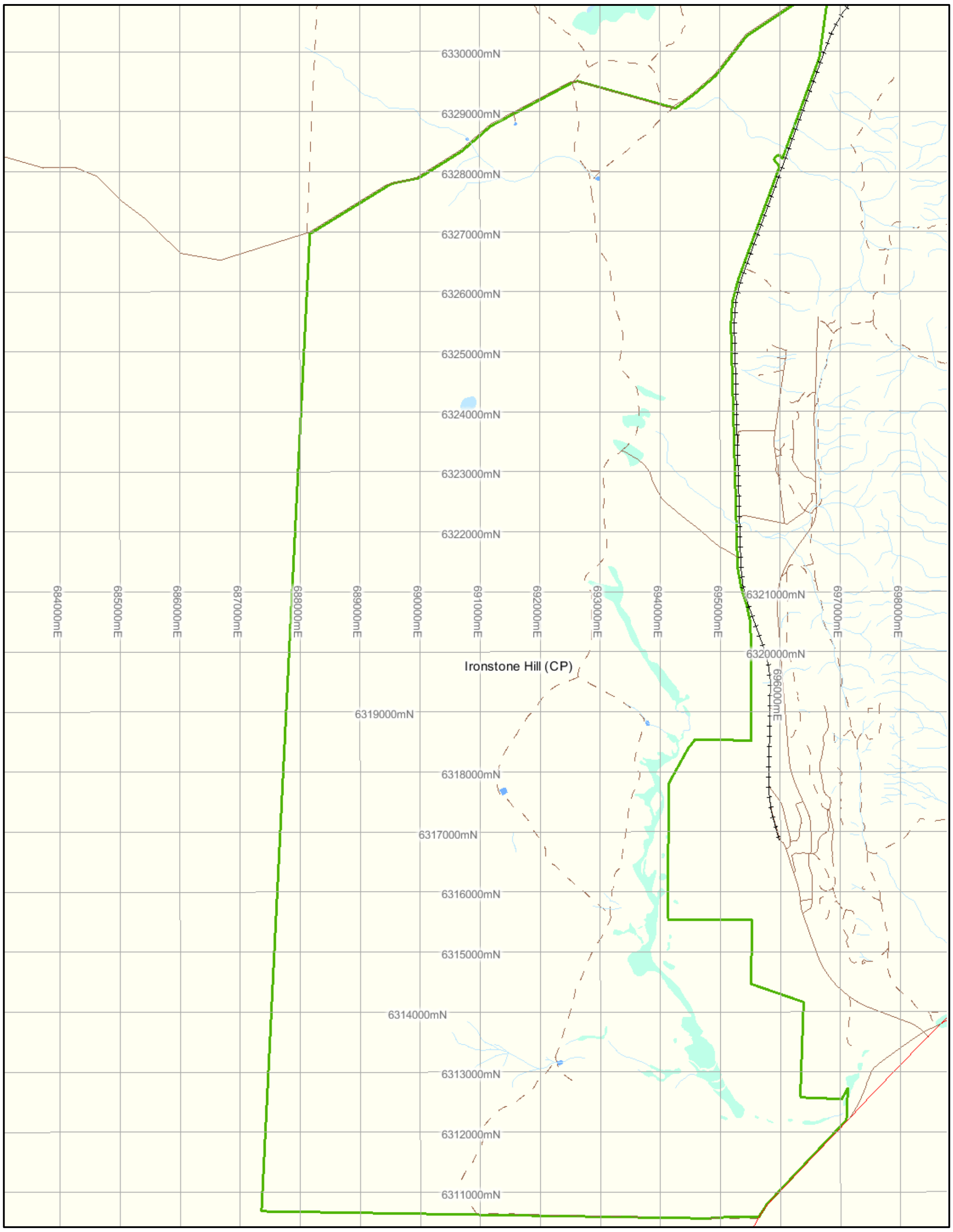
Allotments 81, 84 and 88 of Deposited Plan 83666, Hundred of Moonabie, County of York;

Section 8, Hundred of Moonabie, County of York.

Made by the Governor

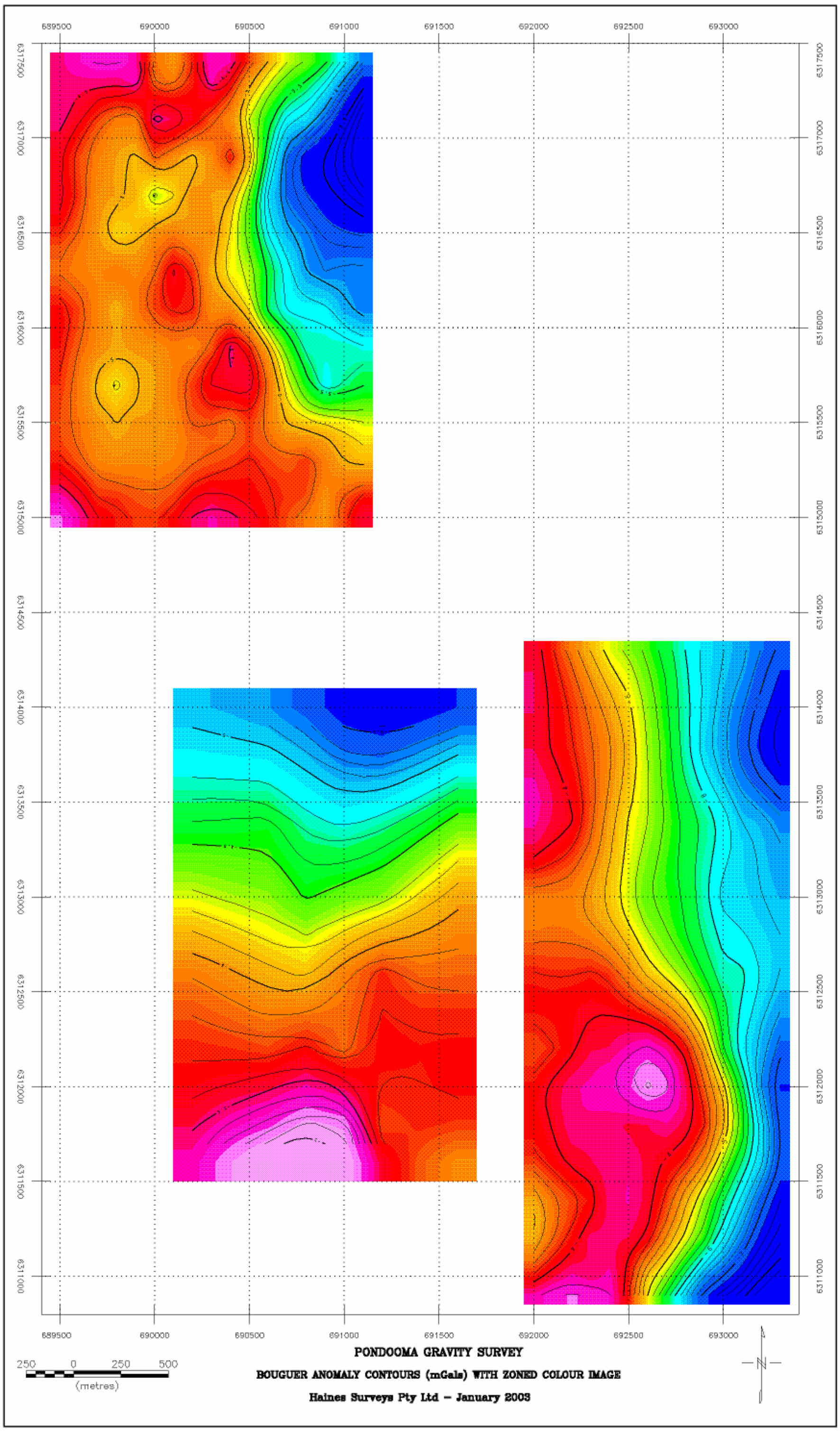
with the advice and consent of the Executive Council
on 26 August 2010

MEC10/0038CS



Ironstone Hill Conservation Park. The north boundary is the Whyalla-Kimba Road, the west boundary is an old Vermin Fence, and the railway along the east boundary ends at Iron Duke Mine.

3.5 GROUND GRAVITY SURVEY (2003)



It is suspected that the three survey areas depicted have been individually normalised for colour scaling. Tie lines were planned but were never measured. The grid lines are AMG84.

4 DATA

4.1 CENTREX ROCK SAMPLES

The following table lists every rock sample collected by Centrex. Flag “a” indicates a sample that was assayed. Flag “g” indicates a larger sample collected for geochronology; with ages and PACE report sample numbers if analysed. The other samples were collected primarily to aid in outcrop correlations.

Sample	Easting	Northing	flag	notes
IH008	690908	6317223	a	magnetite BIF
IH009	689963	6317243	a	magnetite BIF
IH010	690013	6317376	a	magnetite BIF
IH016	690019	6317351	a	magnetite BIF talus
IH017	690000	6317351	a	magnetite BIF
IH018	689980	6317349	a	magnetite BIF
IH019	689960	6317353	a	magnetite BIF talus
IH025	693869	6315802	a	hematite/magnetite “rod” from mylonite
IH027 (R1721025)	691685	6312303	a,g (3249±4Ma)	small Gilles Gneiss enclave within large body of fine grained pink granite
IH030	693990	6314689	a	porphyritic amphibolite within mylonite
IH031	691722	6312287	-	fine grained pink granite subcrop
IH033	691876	6312255	-	fine grained pink granite subcrop
IH034	691279	6312524	-	mylonitic pink granite
IH035	691297	6312643	-	foliated amphibolite dyke within foliated pink granite
IH036	691170	6312650	-	grey gneiss
IH037	691253	6312466	-	foliated pink granite
IH038	691253	6312466	-	foliated amphibolite float
IH039	691362	6314573	-	brecciated quartzite/chert with quartz veining, trace mica
IH040	692703	6314611	-	fine grained pink granite subcrop
IH041	693103	6315634	-	fine grained pink granite subcrop
IH042	693131	6315673	-	Charleston Granite dyke
IH050	693874	6314682	-	mylonite
IH051	693725	6314588	-	mylonite
IH052	693665	6314551	-	mylonite
IH053	693782	6314641	-	mylonite
IH054	693417	6314700	-	mylonitic granite
IH055	693032	6314786	-	fine grained pink granite
IH056	691294	6312456	-	amphibolite

Sample	Easting	Northing	flag	notes
IH057	693899	6314697	-	mylonite in contact with IH058
IH058	693899	6314697	-	fine grained amphibolite
IH059	692595	6314200	-	fine grained pink granite float
IH060	694042	6314561	-	magnetite/hematite schist cobbles on mylonite outcrop
IH061	693824	6313228	g	metagabbro
IH078	693452	6315739	-	metagabbro in contact with Charleston Granite dyke
IH079	690585	6320159	-	porphyritic amphibolite within gneiss
IH080	693863	6315800	-	sieved +6.4mm fraction from alluvium
IH081	693857	6315799	-	sieved +6.4mm fraction from alluvium
IH082	693719	6316006	-	sieved +6.4mm fraction from alluvium

4.2 CENTREX ASSAYS

The first table shows Al_2O_3, As, Ba, CaO, Co, Cr, Cu, Fe, K_2O, MgO and Mn assays. The second table shows Na_2O, Ni, P, Pb, S, SiO_2, TiO_2, V_2O_5, Zn and LOI @1000C. All values are in weight % and the values below detection limit are listed as "nd". All assays were done by ALS Laboratories using their XRF-11 method, which is designed for iron ores.

Most of the samples assayed were BIFs. Other rock assays are highlighted in green. Analytical detection limits were:

Al_2O_3	As	Ba	CaO	Co	Cr	Cu	Fe	K_2O	MgO	Mn
0.01%	0.005%	0.01%	0.01%	0.002%	0.002%	0.002%	0.01%	0.002%	0.01%	0.002%

Na_2O	Ni	P	Pb	S	SiO_2	TiO_2	V_2O_5	Zn	LOI@1000C
0.02%	0.002%	0.001%	0.002%	0.001%	0.01%	0.01%	0.002%	0.002%	0.01%

Sample	Al_2O_3	As	Ba	CaO	Co	Cr	Cu	Fe	K_2O	MgO	Mn
IH008	0.14	nd	0.008	0.07	nd	nd	nd	28.9	nd	0.10	0.037
IH009	0.09	nd	0.005	0.04	nd	nd	nd	35.3	nd	0.02	0.017
IH010	0.10	nd	0.005	0.03	nd	nd	0.008	38.1	nd	0.02	0.020
IH016	0.19	nd	0.005	0.13	nd	nd	nd	37.0	nd	0.08	0.046
IH017	0.03	nd	0.005	0.02	nd	nd	nd	33.2	nd	0.05	0.033
IH018	0.11	nd	0.005	0.11	nd	nd	nd	32.3	nd	0.15	0.027
IH019	0.60	nd	0.018	0.30	nd	0.001	nd	34.6	0.01	0.38	0.043
IH025	0.52	nd	0.262	0.07	nd	0.003	nd	65.6	0.01	0.10	0.040
IH027	14.70	nd	0.154	1.80	nd	nd	nd	1.9	3.97	0.58	0.028
IH030	16.90	nd	0.025	10.30	nd	0.008	nd	8.0	1.38	5.46	0.134

Sample	Na_2O	Ni	P	Pb	S	SiO_2	TiO_2	V_2O_5	Zn	LOI
IH008	0.02	nd	0.02	nd	0.02	57.7	nd	nd	nd	0.38
IH009	0.01	nd	0.09	nd	0.02	48.5	0.01	nd	nd	0.6
IH010	0.02	nd	0.04	nd	0.02	44.1	nd	nd	nd	1.06
IH016	0.02	nd	0.04	nd	0.01	48.3	0.01	nd	nd	-0.2
IH017	0.01	nd	0.04	nd	0.02	51.7	nd	nd	nd	0.53
IH018	0.02	nd	0.06	nd	0.02	52.8	nd	nd	nd	0.42
IH019	0.02	nd	0.03	nd	0.01	48.5	nd	nd	nd	0.45
IH025	0.05	nd	0.02	nd	0.09	4.1	0.04	0.01	0.01	0.64
IH027	3.9	nd	0.03	nd	0	71.1	0.27	nd	nd	0.73
IH030	2.67	0.01	0.03	nd	0.03	49.1	0.85	0.02	0.01	1.55

4.3 OTHER GEOCHEMISTRY

The following tables list whole rock geochemical analyses by other parties within the tenement, as compiled by Goodwin (2010). Centrex sample numbers are included in descriptions where applicable. Unlike Centrex's assays the analytical techniques used below were designed for rocks rather than iron ores.

R_number	Easting	Northing	description (from Centrex mapping)
1723515	691315	6312619	foliated amphibolite (within Gilles Gneiss) near IH035
1723516	691694	6312302	sheared Gilles Gneiss near IH027
1723517	691670	6312337	fine-grained pink granite
1723518	693969	6314663	amphibolite body in mylonite zone
1723519	693998	6314650	porphyritic amphibolite body in mylonite zone
1723520	693886	6314693	amphibolite body in mylonite zone near IH058
1723526	693824	6313228	metagabbro "red gabbro" IH061
1721025	691685	6312303	Gilles Gneiss IH027

ASSAY	Al2O3	CaO	Fe2O3	K2O	MnO	MgO	Na2O	P2O5	SiO2	TiO2	LOI
UNITS	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*
DETECTION LIMIT	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.005*	*0.01*
1723515	12.40	9.24	15.20	1.09	0.23	6.98	2.51	0.10	49.90	1.015	1.03
1723516	13.80	0.71	1.25	5.32	0.02	0.21	3.80	0.02	73.10	0.140	0.63
1723517	14.20	1.03	1.69	5.77	0.02	0.31	3.53	0.04	72.80	0.235	0.53
1723518	14.70	10.10	11.50	1.40	0.21	7.75	2.43	0.09	50.10	0.905	1.78
1723519	15.90	3.28	5.84	2.49	0.05	1.39	4.85	0.44	63.90	0.850	0.58
1723520	13.90	9.33	12.00	1.08	0.18	7.15	3.00	0.08	51.80	0.850	1.38
1723526	14.50	5.70	8.67	4.67	0.11	4.98	3.46	0.82	52.40	1.370	1.32
1721025	15.20	1.93	2.14	3.74	0.02	0.66	4.11	0.08	69.70	0.290	1.07

ASSAY	Ag	As	Ba	Be	Bi	Cd	Ce	Co	Cr	Cs	Cu
UNITS	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*
DETECTION LIMIT	*0.1*	*0.5*	*10*	*0.5*	*0.1*	*0.1*	*1*	*0.2*	*20*	*0.1*	*0.5*
1723515	<0.1	1.5	650	<0.5	0.1	<0.1	23	60	125	0.8	75
1723516	<0.1	1.5	950	3.5	0.1	<0.1	110	65	<20	2.1	1.5
1723517	<0.1	1	900	2.5	<0.1	<0.1	185	60	<20	1.8	<0.5
1723518	0.2	1.5	295	<0.5	0.2	0.1	18	55	300	2.3	85
1723519	<0.1	1	1100	1	<0.1	<0.1	325	32	20	0.9	21.5
1723520	<0.1	2.5	235	<0.5	0.3	<0.1	18	60	95	2.6	105
1723526	0.1	1.5	6200	4	0.2	<0.1	420	45.5	145	1.4	30
1721025	<0.1	<0.5	1600	1	<0.1	<0.1	130	65	<20	1	25.5

ASSAY	Dy	Er	Eu	Ga	Gd	Hf	Ho	In	La	Lu	Mo
UNITS	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*
DETECTION LIMIT	*0.02*	*0.05*	*0.02*	*0.1*	*0.05*	*1*	*0.02*	*0.5*	*1*	*0.02*	*2*
1723515	5.5	3.4	1.3	19	4.9	2	1.2	<0.5	12	0.46	<2
1723516	0.92	0.45	0.64	26.5	1.6	4	0.16	<0.5	65	0.06	<2
1723517	1.75	0.75	1.15	29.5	3.4	5	0.3	<0.5	110	0.1	<2
1723518	3.6	2.1	1.15	16.5	3.6	1	0.76	<0.5	7	0.28	<2
1723519	3.3	1.75	2.2	26.5	5.5	7	0.62	<0.5	180	0.18	<2
1723520	4	2.6	1.1	17.5	3.7	2	0.88	<0.5	8	0.34	<2
1723526	6.5	2.6	6.5	26.5	14.5	9	1.05	<0.5	185	0.32	<2
1721025	0.4	0.15	0.78	20.5	0.9	4	0.06	<0.5	85	0.2	<2

ASSAY	Nb	Nd	Ni	Pb	Pr	Rb	Sb	Sc	Se	Sm	Sr
UNITS	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*
DETECTION LIMIT	*2*	*0.02*	*2*	*0.5*	*0.05*	*0.5*	*0.5*	*5*	*0.5*	*0.02*	*5*
1723515	3	16.5	85	12	3.9	35	<0.5	45	<0.5	4	200
1723516	7	24	2	50	8	235	<0.5	<5	<0.5	3.2	230
1723517	10	60	<2	70	20.5	280	<0.5	<5	<0.5	7.5	190
1723518	3	13.5	75	8.5	3.2	75	<0.5	40	<0.5	3.1	315
1723519	14	85	12	23.5	27	75	<0.5	<5	<0.5	9.5	1000
1723520	2	12	45	11.5	2.6	47.5	<0.5	40	<0.5	3	205
1723526	23	215	90	27	60	100	<0.5	20	<0.5	29	1200
1721025	2	22.5	7	25.5	8	100	<0.5	<5	<0.5	2.4	480

ASSAY	Tb	Te	Th	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
UNITS	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*
DETECTION LIMIT	*0.02*	*0.2*	*0.5*	*0.1*	*0.05*	*0.5*	*20*	*3*	*1*	*0.05*	*0.5*	*4*
1723515	0.86	<0.2	2	0.3	0.45	0.5	345	100	26	3.3	130	75
1723516	0.2	<0.2	60	1.2	0.05	7.5	<20	600	5	0.45	24	140
1723517	0.42	<0.2	80	1.5	0.1	12.5	<20	500	7	0.6	34	190
1723518	0.58	<0.2	0.5	0.5	0.3	<0.5	285	75	16	1.95	115	55
1723519	0.7	<0.2	46.5	0.5	0.2	3	90	180	17	1.4	115	320
1723520	0.62	<0.2	1	0.3	0.35	0.5	290	135	20	2.4	115	55
1723526	1.6	<0.2	28.5	0.9	0.3	3.5	140	120	24	2	100	415
1721025	0.1	<0.2	22.5	0.6	<0.05	1	25	550	2	0.15	30.5	155

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End of report.