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Table 2.1  Summary of Historical Tenements in and near the EL 29556 Area.
SUMMARY

Pacific Exploration Pty Ltd (“Pacific”) acquired YAMBAH mineral tenements (EL 29554, EL 29555, EL 29556, and EL 29575) in southern Northern Territory for exploring mineral resources, such as uranium, gold, copper, lead, zinc and other metal minerals, as well as phosphate. The EL 29556 was granted on 19 February 2013. The historical exploration tenements in this area were granted to explore for not only uranium but gold, base metals, nickel and other commodities. In this area, historically, NuPower carried out an airborne electromagnetic (AEM) survey for exploring palaeochannel uranium deposits (EL 25325).

The regional geology comprises Tertiary sediments (~300 m in thickness) and the basement rocks mainly composed of granites and Gneiss. The tenement (EL 29556) is underlain by basement rocks of the Aileron Province comprising greenschist to granulite facies metamorphic rocks with protolith ages in the range 1865-1710 Ma. It forms part of the North Australian Craton and is geologically continuous with the gold-bearing Tanami and Tennant Regions to the north. This area has the potential to host not only surficial and/or sandstone style uranium mineralisation probably accumulated in palaeovalleys, but also metasomatite/ vein style uranium and other metal mineralisation developed in the granitic and metamorphic rocks.

Historical exploration in the Yambah region has focussed on the potential of the basement rocks to host layered mafic-ultramafic intrusions containing Ni-Cu-Co and platinoid (Pt-Pd) mineralisation. Several companies have also recognised the potential of the Cainozoic sedimentary sequences for secondary uranium deposits derived by the erosion of the surrounding uraniferous basement rocks.

Exploration during the reporting period comprised ground reconnaissance trip to locate and sample the surface geology and nearby known mineral occurrences. The desktop study of EL 29556 for mineral exploration has been focused the overview and technical proposal of the geological, geophysical and tectonic setting. This preliminary geoscientific study aims to investigate the geophysical and geological expression of structures related to any mineralisation. These studies will assist exploration in the Yambah region and provide fundamental data for increasing knowledge of geological processes and landscape evolution within this region.
1. INTRODUCTION

1.1 Background

PACIFIC EXPLORATION PTY LTD (“Pacific”) acquired four mineral exploration tenements in southern Northern Territory (EL 29554, EL 29555, EL 29556 and EL 29575) and is developing the Yambah Exploration Project (Figure 1.1). The licenses were granted on 19 February 2013 for a period of 6 years. Geotechnically, these tenements are located within the Arunta Region, associated with the Reynolds, Yalyirimbi and Strangways Ranges (see Figure 4.1). The schedule of rent and expenditure for the tenement EL 29556 is summarised in Table 1.1.

Table 1.1 Pacific Exploration Pty Ltd Tenement EL 29556 Schedule.

<table>
<thead>
<tr>
<th>Tenement ID</th>
<th>Tenement ID Expires</th>
<th>1st Year Rent</th>
<th>1st Year Expenditure</th>
<th>2nd Year Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>EL 29556</td>
<td>19/02/2013</td>
<td>$1,888</td>
<td>$19,000</td>
<td>$25,000</td>
</tr>
</tbody>
</table>

Basement rocks of the Reynolds, Yalyirimbi and Strangways Ranges contain elevated background levels of uranium and thorium and have been explored for gold, base metals, rare earth elements and uranium. Success came with the discovery of elevated levels of rare earth elements hosted by massive fluorapatite in the Nolan’s Bore area by PNC Exploration (Australia) Pty Ltd in 1995 (Thevissen, 1995). This occurred during follow-up of an airborne radiometric anomaly as part of that company’s uranium exploration program along the Reynolds Range. In 1972 it was recognised that while these rocks may host primary deposits of uranium, they also provided a potential source of uranium for secondary uranium deposits. The products of the weathering and erosion of these rocks throughout the Cainozoic have accumulated in flanking basins as thick sequences of unconsolidated material and provided a potential host for the precipitation of uranium from solution in groundwater sourced from the upstanding ranges and percolating through these basinal sediments. Arafura Resources and NuPower Resources also recognised the potential of the Cainozoic basins in the Aileron region on the flanks of the uraniferous basement rocks for secondary sandstone-hosted uranium deposits and applied for and were granted a number of exploration licenses here, including EL 25325, Yambah that covers part of the Burt Basin.

A desktop study compiled by Pacific Exploration Pty Ltd aims to investigate mineral potentials. Recommendations for the comprehensive prospectivity and exploration techniques have been provided. The interpretation of the remote sensing, magnetic, gravity and morphology, based on the current data, thus formed a basis for mineral exploration in the YAMBAH exploration project area, and further investigation into the geomorphology, geology geochemistry and geophysics of the project area and associated mineralization is necessary.
Figure 1.1 Regional Location Map showing “Pacific” YAMBAH exploration project ELs. EL 29556 is located in the eastern part of the map.
1.2 Location, Access and Logistics

EL 29556 is located approximately 70 kilometres north of Alice Springs and 1200 kilometres south-southeast of Darwin by the Stuart Highway in the southern part of the Northern Territory of Australia (Figure 1.1). The area is closed to the junction of Plenty Highway with the Stuart Highway and Alice Springs-Darwin Railway. Access to areas of interest in 2008 was from the Stuart Highway via the network of station roads and tracks linking the water bore.

Alice Springs (pop. 27,000) is well serviced by road transport and interstate bus services, because of its location mid-way between Adelaide and Darwin. The Stuart Highway and Adelaide-Darwin transcontinental railway corridor, passing through Alice Springs, bisect the area. Alice Springs is also serviced daily by jet aircraft from several Australian capital cities (Sydney, Adelaide, Perth and Darwin) and less regularly from Brisbane, Cairns and Broome.

The natural gas pipeline from the Amadeus Basin (west of Alice Springs, see Figure 4.1) to Darwin passes within 60 kilometres to the west of the area.

Alice Springs is the closest services centre, 70km by road via the Stuart Highway. The Aileron Roadhouse, located on the Stuart Highway with fuel and accommodation, lies 80km by road north of the license area.

The nearest station homesteads are Yambah in the eastern part of the area on the Stuart Highway, Bushy Park on the Plenty Highway and Aileron near the Aileron Roadhouse.

1.3 Climate and Vegetation

The region has a semi-arid continental climate, characterised by long hot summers when temperatures regularly exceed 40°C, and short mild winters (Stewart, 1982). The average rainfall is about 280mm, most of which falls between October and March, but both frequency and amount are erratic.” (Stewart, 1982).

The majority of the tenement is covered by various thicknesses of regolith cover and acacia trees and bush / grass undergrowth (Figure 1.2).

Vegetation throughout most of the area consists of tall mulga open shrubland with a woollybutt open grassland understorey. This gives way in the northwest to hummocky grassland with a tall acacia sparse shrubland overstorey” (Wilson et. al., 1991).
Figure 1.2  Photo imagery of EL 29556 showing regolith cover and acacia trees and bush / grass undergrowth extended to hills (photo taken in January 2014).

1.4 Topography and Drainage

The area of the EL 29556 comprises a flat sandy plain rising gently eastwards from around 600m ASL to around 1000m ASL east of the Alice Springs-Darwin Railway, at the base of the Strangways Ranges (Figure 1.3). Elevations in the eastern ranges exceed 1000m ASL. Creeks that rise in the Strangways Ranges and discharge westwards into the area include Burt and Ironwood Creeks.
Figure 1.3 Landsat ETM7 realistic 123 over DTM imagery showing relationships of landscapes, roads, drainages, and locality and “Pacific” YAMBAH exploration project ELs, including EL 29556.
2. PREVIOUS EXPLORATION

Previous exploration in the Yambah region has focussed on the potential of the basement rocks to host layered mafic-ultramafic intrusions containing Ni-Cu-Co and platinoid (Pt-Pd) mineralisation (Table 2.1). Several companies have also recognised the potential of the Cainozoic sedimentary sequences for secondary uranium deposits derived by the erosion of the surrounding uraniferous basement rocks.

A review of the historical exploration conducted over and near EL 29556 was completed by identifying the historical tenement that overlapped with the current tenement (Table 2.1).

Table 2.1 Summary of Historical Tenements in and near the EL 29556 Area.

<table>
<thead>
<tr>
<th>Historical Tenement</th>
<th>Company</th>
<th>Granted</th>
<th>Activity</th>
<th>Overlaps/ nearby</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP 2826</td>
<td>Planet Mining Co. Pty Ltd</td>
<td>1970</td>
<td>geological mapping, aerial photography, soil and rock chip sampling, Airtrace and IP geophysical surveys, trench sampling and diamond core drilling and generated an abundance of data</td>
<td>EL 29556</td>
<td>Copper, Red Rock Bore Prospect.</td>
</tr>
<tr>
<td>EL 58</td>
<td>Planet Mining Co. Pty Ltd</td>
<td>1970</td>
<td>geological mapping, aerial photography, soil and rock chip sampling, Airtrace and IP geophysical surveys, trench sampling and diamond core drilling and generated an abundance of data</td>
<td>EL 29556</td>
<td>Copper, Red Rock Bore Prospect.</td>
</tr>
<tr>
<td>EL 1341</td>
<td>Dampier Mining Company Limited</td>
<td>1976</td>
<td>Geologic traversing and rock chip samples.</td>
<td>EL 29556</td>
<td>Stratiform copper-lead-zinc</td>
</tr>
<tr>
<td>EL 1889</td>
<td>Triako Mines NL</td>
<td>1979</td>
<td>geological mapping, soil and rock chip sampling, IP survey and 5 diamond drill holes</td>
<td>EL 29556</td>
<td>Minerals in Red Rock</td>
</tr>
<tr>
<td>EL 3541</td>
<td>C.R.A. Exploration Pty. Ltd.</td>
<td>1982</td>
<td>Airborne magnetometer survey, geochemical sampling, gravel sampling.</td>
<td>EL 29556</td>
<td>base metals, diamonds</td>
</tr>
<tr>
<td>EL 3496</td>
<td>Negri River Corp.</td>
<td>1982</td>
<td>Air photo and Landsat image interpretation and stream sediment and gravel sampling</td>
<td>EL 29556</td>
<td>Diamond, base metals</td>
</tr>
<tr>
<td>EL 4420</td>
<td>Metwell Pty. Ltd.</td>
<td>1983</td>
<td>Rock chip, soil sampling, backhoe trench channel sampling, magnetic and scintillometer</td>
<td>EL 29556</td>
<td>Gold and base metals</td>
</tr>
<tr>
<td>EL 5267</td>
<td>McMahon Construction Pty Ltd</td>
<td>1987</td>
<td>E.M. 37 (Induced Polarization) survey</td>
<td>EL 29556</td>
<td>Sulphide bodies</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------</td>
<td>------</td>
<td>-------------------------------------</td>
<td>----------</td>
<td>----------------</td>
</tr>
<tr>
<td>EL 5258</td>
<td>McMahon Construction Pty Ltd</td>
<td>1987</td>
<td>E.M. 37 (Induced Polarization) survey</td>
<td>EL 29556</td>
<td>Sulphide bodies</td>
</tr>
<tr>
<td>EL 6832</td>
<td>White Range Gold NL</td>
<td>1990</td>
<td>Review of earlier work and carried out some geologic reconnaissance.</td>
<td>EL 29556</td>
<td>Base metals, gold</td>
</tr>
<tr>
<td>EL 7858</td>
<td>Aberfoyle Resources Limited</td>
<td>1992</td>
<td>Ground TEM survey over the Edwards Creek gossan.</td>
<td>EL 29556</td>
<td>Base metals</td>
</tr>
<tr>
<td>EL 8125</td>
<td>Roebuck Resources NL</td>
<td>1994</td>
<td>Interpretation of images of aeromagnetic data, stream sediment sampling, ground magnetic traverses followed by RC, RAB and diamond core drilling.</td>
<td>EL 29556</td>
<td>Gold and base metals</td>
</tr>
<tr>
<td>EL 9208</td>
<td>Pasminco Exploration</td>
<td>1995</td>
<td>Geological mapping, stream sediment sampling and rock chip sampling.</td>
<td>EL 29556</td>
<td>Lead-zinc</td>
</tr>
<tr>
<td>EL 10401</td>
<td>Deep Yellow Ltd</td>
<td>2001</td>
<td>Desktop study, ground reconnaissance combined with rockchip sampling.</td>
<td>EL 29556</td>
<td>Uranium &amp; other metals</td>
</tr>
<tr>
<td>EL 25325</td>
<td>NuPower Resources Ltd</td>
<td>2007</td>
<td>Airborne electromagnetic surveys (AEM), groundwater sampling, bores sampling, drilling.</td>
<td>EL 29556</td>
<td>Uranium</td>
</tr>
</tbody>
</table>

**AP 2826 and EL 58, 1970 - Planet Mining Co. Pty Ltd**

Planet explored for base metals in this area where was located east of the EL 29556 and Stuart Highway. The area was originally covered by AP 2826 in 1970 and later converted to EL58. It contains the Red Rock Bore Prospect which is a sub-economic copper prospect. Planet carried out extensive exploration including geological mapping, aerial photography, soil and rock chip sampling, Airtrace and IP geophysical surveys, trench sampling and diamond core drilling and generated an abundance of data. The tenement was relinquished in 1974.

**EL 1341, 1976 - Dampier Mining Company Limited**

EL1341 overlapped the southeast part of Yambah. Dampier Mining explored the area for stratiform copper-lead-zinc mineralisation and carried out geologic traversing and
rock chip samples. They considered that the mineralisation was low grade and small in size and relinquished the tenement in 1977.

**EL 1889, 1979 - Triako Mines NL**

The tenements overlapped the eastern part of Yambah and part of the western section. Triako carried out geological mapping, soil and rock chip sampling, an IP survey and drilled 5 diamond drill holes at the Red Rock and Harry’s Bore base metal prospects but considered the results uneconomic and relinquished the ground.

**EL 3541, 1982 - C.R.A. Exploration Pty. Ltd.**

This tenement overlapped the southeast part of the Yambah license. CRA conducted an airborne magnetometer survey, geochemical sampling for base metals and gravel sampling for micro-diamonds. The results were unsatisfactory and the tenement was subsequently dropped in 1983.

**EL 3496 1982 - Negri River Corp.**

This tenement overlapped the eastern part of Yambah. Exploration was focussed on diamond exploration although base metals were of secondary interest. They carried out air photo and Landsat image interpretation and stream sediment and gravel sampling. The results were not sufficiently encouraging to retain the tenement and it was relinquished in 1985.

**EL 4420, 1983 - Metwell Pty. Ltd.**

EL4420 overlapped the southeast corner of Yambah and was explored for gold and base metals. A program of rock chip, soil sampling, backhoe trench channel sampling and magnetic and scintillometer traversing was conducted followed by five diamond core drill holes and several shallow auger holes in areas of basement geology. There was no drilling of the Tertiary sediments. The tenement was relinquished in 1989.

**EL 5267 and EL5258, 1987 - McMahon Construction Pty Ltd**

These EL's overlapped the south central and eastern parts of Yambah. McMahon carried out an E.M. 37 (Induced Polarization) survey to explore for large concealed sulphide bodies, the results of which showed only weak anomalies and the tenements were surrendered in 1989.

**EL 6832, 1990 - White Range Gold NL**

EL6832 overlapped part of the north-eastern section of the tenement. Exploring for base metals White Range Gold completed a review of earlier work and carried out some geologic reconnaissance. The tenement was surrendered in 1991.
EL 7858, 1992 - Aberfoyle Resources Limited

This tenement overlapped a small area of the southeast part of Yambah. Exploration was for base metals and Aberfoyle conducted a ground TEM survey over the Edwards Creek gossan. The tenement was relinquished in 1994.

EL 8125, 1994 - Roebuck Resources NL

EL8125 overlapped parts of the western section and northeast sections of Yambah. The area was considered to be prospective for gold and base metals and following the interpretation of images of aeromagnetic data obtained from NT Dept of Mines and Energy Roebuck carried out a program of stream sediment sampling, ground magnetic traverses followed by RC, RAB and diamond core drilling. Results were disappointing and the tenement was relinquished in 1997.

EL 9208, 1995 - Pasminco Exploration

EL 9208 partly overlapped the central eastern part of the Yambah tenement. Pasminco considered the area prospective for lead-zinc mineralisation and conducted a program of geological mapping, stream sediment sampling and rock chip sampling. Results were disappointing and the tenement was relinquished in 1997.

EL 10401, 2001 - Deep Yellow Ltd

EL 10401 partly overlapped the central eastern part of the Yambah tenement. Deep Yellow Ltd considered the area prospective for uranium mineralisation and conducted a program of desktop study, ground reconnaissance combined with rock chip sampling. Results were disappointing and the tenement was relinquished in 2008.

EL 25325, 2007 - NuPower Resources Ltd (Davey, 2012)

Arafura Resources NL selected Yambah EL 25325 for exploring secondary sandstone hosted type uranium mineralisation in unconsolidated Cainozoic basin sediments of the Burt Basin, derived by erosion of adjacent uraniferous basement granites and gneisses. The license was granted on 17 January 2007 and transferred to NuPower Resources Ltd on 14 March 2007 as a result of the demerger of Arafura’s uranium assets into the newly formed company focussed on uranium. NuPower carried out an airborne electromagnetic (AEM) survey in June-July 2007 over the western 2/3rds of the area as part of a larger survey of NuPower’s tenements in the Aileron region, designed to explore for buried palaeochannels at the base of and within the Cainozoic sedimentary package as potential hosts for secondary uranium. Final results from the AEM survey show that the technique has successfully identified sections of several major palaeochannels in the license area.

Airborne electromagnetic surveys (AEM, flown at 1km line spacing during 2007) have been applied in the entire extent of EL 25325 for exploring secondary uranium deposits hosted in palaeochannel systems (Rafferty, 2008). Although inversion and further processing of the data was planned the data has already identified significant palaeochannel systems thought the license area. Inversion of the AEM survey data
Pacific Exploration Pty Ltd - Annual Report on Mineral Exploration of EL 29556

(reported previously, Higgins, 2009) for EL25325 showed two well-defined palaeochannels on Yambah that appear to be isolated from the Burt Basin to the west. These two palaeochannels area hereby named the ‘Canteen’ and ‘Mistake’ Palaeochannels (after Canteen and Mistake Bores). From the extent and size of the Burt Basin and its tributaries revealed by the AEM data, the palaeochannels under Yambah form part of a much more extensive regional palaeodrainage system. The Hann Range forms a prominent basement high to the north of the tenement whilst the Strangways Ranges form a similar high to the east. Minor to moderate sized palaeochannels drain the Hann Range to the south and southeast, and north off the MacDonnell Ranges into the Burt Basin. Palaeochannels are poorly developed in the southeast and eastern portions of the tenement and the Sixteen Mile Basin may be entirely separate from the Burt Basin.

A regional groundwater sampling program was commenced in 2007 that included EL 25325, the results of which were intended to assist with interpretation and targeting of the palaeochannels. Eight bores were sampled, the results of which were reported previously (Rafferty, 2008).

During 2008 the NTGS conducted a helicopter-borne regional gravity survey over the central Arunta Region with survey points spaced 4km apart. NuPower contributed to the program in order to obtain more detailed, 2km spaced data, over its Aileron Project tenements, which included Yambah. Results were reported previously, (Higgins, 2009).

NuPower drilled 4 vertical rotary mud drill holes for 504m during Year 2 on Yambah to follow up the results of the AEM survey, (Higgins, 2009). The drilling encountered significant thicknesses of Tertiary sediments on Yambah, thus confirming the presence of the buried palaeodrainage system indicated by the 2007 AEM survey. Drilling indicated that a thick succession of oxidised clays, interpreted Waite Formation, rests directly on weathered crystalline basement. Kaolinitic and/or carbonaceous sands of Hale Formation were not intersected by drilling due to the shallower nature of the palaeochannel system. The holes were logged with a downhole gamma probe, but there was no anomalous gamma in any of the holes. Whilst the palaeodrainage system appears to be well-developed, the prospectivity of the Canteen and Mistake palaeochannels is reduced by the absence of sands and the oxidised nature of the Waite Formation. It was recommended that future efforts should focus on the northern regions of the tenement (particularly the Mistake Palaeochannel) where the palaeochannels may be more deeply incised and may contain reduced sands of the Hale Formation.

During 2008, further groundwater samples from 6 bores that included repeat samples from 5 of the bores sampled during Year 1, the results of which were reported previously, (Higgins 2009). Nine groundwater samples were also taken from 3 of NuPower rotary mud drill holes. It was realised that the groundwater from a newly drilled hole would initially be contaminated but it was thought that this would re-equilibrate back to natural groundwater over time. A series of samples was therefore taken from each drillhole to determine whether this had occurred and if the latest sample could be regarded as a sample of natural uncontaminated groundwater. These results were also reported previously, (Higgins, 2009).

During August 2008 to October 2009, four water samples taken from three of NuPower’s exploration drillholes to determine whether the groundwater had re-equilibrated to natural groundwater conditions over an extended period of time so that the
latest sample could be assumed to represent natural groundwater, uncontaminated by the rotary mud drilling (Davey, 2012).
3. GEOLOGY

3.1 Regional Geology

The YAMBAH project lies within the Arunta region of the North Australian Craton. EL 29556 is situated in the Aileron Province of the Arunta Region in the southern part of the Northern Territory (Figure 3.1). Deformed and metamorphosed Palaeoproterozoic orogenic rocks older than 1800 million years crop out as major tectonic units surrounded by younger rocks and essentially form the recognisable and inferred basement to the North Australian Craton. These Palaeoproterozoic rocks form the Pine Creek Orogen, Tanami Region, northern Arunta Province, and Tennant, Murphy and Arnhem Inliers. They include remnants of Archaean rocks, which have been dated at 2500 million years.

Figure 3.1 Geological Regions of the Northern Territory and “Pacific” YAMBAH project ELs.

To the south, the rocks of the North Australian Craton pass into the Central Australian Mobile Belts of the Proterozoic Orogens of the Arunta Region and Musgrave Block, consisting of granulite and amphibolite facies, metamorphosed sediments and mafic
volcanics intruded by granitoids. In the southern Arunta Province, episodic igneous activity took place between 1880-1050 million years and deformation included a series of major tectonic events, including retrogressive metamorphism in the Proterozoic and Palaeozoic. In the Strangways Ranges, these basement rocks are exposed in the easternmost part of the YAMBAH project area and expected to lie at depth beneath unconsolidated Cainozoic sediments in the eastern part of the area.

Proterozoic-Palaeozoic basins form part of the North Australian Platform Cover and comprise mildly deformed, largely unmetamorphosed predominantly sedimentary successions unconformably overlying the Proterozoic Orogens (Davey, 2012). This includes the Ngalia and Georgina Basins in the Aileron region. These rocks are absent in the YAMBAH project area.

A system of major west-northwest, east northeast and north-northeast trending dipping thrust faults and shear zones affects the Arunta Region. The associated shear zones can be up to hundreds of metres in width and extend for several kilometres, and are thought to have formed during the 400-300 Ma Alice Springs Orogeny (Cartwright et al., 1999). East-northeast structures underlie the Yambah region.

Pre-Cambrian-Proterozoic

The basement rocks in the Aileron region comprise part of the Arunta Region, a complex basement inlier in central Australia that has undergone a prolonged history of sedimentation, magmatism and tectonism extending from the Palaeoproterozoic to the Palaeozoic (NTGS the website, December, 2004). The Arunta Region can be subdivided into the three, largely fault bounded terranes with distinct geological histories: the Aileron, Warumpi and Irindina Provinces (Figure 3.1).

3.2 Local (YAMBAH ELs) Geology

The geology is illustrated by the ALICE SPRINGS 1:250,000 geological mapsheet (Figure 3.2).

Pre-Cambrian-Proterozoic

The Yambah tenements are underlain by basement rocks of the Aileron Province (Figure 3.1). The Aileron Province comprises greenschist to granulite facies metamorphic rocks with protolith ages in the range 1865 Ma -1710 Ma. It forms part of the North Australian Craton and is geologically continuous with the gold-bearing Tanami and Tennant Regions to the north. In contrast, the Warumpi Province comprises amphibolite to granulite facies rocks with protolith ages in the range 1690 Ma -1600 Ma, and is interpreted to be an exotic terrane that accreted to the southern margin of the North Australian Craton at 1640 Ma. The Irindina Province in the Harts Range region comprises Neoproterozoic to Cambrian metasediments that formed in a major depocentre within the Centralian Superbasin. It underwent high-grade metamorphism and deformation during Ordovician (480 Ma- 450 Ma).”

Basement geology is dominated by quartzofeldspathic gneiss of the Strangways Metamorphic Complex, which has been assigned by the Northern Territory Geological Survey (NTGS) and TENL to the basal (>1870 Ma) Narwietooma Metamorphics. The
Wuluma Granite is located in the east of EL 29556 and has been interpreted as part of a 1760-1740 Ma intrusive suite formed by partial melting of metasediments.

The Arunta Basement in this region is further subdivided into the Central and Southern Provinces by the Redbank Thrust Zone, a major north dipping crustal-scale northwest trending structure. Yambah ELs lies north of the Redbank Thrust Zone in the Central Zone where it is underlain by metamorphic rocks of Division 1 of the Arunta Block comprising mafic to felsic granulites of the Strangways Metamorphic Complex that were deformed, metamorphosed and intruded locally by megacrystic syntectonic granites during the Strangways Orogeny around 1760-1750Ma. Rocks of the Strangways Metamorphic Complex include:
• Yambah Granulite: felsic and mafic granulites, cordierite granulite, quartzofeldspathic gneiss and amphibolite;
• Ingula Migmatite Suite and Erontonga Metamorphics: quartzofeldspathic gneiss, some mafic rocks, cordierite-garnet gneiss, intruded by granites of the Wuluma Granitoid;
• Enbra Granulite: mafic-intermediate granulites; and
• Cadney Metamorphics: calc-silicate rocks and schistose biotite and sillimanite gneiss.

The Harry Creek Deformed Zone along the southern boundary of the license separates these rocks from interlayered mafic granulites and garnet gneisses of the Adla Granulite and layered granitic rocks, garnet biotite gneiss, feldspar augen gneiss, amphibolite and quartzose gneiss of Division 2 of the Arunta Block. Minor outcrops of retrogressed greenschist facies rocks in shear zones are also present.

Cainozoic Geology

The southern NT forms a ‘basin and range’ province with Proterozoic and Palaeozoic rocks forming prominent ranges separated by broad valleys (Figures 3.1, 3.2 and 3.3). Cainozoic sedimentary basins are widespread and well-developed within these intervening topographic depressions with at least twenty major basins known (Senior et al., 1995). The Burt Plain is an extensive flat feature roughly 50km by 25km in size that is the modern day expression of the Late Tertiary land surface developed on Tertiary lacustrine sediments of the Burt Basin. The Yambah tenements cover portions of the eastern half of the Burt Plain (Figures 3.2 and 3.3).

Figure 3.3 Geology of the Aileron Region showing relationships of major faults, geology and the historical ELs related to the “Pacific” YAMBAH project ELs (Figure 3.2) (modified from Davey, 2012).
Neoproterozoic-Palaeozoic Ngalia Basin sediments are thought to be absent beneath Yambah project areas, and the basin is thought to rest directly on crystalline basement of the Arunta Complex.

The relatively small Hale Basin (Figure 3.4) was explored extensively for coal (lignite) and sedimentary uranium during the late 1970’s and early 1980’s and is considered to be the best known Cainozoic basin in the NT. Senior et al. (1995) compiled a summary of the available information and defined a two-fold stratigraphic subdivision that broadly corresponds with the observed pattern of Cainozoic sedimentation elsewhere in southern Australia, and comprises a restricted, fluvial palaeochannel dominated Palaeogene succession (Hale Formation) overlain by a more widespread, dominantly lacustrine Neogene succession (Waite Formation) (Figure 3.5).Whilst the succession in the Hale Basin is relatively thin (<100m), it can considered to represent a generalised Tertiary stratigraphy for the southern NT, and despite being initially defined in separate, small and isolated Tertiary Basins, these formations are components of a much larger Tertiary palaeodrainage system, the extent and size of which has until now been vastly underappreciated.

Due to a lack of outcrop and strong weathering overprints, the paucity of drillholes and a lack of attention paid to the ‘cover’ overlying crystalline basement, the stratigraphy of the intermontane Cainozoic basins of the southern NT region is generally poorly known.
Knowledge of the distribution and extent of the Cainozoic has been largely gained through accidental intersections in water bores or in drillholes seeking mineralisation under cover (Davey, 2012). Early (1933) drilling of Sixteen Mile Bore in what became known as the Sixteen Mile Basin (Figure 3.3) to the southeast of the tenement indicated considerable thicknesses of probable Tertiary sediments including carbonaceous shales (Hossfeld, 1954).
Subsequent drilling around Sixteen Mile Bore in 1950, 1966 identified approximately 17m of clay with thin lignite seams from 145m (Edworthy, 1967). A shallow lacustrine environment, possibly a playa lake, is suggested by the presence of analcite.

Limited stratigraphic drilling was undertaken in the southern NT region by both the BMR (now Geoscience Australia) and the NTGS during the late 1970’s and early 1980’s and these drilling programs have provided the majority of the information on the Cainozoic succession. The NTGS drilled 3 cored holes in the region around Sixteen Mile Bore in 1978, and 1981 that encountered carbonaceous material with one hole intersecting 51m of carbonaceous clay and thin lignite seams from 126 m. Occurrences of lignite and carbonaceous Tertiary sediments were discussed by Wyche (1983).

**Deposition and Weathering**

Deposition of Cainozoic sediments was episodic and punctuated by hiatuses during which prolonged periods of weathering resulted in the formation of well-developed weathered profiles (palaeosols and duricrusts). These weathering events affected Arunta igneous and metamorphic basement rocks and the overlying Tertiary succession (Senior et al., 1995).

**Weathering Event A** (Senior et al.’s 1994, 1995) occurred during the Late Cretaceous to Early Tertiary (Palaeocene). A trizonal profile was developed in basement rocks over a widespread area of the Arunta Region and at the base of surrounding Tertiary basins. The trizonal profile consists of a basal kaolinitic zone up to 10 meters thick those grades into a multicoloured mottled zone up to 10 meters thick. The mottled zone is overlain by a ferruginous (ferricrete) zone up to 8 meters thick.

Following uplift and partial truncation of the deeply weathered basement rocks, sedimentation in the surrounding Tertiary basins began in the Palaeocene with deposition of thick colluvium including fanglomerates flanking the ranges. This was followed by deposition of alluvial and lacustrine sand, silt and clay (locally carbonaceous) and lignite of the Lower Hale Formation in the Ti-Tree and Burt Basins during the Early to Middle Eocene. Locally this includes a basal lacustrine green and grey pyritic mudstone, white mudstone and siltstone, and red iron oxide stained siltstone and siltstone.

**Weathering Event B**, recorded in the Hale Basin, occurred prior to the Middle Eocene, although there is little evidence elsewhere for this weathering event (Senior et al., 1995). This resulted in lithification and formation of a second ferricrete profile.

Deposition of sandstones of the Upper Hale Formation took place during the Late Eocene and these sediments were subsequently overprinted by Weathering Event C marking widespread exposure and surficial weathering in response to a prolonged period of non-deposition during the Oligocene.

Climatic amelioration during the Early Miocene rejuvenated the palaeodrainage systems and led to the deposition of fluvial sands at the base of the Waite Formation. A change from fluvial to lacustrine sedimentation then followed during the Middle to Late Miocene and resulted in the accumulation of over 300 meters of fluviatile and lacustrine limestone, sands, muds, and sandy conglomerate in localised depocentres.
The upper portions of the Waite Formation are regionally extensive, consisting largely of clay and dolomitic clays that reflect the widespread development of broad, shallow evaporitic lakes throughout southern Australia as the continent drifted further northwards and became progressively more arid and seasonal. These sediments are frequently capped by calcritised limestones and distinctive chalcedonic silcretes that form regionally widespread stratigraphic markers.

Towards the ranges, the Waite Formation interfingers with, and is conformably overlain by a moderately thick (<60m) succession of oxidised colluvial material shed from the ranges in response to neotectonism during the (?Late) Pliocene. A broadly coarsening upwards alluvial fan succession can be recognised throughout the region. This unit is informally referred to as the Napperby Formation and comprises a succession of oxidised and haematitic, clayey sands, sandy clays and minor conglomerates.

Overlying these sediments are unconsolidated Quaternary sediments including quartz sands, silts, red earths and clayey and sandy soils that record a complex history of deposition, erosion and redeposition due to climate changes and gentle tilting. Large outwash fans from the northern side of the MacDonnell Ranges have formed alluvial plains and overbank deposits alongside sandy drainage channels. The Formation of calcretes, particularly within drainage channels and atop the Waite Formation, was widespread during the Quaternary.
4. MINERALISATION

4.1 Source Rocks of Minerals

In this region, the basement rocks of the Reynolds, Yalyirimbi and Strangways Ranges have been explored for gold, base metals, rare earth elements and uranium, and contain elevated background levels of uranium and thorium. The discovery of elevated levels of rare earth elements hosted by massive fluorapatite in the Nolan’s Bore area resulted from an airborne radiometric survey along the Reynolds Range by PNC Exploration (Australia) Pty Ltd in 1995 (Thevissen, 1995). As far back as 1972 it was recognised that while these rocks may host primary deposits of uranium, they also provided a potential source of uranium for secondary uranium deposits (Figures 4.1 and 4.2). The products of the weathering and erosion of these rocks throughout the Cainozoic have accumulated in flanking basins (including Burt Basin) as thick sequences of unconsolidated material and provided a potential host for the precipitation of uranium from solution in groundwater sourced from the upstanding ranges and percolating through these basinal sediments.

In recent exploration activities (e.g., Arafura Resources and Unpowered Resources Ltd) with this target model, also recognised the potential of the Cainozoic basins in the Aileron region on the flanks of the uraniferous basement rocks for secondary sandstone-hosted uranium deposits. Pacific Exploration Pty Ltd applied for and was granted a number of exploration licenses here, including EL 29556, Yambah that covers part of the Burt Basin. Yambah ELs (EL 29554, EL 29555, EL 29556, and EL 29575) were selected by Pacific Exploration Pty Ltd mainly because of the potential for secondary sandstone hosted type uranium mineralisation in unconsolidated Cainozoic basin sediments of the Burt Basin, derived by erosion of adjacent uraniferous basement granites and gneisses.

The distribution of known uranium resources exhibits a clear spatial relationship with uranium-enriched bedrock in this region (Figure 4.2). The location of deposits is strongly influenced by the presence of Proterozoic age leachable uranium-rich source rocks in the headwaters of paleodrainages draining into the sedimentary basins developed in Proterozoic Orogenic Domains (Figure 4.1). Significant uraniferous igneous rocks (containing >10 ppm uranium) formed during the Proterozoic are widespread throughout this region.

4.2 Potential Mineralisation

Relevance to the “Pacific” tenement EL 29556 and surrounding areas the mineral potentials are the hard-rock hosted metals, and sandstone-hosted and possibly surficial uranium mineralisation. These occurrences fall within the zone of regional uranium potential in the Northern Territory (Lally and Bajwah, 2006) (Figure 4.1). In the Burt Basin, the sandstone and surficial types of uranium mineralisation can be deposited in paleovalley/lake and defined as any diagenetic/epigenetic concentration of uranium minerals occurring in fluvial, alluvial, lacustrine, and estuarine sediments. In the northwest of the region, recent discoveries of paleovalley-related uranium mineralisation (e.g., Afghan Swan deposit in Ngalia Basin of NT) highlight the potential prospectivity of the project area (Figures 4.1 and 4.2). In the project area examples, uranium mineralisation...
may occur in and nearby the sedimentary (e.g., Burt Basin) basins flanking or overlying northeastern Proterozoic rocks known to be enriched in uranium (Figure 4.1).

Figure 4.1 Uranium occurrences and areas with potential for uranium in the project region (from M Ahmad, NTGS, unpublished data).

The uranium fields of the **Amadeus Basin and Ngalia Basin** are associated with the project area, where the sandstone-hosted uranium mineralisation is reported from the Carboniferous Mount Eclipse Sandstone and Kerridy Sandstone Formations of the Ngalia and Amadeus Basins (Figure 4.1). Sedimentary rocks of the Ngalia Basin were derived from, and deposited on felsic granite gneiss and schist of the Arunta Block which are significantly enriched in uranium. The Yulyupunya Granite Gneiss (1780Ma) and the Southwark Granite Suite, for example, contain up to 22.5ppm uranium (Young et al. 1995). Early shallow marine conditions were followed by continental conditions culminating in the Mount Eclipse Sandstone which was deposited in response to tectonic uplift and erosion of the Arunta Block at 350Ma to 370Ma. Importantly as uranium reductant, carbonaceous material is also common with a 7m thick unit of lignite reported (Spark, 1975).

Several occurrences of calcrete-hosted uranium within and to the south of the Ngalia Basin have been identified. The most significant deposit, Napperby (New Well) (Figure 3.1 and Figure 4.2) contain an inferred resource of 9.34Mt U₃O₈ ore at a grade of 0.036% U₃O₈ (Northern Territory Government report, March 2013). Napperby (New Well) is situated in the drainage system of Napperby River and Lake Lewis, a playa lake system (Figure 3.1).

Minor uranium prospects and occurrences categorised as metasomatite and intrusive-type uranium are located within the Aileron and Irindina provinces of the Arunta Region, particularly in the Harts Range, Entia Dome and Reynolds Range areas. The region is under-explored and the possibility exists for further discoveries of these styles of
uranium deposits (Lally and Bajwah, 2006). The Nolans Bore mineralisation of fluorapatite occurs in the southeastern part of the Reynolds Range, 13km northwest of Aileron.

Also, a number of mineral prospects and occurrences mostly categorised as hard-rock and tectonic-type minerals are located in the east of the EL 29556.

Figure 4.2 Uranium occurrences in the region [uranium occurrences shown in blue. Yellow: most recent exploration activity. Advanced or significant under developed occurrences shown with pickaxe (Northern Territory Government Report, March 2013)].
5. INTERPRETATION AND MINERAL PROSPECTIVITY

An assessment of the YAMBAH project for sandstone-hosted and/or surfacial uranium deposits was to undertake a compilation of geological, geophysical, topographical and historical open file data over the tenement areas and provide initial recommendations for ongoing exploration.

The current interpretation and discussion are mainly based on the associated public domain geophysical and geological data including aeromagnetics, gravity, and DEM, surface and solid geologies for the project area was acquired from the NTGS. Reprocessing of the digital data has enhanced all of the geophysical and geological signatures and has also outlined a number of other subtle features.

5.1 Methodology

Topography (digital elevation models) and Landsat images, magnetic, and gravity methods are integrated into this phase on the basis of GIS for an attempt to correlate the features observed from geological maps. This interpreted result derived from the integrated datasets will be tested and improved by application of new drillholes.

All coordinates listed in this report are in map projection MGA94, Zone 53 (GDA94). The targeting process was undertaken as follows:

- Import of the above into ArcGis and sub-setting into different sample types and grade ranges for presentation and analysis.
- Examination of fact geology and surface geology and to provide geological information for targeting.
- Identification of available airborne geophysical and remote sensing data.
- Review of all data mentioned above to identify uranium targets.
- Identification targets with the potential to contain significant mineralisation.
- Recommendation of effective methods for exploring mineral deposits in the project area [Some useful methods (e.g., for mapping palaeovalleys) will be recommended].

Topography – Digital Elevation Model (DEM)

Topography over the tenement EL 29556 is relatively low and flat in the northern and southwestern part and occurs higher towards the east and southeast, with some very small creek systems (Figure 5.1). A main fault occurs in the southwestern part of the exploration licence EL 29556 (Figure 5.1).
Figure 5.1 Digital Elevation Model (DEM) over surface geology in the EL 29556 area, showing the relationship between geology, fault, Burt basin, and known mineral occurrences.

Generally, DEM is very effective in the recognition of young (e.g., Cenozoic and/or Mesozoic) potential palaeochannel areas, as the lower topographic zones can reflect areas where some of the softer sediments have been eroded away. Therefore, DEMs can be used as surrogates for mapping the palaeochannels and related features when the modern and palaeo-geomorphologies are related spatially and genetically. This scenario should be confirmed by combining other methods, such as night-time thermal imagery, AEM/TEM and drilling. If the presence of potential palaeochannels can be determined, some segments of the palaeochannels here should be favourable for exploring sandstone-hosted and/or calcrete style uranium deposits.

*Landsat TM*
Landsat TM image is useful in defining spectrally anomalous zones or regions when appropriately draped over DEM to enhance terrain visualisations (Figure 5.2). This can be used to figure out the relationship between the U-source rocks and in-situ uranium or U/Th anomalies, which is helpful in exploring for metasomatite uranium mineralisation.

Figure 5.2  Landsat TM imagery of EL 29556 area, showing the relationship of landscape, fault, Burt basin, and known mineral occurrences.

**Total Magnetic Intensity (TMI)**

Magnetic high features in the northern part of the EL 29556 are interpreted as Fe-bearing metamorphic basement and fault images, with some features apparent showing relatively deeper basement to the Burt Basin (Figures 5.3). The Burt Basin margin is not clearly defined by the total magnetic intensity data (Figures 5.4).
Mesozoic and/or Cainozoic paleovalleys are not usually visible on regional magnetic data (Figure 5.4), as they are relatively shallow features. Considering the nearby known mineral occurrences mostly occurring in the higher magnetic zones, the magnetic high features in the EL 29556 indicate potentials of hard rock mineralisation, such as copper, gold, nickel, lead and zinc, which need detailed surveys assist in locating relative deposits.
Mesozoic and/or Cainozoic paleovalleys are not usually visible on regional magnetic data (Figure 5.4), as they are relatively shallow features, but careful use of detailed surveys may assist in locating channel deposits (e.g., basalt buried within the paleovalley generally showing positive magnetic anomaly).

Gravity

Relative high gravity feature occurs in the north of the EL 29556 area where shows a relative moderate gravity feature. Because of normally small scales of palaeovalleys, gravity method should use high resolution survey, especially when it used with DEM,
Landsat, NOAA, or AEM images. The Burt Basin margin is also not clearly defined by the gravity data (Figure 5.5).

Figure 5.5 Gravity of the EL 29556 area, showing Burt Basin, regional faults, Burt basin, and known mineral occurrences.

5.2 Mineral Prospectivity

The tenement is located within the general region of uranium prospectivity (Lally and Bajwah, 2006) and of relevance are occurrences in the area of sandstone-hosted and surficial uranium mineralisation styles. EL 29556 is located in the uranium potential zones of the Ngalia Basin and Amadeus Basin areas shown in Figure 4.1.
Regionally, the style of mineralisation within the Arunta Block gneisses and metamorphic sequences is represented by pegmatite/vein style mineralisation (Sn-Ta-W) and the Nolans Bore metasomatite flour-apatite style mineralisation (REE-P-U).

EL 29556 is located to the southeast of the Ngalia Basin and within the uranium prospective zones (Figures 4.1 and 4.2). It is therefore considered prospective for palaeovalley sandstone-hosted and calcrete style uranium mineralisation, similar to those found within the Palaeozoic continental clastic successions of the Kerridy Sandstone Formation and Mount Eclipse Formation.

Surficial style mineralisation related to, palaeovalley, playa, or terrace deposits may not be developed in areas where significant calcrete and terrace deposits are absent, associated with the drainage system and possible palaeo-playa lakes.
6. CONCLUSIONS AND RECOMMENDATIONS

EL29556 remains highly prospective not only for sandstone-hosted secondary uranium in palaeochannels, but also for other metal deposits with high magnetic anomaly. The combination of DEM, AEM, and night-time thermal remotely-sensed imagery in GIS mode represent by far the best method for palaeovalley-related uranium exploration in the area. Ground magnetic and gravity, shallow seismic, TEM, and test drilling, where necessary, are also important media that can be used in subsurface structure delineation. The detector and orbital configuration of NOAA-AVHRR (1.1 km pixel) and ASTER (90 m pixel) night time data could make it a very useful remote-sensing method in that it detects temperature variations in palaeochannel sediments related to the elevated moisture content of the channel.

Microgravity surveying techniques can also be applied to look for uranium-bearing palaeochannels in the project areas; gravitational techniques should work quite well, given the density contrast of the basement/bedrock and the channel sand. The AEM has proven to be a good guide to conductive variations in the subsurface and is one of the best techniques for detecting buried conductive anomalies.

It is recommended that the exploration program in the next step should be designed to test the tenements for the uranium targets described above. In summary, the following conclusions can be made regarding the geophysical and geological methods for locating potential mineralisation sites:

- Acquires and interprets detailed night-time thermal image image (first), AEM/TEM or shallow seismic data over the project area.

- An airborne electromagnetic survey (AEM) is recommended second as results may define smaller target areas and aid in orientating traverse lines correctly.

- If necessary, carries out ground gravity traverses over the magnetic anomalies with the generation of geology maps.

- Compiles a detailed structural map and analysis of all priority magnetic and radiometric anomalies to determine the controls and disposition of any uranium mineralisation potential.

- Look for signs of channels and intrusives at depth or zones of high physical contrasts along shear zones and or contacts that might mark high redox potential.

- To determine survey line orientation, lithology strike and dip needs to be determined for the palaeovalley and underlying basement.

- Test drilling should traverse across or along the interpreted signatures, and particularly high priority zones selected. When these predictions prove wrong, the information should be used to revise and update the 3D models.

- Conduct a small RAB/RC/diamond drill program targeted at down dip and down plunge extensions to the any mineralisation intersected and to test the source of the uranium conductors located by geophysical survey.

- RC drilling. The cost of drilling possibly 10-100m deep holes to reach the basement means a palaeovalley-related (sandstone and surficial-style) uranium deposit would need to be found.
- Sample water from aquifers intercepted by station bores to map U distribution.
- Any trace of valuable minerals within the basinal sediments or bedrocks (e.g., gold, uranium) is of interest as a guide to the location of basement mineralisation.
KEY REFERENCES


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APPENDIX 1 – EXPENDITURE REPORT