# Pacific Consulting Services Pty Ltd

## Report on the Exploration Potential of the Kulgera Project – Northern Territory for the Kajeena Mining Company Pty Ltd.

**Exploration Licences 10055 & 10060.**

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## Summary

The Kulgera Project is located in the Northern Territory on the border with South Australia and straddles the north – south railway line. The project comprises Exploration Licences EL 10055 & EL 10060 which were granted on the 13th of December, 2001.

The licences cover the Proterozoic Musgrave Block and later Eromanga Basin sediments.

Previous explorers have undertaken limited grassroots regional scale exploration. Their targets have been sedimentary uranium, rare earths, heavy minerals, gold, base metals, opal/gemstone, and dimension stone.

The Kulgera Project area is dissected by two noted regional structures with little known about the eastern tenement. These structures will have been active during periods of deformation and metamorphism and provided conduits for fluid flow. These faults and associated structures are prospective for:

- **Nickel – copper –PGE mineralisation associated with mafic intrusives.**
- **Gold mineralisation derived from metamorphic fluids of the classic and Tick Hill style.**
- **Diamond bearing diatremes. The recovery of diamonds in the area by prospectors is noted and the potential of the area to host diamondiferous diatremes is considered untested.**

The region has been subject to minimal historic exploration and is amenable to modern exploration techniques.

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# 1. INTRODUCTION

Kajeena Mining Company Pty Ltd holds two granted Exploration Licences (EL 10055 & EL 10060) in the Northen Territory which comprise the Kulgera Project. The project is locted on the Northern territory – South Australian border straddling the north – south railway line. The tenements cover 872 graticular units (~ 2600 $km^2$ ) over lithologies of the Proterozoic Musgrave Block.. The Musgrave Block has been the focus of increased exploration following economic drill intercepts of nickel mineralisation in the western portion of the block, in Western Australia, and some encouraging gold +/- base metals results broadly associated with major E – W trending thrust faults in the Northern Territory.

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- Nickel – copper –PGE mineralisation associated with mafic intrusives.
- Gold mineralisation derived from metamorphic fluids of the classic and Tick Hill style.
- Diamond bearing diatremes. The recovery of diamonds in the area by prospectors is noted and the potential of the area to host diamondiferous diatremes is considered untested.

The fault zones and associated structures in the Kulgera area are the priority exploration targets and require detailed interpretation of the magnetics data to be accompanied by field checking for lithology, structure and alteration features.

## 2. LOCATION & ACCESS

The tenement areas are located on the Northern Territory - South Australian border straddling the Adelaide – Alice Springs Railway line near Kulgera. Access is via the Stuart Highway, then via station tracks from Kulgera, Umbera and Mount Cavenagh Homesteads. Vehicle access over most of the tenements is good utilising station tracks and fence lines.

The region in semi-arid with long hot summers and daily maximum temperatures reaching 40°C for much of January and February. Winters are milder with diurnal temperatures ranging from a typical minimum of 0°C overnight to daily maximum's in the low-mid 20°C's. Rainfall occurs generally in late summer with 250-300mm the annual average total. Land usage is pastoral with beef cattle the main commodity.

The topography is flat to gently undulating, containing low scrubby vegetation, sand dune patches, small hills and ridgelines.

## 3. Tenement Details

**EL 10055 and EL 10060 Tenure**

| Exploration Licence | No. Blocks (Area $km^2$) | Grant Date | Expiry Date | Expenditure Covenant |
|---|---|---|---|---|
| EL 10055 | 500 (1528) | 13/12/2001 | 12/12/2007 | $40,000 |
| EL 10060 | 372 (1121) | 13/12/2001 | 12/12/2007 | $40,000 |

# 3. REGIONAL GEOLOGY

There are four distinct tectonic units within the Kulgera region. They comprise the Musgrave Block, Amadeus Basin, Eromanga Basin; and surficial Cainozoic-Quaternary rocks.

## 3.1 Musgrave Block

The Musgrave Block is an E-W trending Meso-Neoproterozoic mobile zone consisting of juxtaposed high and low grade metamorphic rocks and granitic and mafic intrusives. Within the tenements there are two terranes identified within the Musgrave Block (Edgoose, 1993).

### Mulga Park Terrane

The oldest unit in the NE Musgrave Block is assigned to the Mulga Park Terrane. It contains porphyritic foliated granulites of unknown age and contains some quartzite intervals. Mylonitic foliations are present, striking EW and dipping at 30° with an age determination of 729 Ma, precursor to the Petermann Orogeny.

**Mulga Park Terrane Stratigraphy**

| Unit Name | Unit Description | Field Relationship | Depositional Environment |
|---|---|---|---|
| Sentinel Beds | Quartzite, foliated; Quartz – mica ± garnet schist | Associated with Granite 1 | Vein Quartz |
| Granite 2 | Granite, medium grained, garnet bearing, unfoliated, intruded by pegmatite's | | Intrusive |
| Granite 1 | Granite, medium grained, porphyritic, with a strong mylonitic fabric (does not crop out (DDH K6)) | Metamorphosed to upper green schist – amphibolite facies | Intrusive |

### Fregon Terrane

The Fregon Terrane occupies the majority of the Project area where low hills with relatively good exposure are separated by sand plains with scattered outcrops. The geology comprises metamorphosed acid volcanics, quartzo-feldspathic gneiss, and peraluminous gneiss divided into several units. Peak metamorphism occurred at ≈ 1200Ma, with extension and intrusion of the Alcurra Dolerite Swarm related to the onset of the opening of the Amadeus Basin at ≈ 1050 Ma.

**Fregon Terrane Stratigraphy**

| Unit Name | Unit Description | Field Relationship | Depositional Environment |
|---|---|---|---|
| Alcurra Dyke Swam:-Dolerite Dykes | | Intrude Ayers Ranges and Kulgera Adamellites and gneisses of Fregon Terrane | Intrusive |
| Kulgera Adamellite | Granite; adamelite; porpyritic; with porphyritic microgranite dykes | Intrudes Calamity, Outounya and Kalamurta gneissic units | Intrusive |
| Ayres Ranges Adamellite | Monzonite; granodiorite; both porphyritic | Intrudes Calamity, Outounya and Kalamurta gneissic units | Intrusive |
| **Unit Name** | **Unit Description** | **Field Relationship** | **Depositional Environment** |
| Gneissic Granite / Granite Gneiss | Well layered with quartz – feldspathic bands, partial melts, intruded by quartz feldspar and microgranite dykes | Intrudes Calamity, Outounya and Kalamurta gneissic units | Intrusive |
| Calamity Gneissic Unit/Granite Gneiss | Tonalitic biotite gneiss, well layered; clinopyroxene–hornblende gneiss; later cross cutting red granite dykes | Metamorphosed to transitional granulite grade. Intruded Outounya and Kalamurta gneissic units prior to metamorphism | ?Sediments Intrusives |
| Outounya Gneissic Unit/Acid Gneiss | Quartzo – feldspathic gneiss + amphibole + garnet | Metamorphosed to transitional granulite grade. Extruded or intruded approximately simultaneously with deposition of sediments of Kalamurta Gneissic Unit | Extrusive acid volcanics and/or intrusives |
| Kalamurta Gneissic Unit/Peraluminous Gneiss | Cordierite and Silliminite ± garnet; quartzo feldspathic gneiss; minor amphibole | Metamorphosed to transitional granulite grade. Deposited and/or intruded simultaneously with extrusion/intrusion of volcanic\intrusives of Outounya Gneissic Unit | Sedimentary?/ altered intrusives |

## 3.2 Amadeus Basin

The Amadeus Basin is a large intracratonic structure of Neoproterozoic to Palaeozoic age located in Central Australia and is poorly exposed within the tenement areas. Only two units of the Devonian-age Finke Group are exposed. Most exposures are thin and incomplete suggesting the basin has had a complex evolutionary history.

### Finke Group

The Finke group is more restricted and poorly exposed than the other units of the Amadeus Basin, with minimum thickness for the group ≈200m but its true width is unknown.

### Horse Bend Shale

The Horse Bend Shale is the most exposed of the group and is uniform over its large outcrop area. It may be found shallowly buried under Quaternary sediments. In

outcrop the shale consists of interbedded fine sandstone and dominant shale. The chocolate brown colour of the outcrops is distinctive being broken by thin khaki–green intervals. The shale is extremely fragmented and sedimentary structures such as ripple marks are frequent. Biotite is common along bedding planes demonstrating its detrital nature. Calcrete is found capping the unit and assists its preservation.

**Idracowra Sandstone**

The Idracowra Sandstone within the Kulgera region overlies the Horse Bend Shale; it is a highly weathered unit with bedding moderately cross-bedded to well bedded. Tertiary silcrete and ferricrete commonly caps the unit assisting preservation. The sandstone itself is pale, quartz rich and heavily kaolinised with the lower part consisting of coarser pebble layers.

## 3.3 Eromanga Basin

This Mesozoic Basin covers large portions of SA, QLD and the NT and cohesion with naming of similar groups has not taken place. The early edition shows a far greater coverage of the Eromanga Basin within the area than actually exists from the more recent mapping completed.

The coverage of the Eromanga Basin within the Exploration Licence areas is limited to restricted outcrops of the De Souza Sandstone

**De Souza Sandstone**

The De Souza Sandstone is of Jurassic Age and covers small areas fringing the Musgrave Block basement. The unit is derived from the basement rocks and is composed of kaolinised sandstone/siltstone; with quartz and granite pebble conglomerates. It is well bedded and may be ferriginised at surface resulting in a resistant cap overlain by tertiary silcretes. The conglomerate units contain well-rounded and sometimes polished pebbles.

## 3.4 Cainozoic – Quaternary Cover Rocks

**Tertiary Deposits (Cainozoic)**

Deposits of Tertiary Age within the Project area consist predominantly of duricrusts, with some consolidation and largely unconsolidated sedimentary deposits also occurring. They have been divided into Autochthonous Soils (Cz) and Ferricrete (Czf). Tertiary-age rocks form scattered outcrops across the area.

Unit Cz is distinctive and contains autochthonous soils. It consists of small rock fragments and grains weathered directly from shallow subcrop and outcrop.

Unit Czf represents ferricrete, usually strongly silicified. The unit consists of fine grained ironstones, heavily ferruginised sandstone and iron oxide cemented breccia. The appears a strong association with silcrete, but in the Kulgera area there is a lack of silcrete (Czs) mapped. Most areas of ferricrete are too small to show in government mapping.

**Quaternary Deposits**

Quaternary Deposits cover about 70% of the surface area, and consist mostly of unconsolidated material. Because of the arid climate, deposition by fluvial means is rare. Wind and groundwater chemical deposition are the significant deposition mechanisms in the area. The Quaternary Units are: Talus and scree (Qt), Colluvium (Qr) sheet-wash, Alluvium (Qa), Calcrete (Qc), and Transported sand (Qs).

Unit Qt is composed of gentle slopes of rock rubble, sand and clay. They are identical to Tertiary deposits but are not cut or dissected by modern drainages like the former.

Unit Qr are areas of sandy sheetflood as both discrete bodies, and interdispersed with sand sheets. They exhibit arcuate vegetation patterns, containing alternating thick saltbush, mulga and sparse cover. The material is comprised of red desert sand and red clayey deposits.

Unit Qa consists of sand, clay and pebble to cobble material restricted to depositional environments of larger drainages.

Unit Qc consists of calcrete and is widespread, although often covered by transported sand. It represents groundwater precipitate hosting or replacing older Cainozoic sediments. Vegetation patches are common due to water ponding in the calcrete depressions. The calcrete consists of fine grained calcite in nodular, spherulitic and amorphous form, with larger sparry calcite crystals in veins and vughs. Chalcedony as veins is sometimes present and was formed simultaneously with the calcrete. The calcrete is an important aquifer for the pastoral and tourism industries.

Unit Qs represents transported sand, which is the most dominant surface forming feature in the region. This is either as sand, either transported sheets or dune fields. Sand dunes may be linear and reach 12m in height, although most display smaller dimensions and display a reticulate pattern. Most dunes are stable with small shrubs and spinifex acting as stabilisers. The sand is consistent and is red in colour, medium to fine grained, and consists of quartz and fine clays.

# 4. PREVIOUS EXPLORATION AND MINING

## Mining History

Reports of mining in the area consist of a small isolated patch of muscovite mica being mined from near Umbera Well during the Second World War, and a small quantity of Beryl being mined from a pegmatite near Kulgera.

## Previous Exploration

Most previous exploration has been focused on hydrocarbon potential (not reported here). Other minerals have had only cursory exploration conducted including uranium, rare earths, heavy minerals, gold, base metals, opal, and dimension stone. Summary of previous work by company and tenure is as follows:

### Geosurveys (open range exploration)

Geosurveys in 1968 carried out open range exploration for rare earth minerals near Victory Downs. Isolated occurrences of monazite, allanite, orthite, samarskite and euxcenite were recorded, but not of sufficient quantity for exploitation. Host rocks were pegmatites and quartz reefs from the Musgrave Block.

### Dillingham Minerals (AP 2911 & AP 3243)

Dillingham were exploring for unidentified minerals, possibly heavy mineral sands near Kulgera in 1971. Title was relinquished.

### Agip Nucleare Australia Pty Ltd (EL 1215)

Agip were exploring for uranium, completing 10 RC holes for 918m of drilling with no success. The collars can be seen in Figure 4, with most of this work completed outside the current Kulgera EL's. Disappointing results meant the ground was relinquished.

### EL1417 (possibly Cultus Pacific)

An unidentified company (Cultus Pacific?) explored for uranium in 1978-79. One basement high with an elevated radiometric? anomaly was detected. No further work was conducted and the tenement was dropped.

### Cultus Pacific NL (EL 1494)

Exploring the area for potential sedimentary uranium in the Eromanga Basin. The water was sampled from the bores in the region and analysed for uranium, with a peak result of 12ppm. This anomaly was decided not worth pursuing. Tenement was relinquished.

### R.J. Burke (EL 5602)

Exploration targeted base metals and gold, with 390 sediment pan concentrates collected for analysis from various parts of the EL. No analytical results and no location plan were submitted. It was stated that no visible gold was found in the

concentrates and magnetite was the only accessory mineral. Magnetite in pegmatites was the likely cause of aeromagnetic anomalies. Tin was observed in pan cons. Title was relinquished.

**J.W. Benger (EL 5862)**

Benger was exploring for opal bearing strata via auger drilling. Minor gold in was encountered in amphibolite rocks following regional reconnaissance. Opaline rocks similar to Mintabie Opal field were encountered. However his joint venture partner withdrew and the ground was relinquished.

**EDI Constructions (EL 6896)**

EDI was investigating the potential for dimension stone and crushed aggregate in the area. The exploration licence covered a large area of dolerite dyke swarms. The most intense area of intrusives with an areal extent of 4.5 square kms was pegged with mineral claims. In hand specimen the samples exhibited an even, deep black colour and exhibited a high degree of polish. Physical tests showed the samples to have a high bulk density and a low water adsorption rate indicating that the material was basically sound. Regional work was suspended and title relinquished.

## 5. CURRENT EXPLORATION

### Current Explorers

Companies currently exploring within the eastern portion of the Musgrave Block are Kajeena Mining Company and Gem Part Pty Ltd. To the west in the central Northern Musgrave Block and south over the border into South Australia explorers such as Goldsearch Limited and ReLODE are exploring for mineral deposits associated with thrust faults and associated dilational structures, as well as Giles Complex mafic intrusives potentially hosting nickel, platinum, palladium and copper.

### NTGS Magnetics & Radiometrics

NTGS magnetic and radiometric data (Kulgera (1981) & Kulgera West (1986) Airborne Geophysical Surveys) were flown at 500m line spacing and 100m terrain clearance. These were reprocessed and stitched in the course of researching the potential of the area.

### DME Digital Mapping

Second Edition 1:250,000 digital geological maps and explanatory notes for the Kulgera and Finke Sheets are available.

## 6. EXPLORATION TARGETS.

### Geological Interpretation

The geology of the northeast Musgrave Block is affected by a series of major E-W trending thrust faults. The Woodroffe Thrust and ?Mann Fault transect EL 10060. Later intrusives of the Fregon Terrain such as the Ayers Range Adamellite, Kulgera Adamellite and dolerite dykes were emplaced within the earlier mesoproterozoic gneissic rock package.

The major structural features within the Project area and granite intrusives are readily discernible on the magnetics image.

In the Musgrave Block government geologists and explorers have noted ductile and brittle shear zones with associated dilational structures within and linking the regional thrust zones. These dilational sites are control the flow of mineralising fluid flow and focussed metals deposition.

The fault zones and associated structures in the Kulgera area are priority exploration targets and require detailed interpretation of the magnetics data to be accompanied by field checking for lithology, structure and alteration features.

## Target Mineralisation.

The Musgrave Block has been subjected to minimal minerals exploration and a corresponding lack of detailed geological analysis. Exploration interest in recent years has ben driven by interesting nickel – copper intersections in drilling by WMC in the Western Australian part of the Block.

In South Australia stratabound copper sulphide deposits have been correlated as analogous with the Mt Isa copper orebody and in the Northern Territory and South Australia minor base and precious metals have been assayed in quartz veins.

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**Potential is also noted for:**

### Gemstones/Opals

Opal Potch has been reported in the region, but not widely tested. The geological setting and arid conditions are analogous with other central Australian opal terrains.

### Uranium

Sedimentary uranium sources from the gneissic terrains, granites and pegmatites may have been concentrated into overlying youmger sandstone units. Open file reporting of anomalies to 12ppm uranium is encouraging.

### Pegmatites

Pegmatite and granite hosting rare earths could be valid targets. Shallow cover masks much of the gneissic terrain and therefore masking possible radiometric anomalies co-incident with rare earth species.

Sn, W, U, Ta, Mo and Be could be secondary targets from highly fractionated pegmatites and granites which may exhibit magnetic lows within grainy magnetic to flat magnetic terrain as seen in the east Musgraves.

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