Report ARU-15/03

ANNUAL REPORT FOR YEAR ENDING 20th APRIL 2015,
EL 24741 (WOODFORDE),
NORTHERN TERRITORY, AUSTRALIA

By

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</tbody>
</table>
TABLE OF CONTENTS

Copyright statement............................................................................................................... 2
Reporting Details ...................................................................................................................... 2
List of Figures ......................................................................................................................... 4
List of Tables ......................................................................................................................... 4
Appendices (Digital Only) .................................................................................................... 4
SUMMARY .............................................................................................................................. 5
INTRODUCTION ...................................................................................................................... 7
  Background ......................................................................................................................... 7
  Location and access ............................................................................................................ 7
  Topography and drainage ................................................................................................. 7
  Climate and Vegetation .................................................................................................... 8
  Logistics ............................................................................................................................ 8
TENURE ............................................................................................................................... 10
  Mining/Mineral Rights .................................................................................................... 10
  Land Tenure .................................................................................................................... 10
  Native Title ...................................................................................................................... 10
  Site Clearances .............................................................................................................. 11
GEOLOGICAL SETTING ...................................................................................................... 12
  Regional Geology ........................................................................................................... 12
  Cainozoic Regional Geology ........................................................................................... 15
  Deposition and Weathering ............................................................................................ 18
PREVIOUS INVESTIGATIONS ............................................................................................. 20
Other Parties ....................................................................................................................... 20
  CRA Exploration Pty Ltd AP2617 (1970) ........................................................................ 20
  CRA Exploration Ltd EL3360 (1971) .............................................................................. 20
  Tanganyika Holdings Ltd EL241 and EL242 (1972) ........................................................... 20
  CRA Exploration Pty Ltd EL752 (1972). ......................................................................... 20
  Central Pacific Minerals NL EL1384 (1976) .................................................................. 20
  Otter Exploration NL EL1444 (1977) ............................................................................ 21
  BHP Minerals Limited EL2942, EL3075, EL3084 & EL3088 (1981) ................................. 21
  James Weir EL3506 (1982) ............................................................................................ 21
  BHP Minerals Ltd EL4188 (1983) ................................................................................... 21
  Track Minerals Pty Ltd EL 5901 (1988) .......................................................................... 21
  Tidegate Pty Ltd EL8117 (1993) .................................................................................... 21
  PNC Exploration (Australia) Pty Ltd EL 8411 (1994) ...................................................... 21
  Aberfoyle Resources Ltd EL9146 (1995) ....................................................................... 22
  Aberfoyle Resources Ltd EL9145 (1996) ....................................................................... 22
  EL9672 Star Money Lenders Pty Ltd/Arafura Resources Ltd (1996) ................................. 22
  Tanami Gold NL EL2387 (2003) .................................................................................... 22
INVESTIGATIONS ON EL 24741 .................................................................................................................... 23
NuPower Exploration Activities Completed, Year 2, (22/04/07 - 21/04/08) ................................................... 23
NuPower Exploration Activities Completed, Year 3, (22/04/08 – 21/04/09) .................................................... 23
Airborne Electromagnetic (AEM) Survey ...................................................................................................... 23
Station Bore Groundwater Sampling ......................................................................................................... 23
NuPower Exploration Activities Completed, Year 4, (22/04/09 – 21/04/10) .................................................... 23
Airborne Regional Gravity Survey ............................................................................................................... 23
Exploration Drilling ..................................................................................................................................... 23
Groundwater Sampling ............................................................................................................................... 30
NuPower Exploration Activities Completed, Year 5, (22/04/10 – 21/04/11) .................................................... 32
Radiometric Anomaly Reconnaissance ....................................................................................................... 32
Results of Groundwater Sampling ............................................................................................................. 37
Arafura Resources Exploration Activities Completed, Year 5, (21/04/10 – 20/04/11) ................................. 40
Arafura Resources Exploration Activities Completed, Year 6, (21/04/11 – 20/04/12) ................................. 40
Arafura Resources Exploration Activities Completed, Year 7, (21/04/12 - 20/04/13)................................. 41
Arafura Resources Exploration Activities Completed, Year 8, (21/04/13 – 20/04/14) ................................. 41
Arafura Resources Exploration Activities Completed, Year 9, (21/04/14 - 20/04/15) ................................. 41
CONCLUSIONS AND RECOMMENDATIONS .............................................................................................. 42
REFERENCES ................................................................................................................................................ 44

List of Figures
Figure 1 Project locality
Figure 2 Application area
Figure 3 Map of the Arunta Region
Figure 4 Regional geological of the project area
Figure 5 Woodforde AEM
Figure 6 Tertiary basins in the Woodforde area
Figure 7 Composite stratigraphy of Hale Basin
Figure 8 Location of bore and drillhole water samples on Woodforde
Figure 9 NTGS regional airborne thorium image
Figure 10 Anomaly B geology, radiometrics, sample location
Figure 11 Anomaly C geology, radiometrics, sample location
Figure 12 Bores and drill holes groundwater sampled
Figure 13 Solid geology map, REE targets and sampling locations

List of Tables
Table 1 NuPower’s interpreted Tertiary stratigraphy for Woodforde

Appendices (Digital Only)
Appendix 1 High resolution figures
Appendix 2 Biogeochemical sample locations and assays
SUMMARY

This report documents exploration activities up to 20 April 2015 for Exploration Licence 24741 (Woodforde). EL 24741 was granted to Arafura Resources NL on 21 April 2006 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 Resources changed its name to Central Australia Phosphate Limited on 5 February 2013 and was eventually taken over by Rum Jungle Resources Limited in late 2013. Arafura Resources entered into an agreement with Rum Jungle Resources in November 2013 as part of a complex transaction to reacquire the uranium exploration and development rights on EL 24741 and ultimately regained 100% control of the mineral rights and the tenement in February 2014.

The licence area was originally selected by Arafura Resources because of the potential for secondary uranium mineralisation, derived from the erosion of adjacent uraniferous basement granites and gneisses, and hosted by Cainozoic basin sediments of the Ti-Tree Basin. The basement rocks in this area also have potential to host additional REE resources akin to the Nolans Bore deposit on the adjacent tenement.

The southern NT forms a ‘basin and range’ province in which Proterozoic and Palaeozoic rocks form prominent ranges separated by broad valleys in which at least twenty major Cainozoic sedimentary basins have developed. The Ti Tree Basin is one of these Cainozoic basins and underlies the northeastern part of EL 24741. The stratigraphy of these basins is generally poorly known due to a lack of outcrop, strong weathering overprints, the paucity of drillholes and a lack of attention paid to the ‘cover’ overlying crystalline basement. Limited stratigraphic drilling by both the BMR and the NTGS during the 1960’s and 1970’s provides much of the regional stratigraphic information of the Cainozoic Basins. The maximum thickness of the Cainozoic sediments in the Ti-Tree Basin is not currently known. Exploration drillholes by NuPower locally failed to penetrate to basement in the deepest parts, after drilling through a 320m of sediment.

Regional AEM surveys acquired by NuPower indicate that the Tertiary palaeodrainage system is far more extensive and better developed than previously thought and indicating that the Ti-Tree Basin infills a deep structural feature developed in two NW-SE trending grabens immediately to the northeast of the Ti-Tree Fault. Several major palaeochannels flow into the basin from the southwest, north and east.

Twelve, broadly spaced, reconnaissance drillholes were completed on Woodforde during 2008 for a total of 2,919m, from which 1459 samples were collected, of which 102 were sent for chemical assay. The drilling showed that the Tertiary palaeodrainage system on Woodforde is very well developed; reaching thicknesses in excess of 320m and NuPower has been able to establish a preliminary stratigraphic model for the Tertiary Ti-Tree Basin. One drillhole (WF004) intersected uranium mineralisation exceeding 0.01% eU3O8 and indications of anomalous gamma were detected in another six holes. Chemical assays of drillhole cuttings were very disappointing but not unexpected in view of the drilling and sampling methods employed. Composite samples from two drill holes downstream from the Nolans Bore deposit showed no evidence of secondary accumulations of uranium, thorium or rare earth elements.

EL 24741 is underlain by rocks of the Aruna 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 that is subdivided into three, largely fault bounded terranes with distinct geological histories; the Aileron, Warumpi and Irindina Provinces. The basement geology of Woodforde comprises units of the Aileron Province consisting of greenschist to granulite facies metamorphic rocks with protolith ages in the range 1865-1710 Ma.

NuPower conducted reconnaissance sampling for uranium mineralisation over the outcropping basement rocks using the NTGS regional geophysical data. Arafura’s 2008 HyMap hyperspectral covered a small part of EL 24741 however all hyperspectral reconnaissance activities were focused on targets elsewhere. In 2008 and 2013, Arafura acquired multi-tenement detailed airborne geophysical survey data over parts of EL 24741. Both surveys were acquired to better understand the basement geology and to guide regional exploration activities. Arafura merged its three detailed geophysical surveys in the Aileron-Reynolds project area and worked together with Southern Geoscience Consultants to produce a regional geological synthesis and interpretation specifically aimed at identifying REE exploration targets. During 2014 these targets were investigated by the means of a biogeochemical sampling campaign for undercover targets, and field reconnaissance for outcropping targets. Three hundred and eleven biogeochemical samples were collected over 15 traverses across identified targets; of which 115 were subsequently selected for assaying. The assay...
results from this round of sampling identified no anomalous concentrations of REEs or other metals and the ground reconnaissance identified no outcrop of interest. It is suggested that Exploration Licence EL 24741 be reduced during the following year’s tenure.
INTRODUCTION

Background
Basement rocks of the Reynolds and Anmatjira Ranges contain elevated background levels of uranium and thorium and have been explored for gold, base metals, rare earth elements and uranium. Exploration success came with the discovery of elevated levels of rare earth elements hosted by massive fluorapatite in the Nolans 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.

As far back as 1972 it was recognised that while these uraniferous crystalline basement rocks may host primary deposits of uranium, they also provided a source of uranium for secondary uranium mineralisation derived from weathering and dissolution of the uranium by meteoric groundwaters. The products of the weathering and erosion of the crystalline basement throughout the Cainozoic have accumulated in flanking Cainozoic depocentres where they have the potential to host sedimentary uranium mineralisation.

Recognising this potential, Arafura Resources applied for and was granted a number of exploration licenses here, including Woodforde (EL 24741) that covers part of the Cainozoic Ti-Tree Basin. Along with the potential for uranium mineralisation, Arafura Resources has investigated the potential for Nolans-style REE mineralisation in the Palaeoproterozoic basement rocks within EL 24741.

Location and access

The Woodforde Exploration Licence is located approximately 140 kilometres north from Alice Springs along the Stuart Highway (Figure 1). The Stuart Highway and the Amadeus Basin to Darwin gas pipeline pass through the tenement, whilst the Adelaide to Darwin Railway lies approximately 20km to the east.

The tenement covers portions of the Aileron and Pine Hill pastoral leases. The Pine Hill Station homestead lies in the far west of the original tenement, whilst that of Aileron station is situated in the far south of the tenement.

The tenement is situated approximately 40km south of the Ti-Tree Roadhouse, whilst the Aileron Roadhouse is situated within the tenement boundaries. Accommodation and fuel are available at both these locations.

Access to the tenement is via the Stuart Highway and from there via the network of station roads and tracks linking the water bores. It is also possible for light vehicles to access the tenement via the service road alongside the NT Gas pipeline; however a permit must be obtained from NT Gas before using this road.

A major unsealed road, linking the Stuart Highway to Yuendumu (via Pine Hill Homestead) facilitates access to the west of the tenement. This road continues eastwards over the Stuart Highway where it continues to the Territory Grape Farm. The turnoff to this road is well sign posted and lies approximately 16km north of Aileron and 44km south of Ti-Tree.

Topography and drainage

The Woodforde tenement is situated in a ‘basin and range’ province where the Ti-Tree Basin to the northeast is separated from the Reynolds & Anmatjira Ranges to the southwest by the NW-SE trending Ti-Tree Fault. In the southwestern and western areas of the tenement the Reynolds and Anmatjira Ranges attain elevations ranging from 650m to over 800m. Northeast of the Ti-Tree Fault, the landscape over the Ti-Tree Basin consists of a flat, featureless sand-plain that slopes gently away from the ranges at elevations of around 575m to 605m ASL.
The sand plain is mostly devoid of drainage except for minor tributaries of Allunga Creek in the southeast corner of the tenement. The western part of the tenement is dominated by the headwaters of Woodforde and Hanson Rivers draining north-eastwards from the Reynolds Range. Both rivers form wide braided channels on reaching the sandy plains and continue to the northeast past Ti-Tree.

Figure 1. Location of EL 24741 (Woodforde). The blue polygon is the current extent of the licence and the black polygon indicates the extent of the original tenement.

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. Average annual rainfall for the Woodforde region taken from the Territory Grape Farm Bureau of Meteorology weather station is 305.4mm, most of which falls in the November to February period. Average minimum and maximum temperatures in summer are 21.7°C and 37.6°C while the corresponding winter average temperatures are 4.9°C and 22.3°C.

Vegetation in the eastern and northern parts of the license area comprises hummocky spinifex grassland with tall sparse acacia shrubland overstorey in the north passing to tall open mulga shrubland with open woollybutt grassland understory. Isolated thickets of mulga occur along the Stuart Highway north of Aileron. In the western part of the tenement, the Reynolds Range area is covered by hummocky grasslands of weeping spinifex with a low open mixed species woodland overstorey, (Wilson et. al. 1991). Thick, impenetrable stands of mulga occur along drainage lines west of the Stuart Highway.

Logistics

Alice Springs (pop. 27,000) is serviced daily by jet aircraft from several Australian capital cities (Sydney, Melbourne, Adelaide, Perth and Darwin) and less regularly from Brisbane, Cairns and Broome. Because of its location mid-way between Adelaide and Darwin the town is also well serviced by road transport and interstate bus services.
The Adelaide-Darwin transcontinental railway, passing through Alice Springs, passes to within 20km of the east of the license.

The natural gas pipeline from the Amadeus Basin (west of Alice Springs) to Darwin bisects the area near Aileron.

The nearest service station and accommodation are at the Aileron Roadhouse in the southern part of the tenement on the Stuart Highway. The small township of Ti-Tree lies 60 km north by road from Aileron where there is a medical centre, school and police station.

The nearest station homesteads are Aileron adjacent to the Aileron Roadhouse and Pine Hill located just to the west of the area.

The nearest medical facilities are located at Ti-Tree and Alice Springs.
TENURE

Mining/Mineral Rights

Exploration Licence 24741 (Woodforde) was granted 100% to Arafura Resources NL (ABN 22 080 933 455) as 261 blocks on 21 April 2006 and transferred to NuPower Resources Ltd (ABN 91 120 787 859) on 14 March 2007 as a result of the demerger of Arafura’s uranium assets into the newly formed company focussed on uranium. Following the demerger Arafura Resources Limited (ACN 080 933 455) retained all non-uranium rights. NuPower Resources changed its name to Central Australia Phosphate Limited on 5 February 2013 and was eventually taken over by Rum Jungle Resources Limited (ABN 33 122 131 622). Arafura Resources entered into an agreement to purchase EL 24741 from Rum Jungle Resources in November 2013 as part of a complex transaction to reacquire the uranium exploration and development rights on EL 24741. Arafura Resources ultimately regained 100% control of EL 24741 in February 2014.

Land Tenure

As a result of the lack of exploration during the demerger process in Year 1, and delays with the airborne survey and data processing it was not possible to identify any areas for relinquishment at the end of year 2. A waiver of the reduction was requested and granted on 29 July 2008. Preliminary scout drilling has demonstrated the prospectivity of the Tertiary trough for secondary uranium and reconnaissance of radiometric anomalies in the southern part is incomplete. It was therefore not possible to identify areas for relinquishment during the current reporting period. A request of waiver of reduction was granted on 21 April 2009 and all 261 blocks were been renewed for the fourth year of the license. A request to waive reduction for the end of Year 4 was requested 30 April 2010 which was approved 25 May 2010. A further request to waive reduction was also made at the end of Year 5 which was also ultimately approved.

Following Arafura’s request to NuPower and Centralian Phosphate; EL 24741 was reduced to 246 blocks in 2012 and then further reduced to 113 blocks in 2013. Arafura again reduced the title on the anniversary data in 2014 to 57 blocks (Hussey, 2014b) and received a two-year renewal for the area shown in Figure 1. Arafura were advised that the renewal was accepted on 19 September 2014 with retained portion due to expire 20 April 2016.

The license occupies the following perpetual pastoral leases:

  NT Portion 703 Aileron Station.
  NT Portion 725 Pine Hill Station

Native Title

An inspection of the Aboriginal Areas Protection Authority Register of Sacred Sites identified a series of sites located mostly in the headwaters of Hanson and Woodforde rivers in the western part of the tenement. Exploration activities were planned to avoid these areas.

An application for a determination on a Native Title Claim which covers most of the Aileron Station coincides with parts of the Woodforde tenement. A registered Indigenous Land Use Agreement, DI2006/003, registered in the name of the Department of Planning and Infrastructure, called Pine Hill CLA ILUA, on 16/11/2007, covers the central part of the original license.

An Exploration Agreement existed between the Central Land Council and NuPower Resources for the Woodforde tenement.
Site Clearances

Prior to NuPower commencing fieldwork, representatives of the CLC conducted a survey of the proposed drill sites. No significant cultural sites were found and the proposed sites were approved.

Arafura Resources Limited obtained an abstract of registered and recorded sacred sites within the project area from the Aboriginal Areas Protection Authority (AAPA). Arafura also acquired a clearance from the CLC for its reconnaissance exploration program in 2009. This clearance covered all of Arafura’s 2008 hyperspectral survey and is applicable to most areas of outcropping basement currently retained as EL 24741.

Figure 2. The Woodforde tenement (EL 24741) application area.
GEOLOGICAL SETTING

Regional Geology

The project area is located in the Arunta Region, a complex basement inlier which has undergone a prolonged history of sedimentation, magmatism and tectonism extending from the Palaeoproterozoic to the Palaeozoic (Shaw et al., 1984). The Arunta Region covers more than 200 000 km² of the southern Northern Territory and can be subdivided into three, largely fault bounded geological provinces; the Aileron, Warumpi and Inridina Provinces. The Arunta Region is unconformably overlain by unmetamorphosed sedimentary rocks of the Neoproterozoic to mid-Palaeozoic Amadeus, Georgina, Ngalia and Wiso Basins (Walters et al., 1995). The project area is located within the Aileron Province of the Arunta Region (Figure 3).

Figure 3. Map of the Arunta and surrounding regions, their provinces, and the Neoproterozoic to mid-Palaeozoic sedimentary basins. Adapted from Claué-Long et al., (2008).

The Aileron Province predominantly comprises Palaeoproterozoic greenschist to granulite facies metamorphosed sedimentary and igneous rocks. The oldest observed rocks within the province, the Lander Package, are a widespread sequence of clastic sediments, now at various metamorphic grades (Pietsch, 2001). This meta-sedimentary sequence is affected by numerous tectonic and thermal events. The earliest of these is the ca.1810-1800 Ma Stafford Event. During this event bimodal magmatism intruded and metamorphosed the pre-existing sedimentary sequence (Claué-Long et al., 2008). These intrusions during the Stafford Event impose a minimum age on the Lander Package and earlier tectonism. Bimodal magmatism of the ca.1790-1770 Ma Yambah Event is believed to be responsible for pervasive low-grade fabrics across much of the province (Scrimgeour, 2003).

The observed top of the Lander Package is a regional angular unconformity. Above this unconformity lies the Reynolds Package which is a shallow marine and intertidal succession of psammites and pelites with minor calc-silicate rock (Scrimgeour, 2003). Metamorphic grade of the Reynolds Package in the Reynolds Range...
varies from greenschist facies in the northwest to granulite facies in the south-east. The high grade metamorphism in the southeast is related to the ca. 1600-1570Ma Chewings Orogeny. Elsewhere throughout the Aileron Province metamorphic effects from the ca.1740-1690 Ma Strangways Orogeny are observed within the Reynolds package.

The Arunta region was subjected to a long-lived event from 450-300 Ma. The Alice Springs Orogeny is expressed in the Aileron Province as west-north-west trending greenschist to upper amphibolite shear zones. Large scale fluid flow during the Alice Springs Orogeny was responsible for Winnecke-style gold mineralisation and pegmatite associated REE mineralisation (Scrimgeour, 2003).

The regional geology of the surrounding project area is illustrated in Figure 4 (Hussey 2012a). Geological details in Figure 4 are drawn from digital copies of the Napperby (SF 53-9) and Alcoota (SF 53-10) 1:250,000 Geological Series published by the Bureau of Mineral Resources, BMR (now Geoscience Australia). Lithological units and labelling is derived from the published maps and the reader is referred to the published map legends and explanatory notes for additional details. The Reynolds Range Region 1:100,000 Geology Map is also available and is again published by the BMR.

Figure 4. Regional geology, Nolans REE project location and Arafura Resources tenure within the Aileron-Reynolds project.

The following section is from Hussey (2012a).

Palaeoproterozoic metamorphic rocks and intrusive granites in the Reynolds Range belong to the Aileron Province. In Figure 4 these units are differentiated only in the broadest sense with the metasedimentary units coloured light brown, quartzites are bright yellow, and the granites and granitic gneisses coloured in various shades of pinks and red. Distinct marble and calc-silicate rich units are coloured bright light blue.

Because of the high grade of metamorphism which has affected the basement rocks and the relative paucity of continuous outcrop and geological constraints across the Arunta Province, a reliable stratigraphy has not yet been constructed for the metasedimentary sequences. Instead, the Northern Territory Geological Survey recently proposed a series of temporal metasedimentary packages and number of discrete tectono-thermal events to assist with the development of a regional stratigraphic framework in the Arunta Region.
(Scrimgeour, 2003). While the details are yet to be fully resolved, ongoing U-Pb dating of representative rocks suggests most of the mapped metasedimentary units in the Nolan’s Bore area can be assigned to either the 1865-1820 Ma Lander package or the ~1780 Ma Reynolds package (e.g. Claoué-Long et al., 2008). There is also a possibility that some metasedimentary units in the Nolan’s Bore area could be related to the 1810-1790 Ma Ongeva package (cf. Claoué-Long et al., 2008) but this is yet to be fully resolved as it probably requires substantial remapping and the subdivision of the existing geological map units.

The Lander Rock beds (PII) which crop out in the vicinity of Nolans Bore, and the Aileron Metamorphics (Pna) to the southeast of Nolans Bore, are currently included as part of the Lander package. The Mount Thomas Quartzite (Prt), Pine Hill Formation (Prp/r) and Woodforde River beds (Po) unconformably overlie the Lander package and were all originally mapped as Reynolds Range Group, and is the type area for Reynolds package. The Wickstead Creek beds (PI), and the Mt Freeing (Pf) and Mt Dunkin (Pd) Schists have also been included in the Reynolds package.

According to published maps (Figure 4), the Lander Rock beds include schist, phyllite, andalusite hornfels, garnet-cordierite-biotite-quartz granofels, sillimanite-biotite-cordierite-orthoclase granofels, tourmaline metaquartzite and tourmaline-quartz pods. These units are variably migmatitic and have been metamorphosed to amphibolite and granulite facies at Nolans Bore (Hussey, 2008).

The metamorphic rocks in the Nolans Bore area are extensively intruded by igneous suites related to the 1810-1800 Ma Stafford and 1780-1770 Ma Yambah Events, both of which are dominated by large bodies of fractionated granitoids. Igneous rocks related to the Stafford Event crop out almost continuously for about 100 kilometres between the Reynolds and Anmatjira Ranges. Granitic rocks (Pg) which intrude the Lander Rock beds in the immediate vicinity of Nolan’s Bore were not formally differentiated on published maps but, on the basis of mapping conducted by Arafura Resources around Nolan’s Bore in 2005, these are almost certainly a southern extension of the Boothby Orthogneiss (Pgb). Boothby Orthogneiss generally consists of “coarse porphyritic foliated granitic augen gneiss with mantled feldspars” and was recently dated at 1806 ± 4 Ma (Worden et al., 2008).

Hussey (2008) indicates that all of the above units were metamorphosed to granulite facies at 1560-1600 Ma in what has been termed the Chewings Event. The Chewings Event was relatively strain-free producing variable amounts of fine- to coarse-grained leucocratic melts in most country rocks, annealing earlier structural fabrics and overprinting the localised contact metamorphic effects of the Stafford- and Yambah-aged intrusions.

Dykes and irregular masses of very coarse grained pegmatite intrude the above units and transgress all observed metamorphic foliations.

To the south of Reynolds Range the Arunta Inlier is stratigraphically unconformably overlain, though, because of thrusting, structurally underlain by Neoproterozoic and early Palaeozoic sediments (Pav, Pat) of the Ngalia Basin.

As can be seen in Figure 4, unconsolidated Quaternary red soils, alluvial sands and gravels and aeolian sand, (Qr, Qa, Qt) along with minor Quaternary calcrete (Qc), blanket much of the lower lying areas along the northern and southern margins of the Reynolds Range including the area of the Kerosene Camp Creek drainage basin immediately surrounding the Nolan’s Bore prospect. Tertiary saprolite (Tla) and ferricrete (Tlf) is also developed in some parts of the range.

Structurally, the Reynolds Range has been affected by several orogenies. The area is now dominated by numerous major west-northwest trending faults and shear zones (some up to several hundred metres wide) which parallel the regional fabric evident in imagery produced from aeromagnetic data. There have been suggestions that the Reynolds Range occupies a position on a trans-continental basement shear zone which includes the Granites-Tanami Shear further to the west (Stewart, 1997). It may also form part of the Woolanga Lineament, a major west-northwest trending gravity structure commented on by Black and Gulson (1978).

At a local scale the metasediments and metavolcanics have been intensely folded, which, in conjunction with the effects of faulting and granite intrusion and lack of detailed local mapping, results in relatively complicated litho-distributions on existing published geological maps (Figure 4).
Recent investigations suggest that the major west-northwest trending shear zones in the south-eastern Reynolds Range date from the 400-300 Ma Alice Springs Orogeny and not from the ca. 1.6 Ga regional metamorphic event (Cartwright, et al., 1999).

Cainozoic Regional Geology

From NuPower’s annual reports

The southern NT forms a ‘basin and range’ province with Proterozoic and Palaeozoic rocks forming prominent ranges separated by broad valleys. 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 Woodforde tenement covers portions of the eastern half of the Ti-Tree Basin (Figure 5). The mapped 1:250,000 geology and major faults are shown in Figure 5 whilst the 2007 AEM survey results are superimposed over the geology in Figure and show the relationship between the mapped surface geology and the subsurface Ti-Tree Basin.

The stratigraphy of the intermontane Cainozoic basins of the southern NT region is generally poorly known. This is attributed to a lack of outcrop, strong weathering overprints, the paucity of drillholes and a lack of attention paid to the ‘cover’ overlying crystalline basement. 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.

Water bores throughout the Alice Springs region provide only limited stratigraphic information on the upper parts of the Cainozoic as they rarely exceed 100m in depth and are typically <50m deep. Limited stratigraphic drilling (Figure 5) was undertaken in the southern NT region by both the BMR (now Geoscience Australia) and the NTGS during the 1960’s and 1970’s. These programs were summarised in Senior et al., (1994) from which a single paper (Senior et al., 1995) was published. These sources provide almost all of the stratigraphic information on the Cainozoic Basins.

Historical exploration drillholes in the vicinity of the Woodforde tenement are shown in Figure 5. In 1972, CRA Exploration completed a traverse of six drillholes in the western part of the Ti-Tree Basin, one of which (TT6) was located on Woodforde (EL24741). CRA’s work indicated that, in places, the Ti-Tree Basin is in excess of 300m deep. In 1983, BHP also drilled a single drill hole (OG1) to investigate an anomaly in the Proterozoic basement rocks and drilled through 94m of Tertiary sediments before intersecting crystalline basement.

During the late 1970’s and early 1980’s the relatively small Hale Basin (Figure 6) was explored extensively for coal (lignite) and sedimentary uranium and can therefore be considered to be the best known Cainozoic basin in the NT. The stratigraphy of the Hale Basin is summarised in Figure 7 and although the succession in the Hale Basin is relatively thin (<100m), it can considered to represent a generalised Tertiary stratigraphy for the southern NT.

Based upon drilling in the Hale Basin, Senior et al. (1994) defined a broad two-fold stratigraphic subdivision that corresponds well with the observed pattern of Cainozoic sedimentation elsewhere in southern Australia. It comprises a restricted, fluvial palaeochannel dominated Palaeogene succession (Hale Formation) overlain by a more widespread, dominantly lacustrine Neogene succession (Waite Formation). An additional stratigraphic unit, the Napperby Formation (Higgins, 2009) has since been recognised as overlying the Waite Formation and represents the development of prograding alluvial fans shed from the ranges flanking the Cainozoic Basins.

Strong affinities with Eocene palaeochannel sediments in southern Australia (Higgins, 2009) suggest that the Hale Formation should be further subdivided into a Upper subdivision (Late Eocene), comprising the Tug Sandstone Member and representing development of a widespread ‘sand sheet’; and a Lower subdivision (Early-Middle Eocene) recording a fining upwards trend from the fluvial Ambalindum Sandstone Member to the paludal Claraville Mudstone and Ulgnamba Lignite Members.

Whilst Senior et al.’s (1994) Cainozoic stratigraphic units were initially defined in separate, small and isolated Tertiary Basins, these units are now recognised as components of a much larger Tertiary palaeodrainage system, the extent and size of which has until now been vastly underappreciated (Higgins, 2009).
Both historic and recent drilling results indicate that the apparently isolated Tertiary Basins contain very thick sedimentary packages. The Cainozoic fill of the Burt Basin exceeds 200m and the Sixteen-Mile Basin contains at least 180m of sediment. Similarly, the Whitcherry Basin and Waite Basins are known to exceed 250m in thickness in some locations, whilst minor tributaries feeding the Ti-Tree basin contain up to 140m of sediments. The maximum thickness of the Cainozoic sediments in the Ti-Tree Basin is not currently known as exploration drillholes to date in the centre of the basin, after drilling through a minimum of 320m of sediment, have failed to penetrate to basement. Thicknesses of 400-500m of sediments are considered to be likely in the deeper portions of the basin.

![Diagram of Woodforde tenement (EL24741) with NuPower 2007 AEM survey showing major faults and location of historical drillholes. The hot colours are represented by more resistive shallow units. The cooler colours correspond to a greater thickness of Ti-Tree Basin sediments.](image-url)
Figure 6. Tertiary Basins in the Woodforde – Alice Springs Area.
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). Deep weathering was an ongoing process during the Tertiary but was enhanced at particular times during the time by the combination of periods of warm, humid climates, non-deposition and surface exposure. Senior et al. (1995) defined three Palaeogene weathering events which affected Arunta igneous and metamorphic basement rocks and the overlying Tertiary succession. An additional two weathering events
have been recognised from the overlying Neogene succession and appear to correlate with similar periods of weathering and exposure evident in southern Australia.

Weathering Event A (Senior et al., 1994, 1995) occurred during the Late Cretaceous to Early Tertiary (Palaeocene). Trizonal weathering profiles were 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) that grades into a multicoloured mottled zone (up to 10 meters thick) and is then capped by a ferruginous or (laterite/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 fluvio-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. Fluvial sands of the Ambalindum Sandstone Member fine upwards into the paludal Claraville Mudstone and Ulgamba Lignite Members.

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 and consist 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. Two gradational upwards cycles from clays to dolomitic clays to dolomitic limestones (often capped by chalcedonic limestones and silcretes) are commonly observed, suggesting that deposition of the Waite Formation occurred in at least two phases. Weathering Event D was responsible for the formation of the inter-Waite Formation silcrete (possibly in the Middle Miocene).

Outcrops of the Waite Formation are frequently capped by calcretised limestones and distinctive chalcedonic silcretes that form regionally widespread stratigraphic markers. Development of these more variable duricrusts occurred in response to Weathering Event E.

In proximal locations, the Waite Formation interfingers with, and is conformably overlain by a moderately thick (<60m) succession of oxidised colluvial material shed off the Woodforde and Reynolds Ranges in response to neotectonism during the (?Late) Pliocene. This material can be recognised throughout the region and represents a broadly coarsening upwards alluvial fan which can be subdivided into an Upper, Middle and Lower Members. 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. Ferruginised, haematitic alluvial palaeosols (bearing a strong resemblance to modern soils) are a characteristic feature of the Middle Member with palaeosol development potentially corresponding to Weathering Event E (or recording another period of enhanced weathering).

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. In more distal locations, the development of aeolian sand plains was widespread. The formation of calcretes, particularly within drainage channels and atop the Waite Formation, was widespread during the Quaternary (Weathering Event E).
PREVIOUS INVESTIGATIONS

Other Parties

Records of systematic exploration in the Reynolds Range west of the Woodforde tenement date back as early as 1948 (Thevissen, 1995) but most investigations date from about 1965 (Stewart, 1982). Base metals, tin and tungsten were mainly targeted prior to 1973 when uranium exploration gathered momentum. This commodity dominated the exploration in the area for the next 15 years, both in the metamorphic and granitic rocks of Reynolds Range and also in the sandstones of the Ngalia Basin to the south. Since 1990, with the advent of the BLEG geochemical technique more attention has been directed towards gold exploration though some uranium exploration activity still persisted.

CRA Exploration Pty Ltd AP2617 (1970)

Exploration by CRA in this tenement was for gold, silver, base metals and uranium. A stream sediment survey revealed minor anomalies in base metals while water bores in the area yielded anomalous values for uranium. However, follow up work failed to reveal any significant mineral occurrences. Ten auger holes were drilled, varying from a few feet in depth to 105 feet. AP2617 was relinquished in 1971.

CRA Exploration Ltd EL3360 (1971)

EL3360 overlapped the middle and southeast of Woodforde and extended north and eastwards beyond the present tenement. A literature search was undertaken and the presence of anomalous analyses for uranium in local water bores was noted. Fifty-eight water bores were then sampled and 46 gamma logs were run on all open bores. Many of the bores had been idle for several years and this may have affected the analytical results. Continuous ground radiometric traverses were also run. Sediments in the valley of the Kerosene Camp Creek and Woodforde River were sampled by 46 shallow auger drill holes. Additional work was recommended, however this was the final report and the tenement was relinquished in 1972.

Tanganyika Holdings Ltd EL241 and EL242 (1972)

EL241 overlapped the north and extended northeast beyond the Woodforde tenement, while EL242 lay just to the north of Woodforde and extended to the northeast. Inspection of selected anomalies involved stream sediment sampling, radiometric work and field reconnaissance. Initial reconnaissance indicated that the area was not prospective for base metals or precious metals but that it was prospective for uranium. Investigation of the uranium potential was not followed up and the area was relinquished in 1972.

CRA Exploration Pty Ltd EL752 (1972)

EL752 just overlapped the east central boundary of Woodforde and extended eastwards. Based on earlier work in the tenement area, six rotary cored holes were drilled at 5km intervals. The sediments intersected were not considered favourable for uranium deposition due to poor permeability, fine grain size and fair to good sorting. One hole, TT6, is within Woodforde and the other five are on a line bearing northeast at N42ºE from TT6. It was recognised that palaeochannels could exist and three seismic lines were run using the reflection method. The reflection seismic method appears to have successfully indicated basement topography and a subsurface valley structure has been indicated, but the tenement was subsequently relinquished in 1973.

Central Pacific Minerals NL EL1384 (1976)

EL1384 overlapped the central west boundary of Woodforde and extended to the southwest onto the southeast of the NuPower Yalyirimbi tenement. Exploration was for zinc-copper-lead along Precambrian carbonate-amphibolite contacts, scheelite-copper within calc-silicate units and uranium in Precambrian vein and skarn environments. Stream sediment and rock chip samples were collected and minor ground radiometrics were measured. The geochemistry results were generally disappointing and sources of radiation were found to be small pegmatite bodies and fracture zones within the granite. The Exploration License was relinquished in 1978.
Otter Exploration NL EL1444 (1977)
Exploration was for uranium in skarn and sedimentary environments. Water bore analyses were collected and Otter Exploration had an airborne survey flown. Otter also used an earlier BMR survey and their work revealed a total 41 anomalies. Twenty-six of the anomalies were on the granite or gneissic outcrop and 15 occurred over Quaternary alluvial sand. Although all the anomalies were followed up there were no significant results and the tenement was relinquished in 1980.

BHP Minerals Limited EL2942, EL3075, EL3084 & EL3088 (1981)
EL2942 overlapped most of the northern half of Woodforde and extended to the west, slightly overlapping the southeast corner of NuPower’s Yalyirimbi license. EL3088 just overlapped Woodforde to the north and extended to the north, northwest and northeast. ELs 3075 and 3084 were northeast of Woodforde.

BHP’s primary interest in this area was for diamonds with a lesser interest in base metals. Stream sediment samples were collected, but no favourable results indicating the presence of kimberlite deposits or base metals were obtained from the sampling and the tenements were dropped.

James Weir EL3506 (1982)
EL3506 overlapped the central area of the Woodforde tenement and extended slightly to the west and south. Prospecting consisted of a ground scintillometer survey and selected rock chip sampling. One anomalous area of uranium, thorium and rare earths was located but had limited surface extent. Only one report was submitted, without conclusions. EL3506 was relinquished in 1983.

BHP Minerals Ltd EL4188 (1983)
This tenement just overlapped Woodforde at the east central boundary and extended to the north and east. Exploration was for base metals.

A combined aeromagnetic/radiometric survey was flown over the tenement in May 1983 and two gravity traverses were carried out. The resulting magnetic intensity contour map of the area revealed a “bull’s-eye” shaped anomaly, however, subsequent evaluation of the anomaly gave no significant values. One percussion hole, drilled 256m, passed through 94m of Tertiary sediments before intersecting crystalline basement. It was concluded that a unit within the Arunta Complex was the source of the anomaly and geochemical analyses of drill samples for base metals revealed no significant values.

Track Minerals Pty Ltd EL 5901 (1988)
This EL overlapped the southern quarter of Woodforde and extended to the south and slightly east. Exploration was primarily for gold. Stream sediment sampling, geological traverses and rock chip sampling failed to locate any signs of significant gold or base metals mineralisation. There was no drilling and the EL was dropped in 1989.

Tidegate Pty Ltd EL8117 (1993)
EL8117 overlapped the south end of Woodforde and extended south into the Ngalia Basin. It straddled the Stuart Highway with 80% of the tenement east of the highway.

Thirty eight BLEG samples, 38 soil samples and 17 rock chip samples were collected to investigate the presence of gold and platinum mineralisation associated with possible ultramafic rocks at Native Gap Ni-Cr Prospect, Harry’s Yard Amphibolite and in quartz veins at Aileron Gold Reefs Prospect. Results were below expectations and the EL was relinquished in 1994.

PNC Exploration (Australia) Pty Ltd EL 8411 (1994)
EL8411 just overlapped the western side of Woodforde and extended to the west, overlapping most of the eastern boundary of NuPower’s Yalyirimbi tenement.

PNC concentrated their search on identifying chemical-pelitic, meta-sedimentary sequences near the base of the Proterozoic and airborne radiometric surveys combined with ground based reconnaissance located numerous secondary uranium occurrences. One hundred and eighty radiometric anomalies were
investigated of which 30 contained visible secondary uranium minerals, 22 occurring within the Napperby Gneiss.

Reconnaissance work located the Napperby Creek Uranium Prospect. Follow up included semi-detailed geological mapping, magnetics and radiometrics, rock chip sampling and petrology. Helicopter supported reconnaissance located a new uranium occurrence in metasomatised quartz-tourmaline rocks of the Wickstead Creek Beds near Mount Freeling. In addition secondary uranium mineralisation was located in the Napperby Gneiss adjacent to a major WNW shear some 5km from the Napperby Creek Prospect. The area was relinquished in 1996.

Aberfoyle Resources Ltd EL9146 (1995)
EL9146 lay between the NuPower Woodforde and Sandover tenements, slightly overlapping the east boundary of Woodforde and abutting the west boundary of Sandover. It was explored in conjunction with EL9145. Aberfoyle Resources were targeting the gold potential of the Early Proterozoic sequences present on the license and thought to host mineralisation of the type developed to the west in the Granites/Tanami Inlier.

BMR regional airborne magnetic data was acquired and processed along with results from the magnetic survey contracted to World Geoscience Corporation. The aeromagnetic surveys revealed numerous magnetic anomalies. The aerial surveys were followed up with ground magnetic surveys and 6 RAB holes (299m total drilling) drilled in two lines to determine the thickness of cover. Four holes successfully reach basement. Lithologies intersected were generally granitic and no significant geochemical values were obtained. There was no final report and the tenement was relinquished in 1999.

Aberfoyle Resources Ltd EL9145 (1996)
EL9145 overlapped the northern 60% of the Woodforde tenement and extended to the east, west and north. It was explored in conjunction with EL9146 for gold in the Early Proterozoic sequences, as above. World Geoscience Corporation carried out a magnetic and radiometric survey of EL9145 in 1996. This survey revealed numerous magnetic anomalies but there is no record of any follow up investigation of the anomalies. The last report was a partial relinquishment report, there was no final report and the tenement was relinquished in 1999.

EL9672 Star Money Lenders Pty Ltd/Arafura Resources Ltd (1996)
EL9672 overlapped the southern part of Woodforde and extended west and then northwest along the NuPower Yalyirimbi boundary. The first two years of the license involved helicopter supported stream sediment sampling and gold analyses. Limited ground follow-up was also carried out. The results were disappointing and it was concluded that it was unlikely that significant near surface gold mineralisation occurs.

Subsequent literature research in 1999 revealed that PNC had located significant anomalous values of REE in the Nolan’s Bore area. Exploration then shifted to this area, resulting in the Nolan’s Bore REE discovery.

Tanami Gold NL EL22387 (2003)
This tenement was part of a block of tenements held by Tanami Gold which overlapped Woodforde at the north and extended some distance farther to the north. Exploration was for Proterozoic hosted gold mineralisation in the basement rocks of the Napperby area. Stream sediment and rock chip samples were collected but returned no encouraging results. The tenements were relinquished in 2006.
INVESTIGATIONS ON EL 24741

NuPower Exploration Activities Completed, Year 2, (22/04/07 - 21/04/08)

There was no on-ground exploration work undertaken.

NuPower Exploration Activities Completed, Year 3, (22/04/08 – 21/04/09)

Airborne Electromagnetic (AEM) Survey

Details of the 2007 AEM survey covering Woodforde and the Acquisitions and Processing Report have been provided previously (Rafferty, 2008).

Inversion and processing of this data shows a deep Tertiary depocentre along the southern margin of the Ti Tree Basin, fed by well-defined palaeochannel systems in the northeast and southern parts of the survey.

Station Bore Groundwater Sampling

The results of the ground water sampling from station bores throughout the tenement have been reported previously, (Rafferty, 2008). Most bores showed elevated concentrations of U and F, consistent with the model for the formation of secondary sandstone-hosted uranium deposits by the dissolution of uranium (and fluorine) by oxidised ground waters from the surrounding basement granites and gneisses and precipitation of uranium under reducing conditions in the adjacent Cainozoic sedimentary basins.

NuPower Exploration Activities Completed, Year 4, (22/04/09 – 21/04/10)

Airborne Regional Gravity Survey

During 2008 the NTGS conducted a helicopter-borne regional gravity survey (CAGS) 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 parts of EL24741.

It is apparent from the survey that the Ti-Tree Fault is of major crustal significance.

Exploration Drilling

Introduction

Historical exploration drilling had confirmed the presence of a major Tertiary depocentre, the Ti-Tree Basin.

NuPower completed twelve rotary mud drillholes for a total of 2,919m on Woodforde (EL24741) during 2008, results of which have been reported previously, (Higgins & Rafferty, 2009). Of these WF10 was in the area relinquished. All other holes are in areas previously relinquished.

Drilling was based on 3D modelling of the 2007 AEM data and drillholes were designed to target the presence of a buried palaeodrainage system in the southern margin of the Ti-Tree Basin and therefore targeted the deeper regions of the interpreted palaeochannel system in order to determine the thickness and character of the Tertiary fill, and for the presence of uranium.

All holes were geophysically logged and lithological and geophysical logs were reported previously, (ibid).
One hundred and two samples from three drillholes were submitted to ALS Chemex in Alice Springs for assay. Their results were reported previously, (ibid).

Cuttings samples from all 12 drillholes (a total of 1,459 samples) were submitted to the NTGS core library in Alice Springs, (ibid).

Summary of Results

The structural geology of the area is dominated by a system of major WNW-ENE trending and north-northeast dipping thrust and reverse faults, and shear zones formed during the 400-300 Ma Alice Springs Orogeny (Cartwright et al., 1999). These structures control the outcrop of the uraniferous basement rocks Reynolds and Anmatjira Ranges as well as the structure of the Ti-Tree Basin.

The southern margin of the Reynolds Range is formed by the Napperby Thrust where the Arunta Complex is thrust southwards over younger Palaeozoic sediments of the Ngalia Basin. A major geological structure, the Ti-Tree fault, trends NW-SE and runs through the Woodforde tenement where it forms the northern boundary of the Reynolds Range and separates the Reynolds Range from the Ti-Tree basin. At least 300m of vertical relief exists on this fault and reactivation of this structure during the Cainozoic created a deep topographic depression into which vast amounts of arenaceous sediments were deposited by well-developed Tertiary palaeochannels.

The basin architecture and structural setting is similar to the Frome Embayment, SA (host to the Beverley and Four-Mile Uranium Deposits) where a deep Cainozoic sedimentary basin is fault-juxtaposed against outcropping uraniferous Proterozoic crystalline rocks.

NuPower’s exploration drilling indicates that the geology of the Woodforde tenement corresponds closely with the geological model developed for the Whitcherry Basin in the Napperby region on the southern side of the Reynolds Range (Higgins, 2009). However, unlike the Napperby region, Cainozoic sediments directly overlie crystalline basement rather than strongly weathered rocks of the Ngalia Basin.

Although Tertiary sediments are widespread and very well-developed on Woodforde they lie beneath an extensive plain mantled by a thin (<10m) cover of pisolitic colluvium and aeolian sands. Drilling has shown that sediments in the Ti-Tree Basin regularly exceed 320m in thickness and the combination of geophysical and stratigraphic interpretation suggests that thicknesses of 400-500m are quite possible.

As a results of the drilling NuPower believes that the fluvial Hale Formation comprises the majority of the sediments with only minor contributions of the lacustrine Waite Formation. (The Waite Formation however attains considerable thicknesses in localised depocentres further to the east).

The Napperby Formation (informal name) comprises a previously unrecognised Tertiary alluvial fan unit and conformably overlies the Waite Formation. Silcrete horizons are very common within the region frequently making drilling difficult. Reactivation of thrust faults created an asymmetrical Napperby Formation.

NuPower’s exploration drilling program has allowed a preliminary stratigraphic model to be developed for the Whitcherry Basin, and this model has been successfully applied in the Burt and Ti-Tree Basins where it was further refined and expanded. The following section outlines this stratigraphic framework.
### Table 1. Interpreted Tertiary stratigraphy for Woodforde (EL24741).

<table>
<thead>
<tr>
<th>Formation (Italics denote informal nomenclature.)</th>
<th>Interpreted Age</th>
<th>Strat Unit</th>
<th>Member</th>
<th>Strat Code</th>
<th>Oxidation State</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>Quaternary – Recent</td>
<td>Q</td>
<td>-</td>
<td>Qp, Qs, Qa, Qc</td>
<td>Strongly oxidised</td>
<td>Pisolithic or sandy soils. Alluvium, colluvium.</td>
</tr>
<tr>
<td><strong>Napperby Formation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late Miocene – Early Pliocene</td>
<td>Tertiary 1</td>
<td>Upper</td>
<td>T1u</td>
<td></td>
<td>Oxidised</td>
<td>Colluvial. Limonite dominated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Middle</td>
<td>T1m</td>
<td></td>
<td></td>
<td>Alluvial palaeosols. Haematite dominated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lacustrine</td>
<td>T1lac</td>
<td></td>
<td></td>
<td>Lacustrine clays (dolomitic). Two depositional cycles.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower</td>
<td>T1l</td>
<td></td>
<td></td>
<td>Fluvial sands, lag deposit.</td>
</tr>
<tr>
<td><strong>Waite Formation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early – Middle Miocene</td>
<td>Silcrete</td>
<td>Tsi</td>
<td></td>
<td></td>
<td>Neutral</td>
<td>Duricrust. Well to moderately well-developed.</td>
</tr>
<tr>
<td><strong>Hale Formation (Upper)</strong></td>
<td>Late Eocene</td>
<td>Tertiary 2</td>
<td>-</td>
<td>T2cl, T2sd</td>
<td>Oxidised to neutral</td>
<td>Sand or clay end members. Abundant kaolinite.</td>
</tr>
<tr>
<td><strong>Hale Formation (Lower)</strong></td>
<td>Early – Middle Eocene</td>
<td>Tertiary 3</td>
<td>-</td>
<td>T3cl, T3sd</td>
<td>Slightly reduced to reduced</td>
<td>Sand or clay end members. Moderate to minor kaolinite.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>T3c, T3lig</td>
<td>Reduced – strongly reduced</td>
<td>Carbonaceous or lignitic facies. Tertiary age confirmed by palynology.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>T4</td>
<td>Variable / Oxidised to neutral</td>
<td>Basal pebbly and conglomeratic fluvial. Only seen to date in YR011 as base of Eocene succession in Ti-Tree Basin not encountered.</td>
</tr>
</tbody>
</table>

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CAINOZOIC

The Cainozoic succession (Table 1) can be subdivided into three recognisable units which, in the absence of an existing litho-stratigraphic model, were numbered sequentially from the surface downwards. A major stratigraphic break separates the uppermost oxidised Unit T1 from the neutral Unit T2 and reduced & Unit T3.

Drilling on NuPower’s other tenements in the Aileron region suggests that Units T2 & T3 are likely to comprise separate facies of the Hale Formation (Early – Late Eocene) whilst Unit T1 consists of a thin and poorly-developed Waite Formation (Early – Middle Miocene) overlain by variably developed oxidised colluvial sediments of the Napperby Formation (informal name).

Hale Formation

Senior et al. (1994, 1995) defined four members within the Hale Formation (Figure 7). On Woodforde the Formation can be subdivided into two stratigraphic sub-units (Unit T2 & Unit T3) based on the observed lithologies.

Both units are lithologically similar but are differentiated on the basis of their regionally consistent differing redox states. Unit T2 is typically capped by variably developed silcretes and appears to interfingers with and grade downwards into Unit T3. In the Ti-Tree Basin, this redox boundary is generally diffuse and, unlike in the Whitcherry Basin, redox silcretes are not developed at this contact.

It is currently unclear as to whether Unit T2 and Unit T3 represent separate depositional members (corresponding to the Tug and Ambalindum Sandstone Members or if they merely represent the same lithostratigraphic unit with a different redox state. Palynological dating of lignitic and carbonaceous horizons within Unit T3 are correlated with the Ulgnamba Lignite Member and support this interpretation.

(T3) Tertiary Unit T3

Whilst varying considerably in grain size and character, the Unit can be sub-divided into sand-prone (T3sd) and clay-prone (T3cl) end members. Unit T3 is lithologically similar to Unit T2 but is characteristically grey and reduced, and contains lesser amounts of kaolinite. Unit T3 also contains minor pyrite and varying amounts of carbonaceous matter and lignite.

The lithology varies considerably from massive, well-developed greasy reduced to black (carbonaceous) clays through to clayey to clean, angular sands and gravels. Moderate amounts of very well-developed lignite and carbonaceous material were intersected in WF001 and WF004 within the deeper portions of the basin west of the Stuart Highway.

Sands within the unit are composed entirely of white, clear, translucent and grey quartz grains. However, unlike Unit 1, the lower Tertiary succession (Unit T2-T3) is composed almost entirely of quartz and kaolinite and contains very little feldspar.

Lithological and geophysical logging indicates the following depositional environments:

- Braided Fluvial
- Meandering Fluvial
- Deltaic (coarsening upwards delta bar profiles)
- Crevasse Splay
- Possible lacustrine
- Possible shoreface (lacustrine)

Together these facies are interpreted to represent a fairly typical braided fluvio-deltaic palaeodrainage system flowing into the deep fault-bounded grabens forming the Ti-Tree Basin. Paludal sediments occur in the deepest portions of these sedimentary troughs and record the development of swampy conditions early in the Tertiary.

Drilling in the western half of the basin typically encountered a clay prone succession (along with very well developed lignite seams). This material is therefore correlated with the Ulgnamba Lignite and Claraville...
Mudstone Members (Senior et al., 1994). West of the Stuart Highway, the succession was sand prone and consisted of a very thick succession of coarse, clean sands (in places >200m thick).

Whilst the Ti-Tree Basin is known as an excellent source of groundwater, the majority of water bores and monitoring bores do not exceed 100m in depth, instead drawing from a much shallower aquifer (at the base of the Tertiary Unit 1 unit). Occurring below this level, the groundwater potential of such volumes of coarse clastics is very considerable.

Subdividing this sand package according to Senior et al.’s (1994, 1995) nomenclature is difficult due to a lack of key surfaces within the profile. Nonetheless, it is considered that this sand succession may represent the amalgamation of the Ambalindum and Tug Sandstone Members (Hale Formation) in areas where finer grained facies are absent.

WF011 intersected a 110m thick succession of clays and dolomitic clays (interpreted to be Miocene in age) and a significant, yet lithologically indistinguishable, Miocene contribution to the sands also seems likely, particularly when it is considered that the Miocene sediments were partially reworked from the Eocene. Unfortunately, NuPower’s exploration drillholes are the only deep drillholes in the eastern Ti-Tree Basin and insufficient information exists to be more precise.

(T2) Tertiary Unit T2

Like Unit T3, lithology varies considerably within Unit T2 from massive, well-developed, greasy, occasionally micaceous, kaolinitic clays (frequently showing limonite mottling) through to kaolinitic to clean, angular sands and gravels containing prominent kaolinite chips and fragments.

The Unit can be also sub-divided into sand-prone (T2sd) and clay-prone (T2cl) members but considerable lithological variation is present. Nonetheless, the dominantly kaolinitic character of Tertiary Unit T2 is its definitive feature and implies acid weathering conditions. The unit is often capped by a variably developed silcrete suggesting a considerable hiatus between deposition of Unit T2 and Unit T1.

Unit T2 is typically oxidised to neutral and poorly to well-developed limonite mottling (with limonite concretions occurring in some localised intervals) is a frequently observed characteristic of the clay-prone end member. Fining and coarsening upwards profiles observed in the geophysical logs suggest the depositional environments range from braided and meandering fluvial settings through to deltaic and possibly lacustrine settings.

Waite & Napperby Formations

(T1) Tertiary Unit 1

Unit 1 is subdivided into four members that together represent a prograding alluvial fan. The unit was first recognised in the Napperby Region, to the south of the Reynolds Range, where it is characteristically oxidised and feldspathic and is largely derived from stripping of weathered regolith on the Anmatjira and Reynolds Ranges. Similar sediments occur on the northern flank of the Reynolds Range although they are more thinly developed and their development is much more restricted.

Where the complete sedimentary succession is preserved, it grades upwards from a poorly developed basal lag deposit into mottled, dolomitic lacustrine clays and silts of the Waite Formation. The Waite Formation sediments are abruptly overlain by, or grade upwards into oxidised alluvial palaeosols and poorly sorted colluvial sediments of the Napperby Formation (informal name).

The relationship between the Waite and Napperby Formations is interpreted to be similar to the relationship between the Namba and Willawortina Formations in the Frome Embayment (South Australia). Together the Formations record the progradation of an alluvial fan into a lacustrine basin in response to a phase of tectonic uplift.

Unit 1 is interpreted to be Late Miocene – Pliocene in age on the basis of strong lithological and genetic similarities between Unit 1 and similar sediments in southern Australia. A limited number of palynological samples have been taken to provide confirmation.
(T1l) Lower Member – Waite Formation

This Member comprises ferruginous, pisolithic and sandy gravels (with clayey matrix) to pebbly conglomerates. The Member is variably developed (up to 10m thick) and represents a lag deposit developed above the underlying kaolinitic Unit T2 or crystalline basement.

Clasts are composed of ferricrete fragments and lesser ironstone pisoliths, with the remainder composed of resistant lithologies (e.g. silcrete, chert, quartzite and lithic fragments). Clean, oxidised sands are considered to be a finer grained facies of this member. Where sandy, the unconformity between this unit and the underlying Eocene succession is often indistinguishable.

(T1lac) Lacustrine Member – Waite Formation

In more distal locations the Waite Formation consists of well-developed, plastic and absorbent heavy clays, silty clays and dolomitic clays. WF011 intersected 110m of exceptionally well-developed bright green clays of the Waite Formation unconformably overlying sands of the Hale Formation. Two large-scale depositional cycles were evident, grading upwards from well-developed clays into dolomitic clays and finally capping dolomites. Downhole geophysical logs show small cyclical sequences that are interpreted as similar gradational clay-dolomite cycles. Similar cycles are commonly observed within the Namba Formation (Frome Embayment, South Australia).

Several drillholes intersected a thin to moderately thick succession of silty and sandy clays to well-developed plastic clays containing minor disseminated carbonaceous material. These clays are typically khaki-green to olive-green in colour and contain prominent white dolomitic clay to silt clasts and fragments. These sediments are interpreted as a proximal facies of the lacustrine Waite Formation.

The greenish, slightly-reduced, and argillaceous character of this unit, together with the presence of dolomite and carbonate (as opposed to calcrete) are distinguishing features. Towards the basin margins the Formation contains an increasing proportion of clastic and colluvial material as it passes laterally into the Napperby Formation.

(T1m) Middle Member – Napperby Formation

Although not always present, this Member represents a distinctive, finer-grained, red, haematite-dominated succession of ferruginous, sandy silts and palaeosols. A poor to moderate degree of ferruginous cementation is common. Like the Upper Member, the sands are feldspathic and typically contain multi-coloured quartz and feldspar grains showing variable degrees of iron staining (including prominent yellow-stained quartz). The Member is typically silty and better sorted than the Upper Member present and shows strong lithological similarities with the Quaternary – Recent soil profiles.

Where well developed the unit consists of a thick succession of haematitic alluvial silts (soils). Elsewhere multiple phases of haematitic palaeosol profiles may be seen, grading downwards from haematite dominated into limonite dominated sediments. Small-scale soil profile development is frequently observed in the coarser, more poorly sorted, more colluvial facies of the Formation. Where poorly developed, the unit may be difficult to distinguish from the oxidised Upper Member.

(T1u) Upper Member – Napperby Formation

This Member typically comprises a thick package of poorly-sorted, clayey sands and gravels to sandy clays. The Upper Member is characteristically feldspathic and contains clasts, chips and fragments of regolith (silcrete and ferricrete) along with minor gypsum and mica. Sands typically contain multi-coloured quartz and feldspar grains showing variable degrees of iron staining. Isolated fluvial channel sands (up to 10m thick) and poorly- to moderately-developed palaeosol profiles are common and represent development of sandy distributary channels probably somewhat similar to modern drainage. Minor amounts of gypsum, charcoal and carbonaceous fragments are locally present. The member is typically oxidised and limonite dominated, although pale greenish intervals of mottled, slightly reduced clays are also common.

This member coarsens upwards slightly and represents colluvial material deposited as a thin belt of material deposited to the north of the Reynolds Range by a series of coalescing alluvial fans. Minor calcrete development occurs at the top of the unit.
QUATERNARY - RECENT

The Quaternary to Recent succession comprises a well-developed but thin (<10m) strongly oxidised, pebbly, ferruginous and pisolitic gravelly horizon (Qp) that mantles the top of Cainozoic sediments (Tertiary Unit 1) within the Ti-Tree Basin. In more proximal locations closer to the ranges, this unit is poorly sorted, frequently containing pebbles and fragments of silcrete, ferricrete and weathered rock fragments.

Blanketing this unit is a thin (<10m) succession of haematitic aeolian sands (Qs) and colluvial to alluvial soils (Qr). Minor calcrete development occurs within this unit.

**Palynology**

Lignitic and carbonaceous material is moderately widespread in the Tertiary succession and forms useful stratigraphic marker horizons that greatly aid stratigraphic correlations.

Three samples from NuPower’s drilling on Yalyirimbi (EL24548) to the south were submitted to PIRSA as part of a trial run, which confirmed a Tertiary (Early-Middle Eocene) age for carbonaceous and lignitic sediments within the Tertiary Unit T3 horizon (Higgins, 2009).

Thirty-two samples were collected for palynological analysis from suitably reduced or carbonaceous intervals intersected by drilling on Woodforde, and are currently in NuPower’s storage.

**Downhole Geophysical Logging**

All holes were geophysically logged for natural gamma (GAMMA), self-potential (SP) and resistivity (LLS-Laterolog Shallow & LLD - Laterolog Deep).

Six drillholes on Woodforde (EL24741) intersected minor indications of anomalous gamma within sediments interpreted as Hale Formation but estimated grades were <0.01% eU₃O₈. One drillhole (WF004) intersected uranium mineralisation >0.01% eU₃O₈ as determined by standard downhole gamma logging techniques.

**Geochemistry**

A total of 102 drill cuttings samples from three drillholes, WF001, WF003, WF004, were assayed, the sampling methodology and assay techniques were reported previously, (ibid).

The chemical assays from intersections of anomalous gamma from holes WF001 and WF004 are extremely low with the maximum assay being 16.1ppm U (WF004, 230-232m), consistent with the reported gamma equivalent uranium results of <0.01% U₃O₈. Chemical assays for the only higher gamma log interval of 0.012% eU₃O₈ from WF004 are only 3.9 and 4.3ppm U and the effects of radionuclide disequilibrium are unknown. The methods of sample recovery and sampling are believed to be responsible for loss of uranium and the chemical assay results are therefore considered to be unreliable.

Cuttings from holes WF003 and WF001 located respectively within and close to the Woodforde River discharge channel from Kerosene Creek that drains the Nolans Bore rare earths deposit assayed to determine the potential for secondary mineralisation downstream from this important deposit. Assay results are low and it is therefore apparent that there are no zones of secondary accumulation where these holes were drilled.

**Reconnaissance Mapping – Hard Rock Uranium Anomalies**

The results of the reconnaissance of seventeen hard rock uranium radiometric anomalies in the northern part of the tenement were reported previously, (Higgins & Rafferty, 2009).

Assays of stream sediment samples from the Woodforde River-Kerosene Creek area to determine the geochemical signature of the Nolans bore deposit contain no elevated values suggesting that this type of deposit lies undetectable by stream sediment geochemistry at 10-15km downstream from source.
Rock samples to test four isolated U/Th radiometric anomalies associated with small bodies of Boothby Orthogneiss and Aileron Metamorphics exhibited no significant anomalies, although Ce (80-160.5ppm), Nb (9.9-11.9ppm), P (130-430ppm), Rb (337-402ppm), are apparently elevated and may be typical of the Boothby Orthogneiss.

Samples were collected from a prominent U/Th radiometric anomaly in the NW extremity of the tenement in the region of Mt Finniss underlain by a complex faulted terrain of orthogneisses, mafic-felsic granulites, and charnockite. An occurrence of Ce-Th-U-Nd-La mineralisation lies about 5km NW of the area sampled. Two rock chip samples of gneiss are anomalous in Ce (>500ppm), Hf (2.9, 6.2ppm), La (252, 327ppm), Nb (10.1, 10.7ppm), Th (241, 460ppm), and six soil samples are anomalous in Ce (>500ppm), Co (10.9,12.9ppm), Cr (61ppm), Cu, (12.1ppm), Hf (5.3-12.4), La (288-540ppm), Nb (8.8-14.6ppm), Ni (28ppm), P (540ppm), Sn (20.6ppm), Ta (2.42ppm), Th (215-850ppm). These results are considered sufficiently important for further reconnaissance work here.

**Groundwater Sampling**

**Station Bores**

The use of groundwater geochemistry and the NuPower sampling methodology have been discussed previously, (Rafferty, 2008).

The results of six water samples reported previously (Rafferty, 2008) were re-assayed and two additional bores were also sampled were reported previously, (Higgins & Rafferty, 2009). Interpretation of the data can be found in Rafferty (2011).

**Drillhole Water Samples**

Since all of the scout rotary mud drill holes encountered the water table sampling of this water was taken as an opportunity to acquire additional water data particularly where station bores are absent.

It was considered that although the initial samples would be contaminated with drilling mud, that during the course of settling, degradation of the mud and natural influx of groundwater over a period of time that the water would revert to original formation water. A regime of water sampling was therefore carried out for each bore over a period of approximately 12 months. The effect of trace elements introduced by the drilling mud was also considered and a series of mud samples of varying compositions including a blank water sample were also assayed. The results of most of this work have already been reported (Higgins & Rafferty, 2009).

However the last round of sampling was completed in October 2009 and is reported here for the first time. The drillholes are identified in Figure 8 and the sample and assay data and laboratory assay sheets can be found in Rafferty (2011).
Figure 8. Location of bore and drillhole water samples on Woodforde (EL24741).
NuPower Exploration Activities Completed, Year 5, (22/04/10 – 21/04/11)

Radiometric Anomaly Reconnaissance

Introduction

Several days were spent following up coincident radiometric and geochemical thorium and uranium anomalies in this tenement (Figure 9). The anomalies were traversed with geological observations made and plotted on the maps below. Five samples were taken for assay. In addition to the anomalies described below, a weaker and smaller radiometric anomaly approximately midway between Anomalies A and B was found to coincide with a granite outcrop.

Results

Anomaly A is within the area still retained as EL 24741 and details are reported in Rafferty and Davey (2011). Anomaly B and C are within area previously relinquished and the details of these are reproduced below.

Anomaly B

This is a very large strata-parallel radiometric anomaly in the northwestern part of the EL. In this area the following stratigraphic units have been mapped – Weldon Metamorphics (granulites), Tyson Creek Granulite, and Anmatijira Orthogneiss. A geochemical target is also present in the area; in two locations previous NuPower samples had assayed anomalous uranium and thorium.

The dominant lithologies in this area are metamorphosed granite/granodiorite (Figure 10). This is sometimes very coarsely porphyritic with perhaps the size of the phenocrysts being due to overgrowth of feldspar during metamorphism. There are also lesser outcrops of quartzite, quartz biotite and quartz muscovite schist (sometimes with large feldspar phenocrysts/porphyroblasts). Pegmatite sill and dyke outcrops are quite common. These are generally quite small in area, and generally only a few metres wide.
Figure 9. Woodforde River anomaly location and airborne radiometric thorium. Data source NTGS.
The meta-granite/granodiorite has a high radiometric background – typically 400-600cps. An example of spectrometer equivalent U and Th from this is 35ppm U, 373ppm Th. The pegmatites are commonly highly radiometrically anomalous – to >2000cps. Equivalent Th in these rocks is generally considerably higher than U – e.g. 17ppm U with 271ppm Th, 17ppm U with 985ppm Th. The previous NuPower samples were taken from pegmatites, even when described as quartz rubble – really mainly feldspar crystals in scree derived from outcropping pegmatite.

Stream beds in this area are highly radiometrically anomalous – often about 1000cps. This is obviously due to heavy minerals, probably monazite, in the sandy alluvium.

Three rock samples were taken for assay; assays for selected elements are tabulated below:

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>U (ppm)</th>
<th>Th (ppm)</th>
<th>Ce (ppm)</th>
<th>La (ppm)</th>
<th>Nd (ppm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20086</td>
<td>9.1</td>
<td>406</td>
<td>468</td>
<td>215</td>
<td>137.5</td>
<td>pegmatite dyke/sill, fsp-qtz-bt</td>
</tr>
<tr>
<td>20087</td>
<td>32.6</td>
<td>570</td>
<td>653</td>
<td>312</td>
<td>172</td>
<td>porphyritic foliated granodiorite</td>
</tr>
<tr>
<td>20088</td>
<td>9.7</td>
<td>490</td>
<td>787</td>
<td>375</td>
<td>192.5</td>
<td>coarse fsp pegmatite, minor bt</td>
</tr>
</tbody>
</table>

Both the pegmatite bodies and porphyritic foliated granite have elevated uranium, thorium and rare earths. However these values are much too low to be of economic interest.

The radiometric anomaly in this area is due to “hot” meta-granites, granodiorites and pegmatites. Uranium and rare earth contents in these rocks do not approach economic levels. Previous high uranium and thorium assays were also from small irregular pegmatite bodies of no economic significance.

**Anomaly C**

This is north of Anomaly B and is another large strike-parallel anomaly this time coincident with mapped Aloolya Gneiss – described as granitic gneiss with tourmaline and garnet.

Traverses in this area showed it to be underlain by variously foliated sometimes porphyritic granite and granodiorite (Figure 11). There are minor pegmatite, quartz and quartz-tourmaline veins. Just to the south of the radiometric anomaly outcrops of quartzite, schist and dolerite occur. These have been mapped as Weldon Metamorphics.

Radiometric background over the granitic rocks is 400-600cps with rarely up to 800cps. In one location equivalent U was 52ppm with 54ppm Th. Over the schist and dolerite to the south of the radiometric anomaly background was up to 300cps. One sample was taken for assay:

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>U (ppm)</th>
<th>Th (ppm)</th>
<th>Ce (ppm)</th>
<th>La (ppm)</th>
<th>Nb (ppm)</th>
<th>Sample Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20089</td>
<td>18.3</td>
<td>32</td>
<td>44</td>
<td>20.6</td>
<td>4.1</td>
<td>Medium-grained, non-porphyritic weakly gneissic bt granodiorite</td>
</tr>
</tbody>
</table>

This sample of gneissic meta-granodiorite had only weakly anomalous levels of U, Th and slightly elevated rare earths.

No signs of mineralisation were found here and the radiometric anomaly is due to the relatively high U and Th in the meta-intrusives.
Figure 10. Anomaly B geology, radiometrics, sample location.
Figure 11. Anomaly C, geology, radiometrics, sample location.
Conclusions

- The radiometric anomalies traversed were found to be due to “hot” granites and pegmatites. These have typically up to about 50epm U and much higher Th. There is no evidence of Rossing style mineralisation here. Pegmatites can be particularly strongly enriched in U and Th, but this is extremely variable. Sometimes the abundance of biotite or tourmaline is indicative of the amount of U and Th.
- There are elevated levels of rare earths in some pegmatites and meta-granite. However these values are too low to be of economic interest. The pegmatite bodies are generally thin and discontinuous.
- There is very little difference in the composition and texture of the granites/granodiorites within each body. However the style of foliation varies a lot. Foliation is sometimes apparent only from phenocryst alignment, sometimes there is variable schistosity and sometimes a gneissosity.
- The large areas of hot granites and pegmatites here constitute a good protore for uranium mineralisation, however concentrations of uranium in the granites do not approach Rossing type grades and the features of unconformity style mineralisation such as graphitic schists, unconformably overlying sandstone/conglomerate (Kombolgie equivalent) etc. do not exist. No evidence for vein-style mineralisation was seen.

Recommendations

- Further exploration for hard rock uranium does not appear to be justified.
- However the area retains its potential for paleo-channel uranium, and Nolans style rare earth mineralisation under cover. These styles of mineralisation will be further assessed.

Results of Groundwater Sampling

Groundwater sampling of bores and drill holes in the tenement are reported in Rafferty (2009, 2010). Only some assays have been previously reported, and some of these may be in error. Problems were discovered with the assaying, this resulted in all samples being re-assayed.

Interpretation so far has just been for results from water bores.

Rare Earths

There are apparently 2 loci of multi-element REE geochemistry: Anmatjere Bore and RN13927 with different REE signatures as follows;

Anmatjere Bore: Ce, Dy, La, Er, Eu, Nd, Tb, Yb
RN13927: Ce, La, Er, Nd, Pr, Y, Yb

B, F

These elements are typical of granitic intrusives. Anomalies occur in the southeastern and northwestern parts of the area.

Cu, Pb, Mo, Re

These base metals are often typical of felsic intrusives and an anomaly occurs in the eastern part of the area.

Ta, U, Th, Sn

These elements are typical of granitic rocks and a small multi-element Ta, U, Sn, Th anomaly occurs in the area around Aileron.
As, Se, Sb, Cd

This group of toxic elements forms a broad anomaly covering a large part of the area.

Conclusions and Recommendations

REE in water in the area of Anmatjere Bore highlights the prospectivity of this area for mineralisation similar to at Nolans.

REE also occurs in water at RN13927. This is in the southern part of the Ti Tree Basin where a thick sequence of Cainozoic sediments (>200m) overlying the basement is inferred from the AEM. The source of the anomaly is not clear and it seems unlikely that it is derived from basement overlain by such thick cover. It may be instead derived from units in the Cainozoic sedimentary package, enriched in these elements by erosion from the surrounding basement.

An exploration program is recommended as follows:

- Detailed mapping of the Anmatjere Bore anomaly to look for evidence of alteration similar to at Nolans.
- A detailed airborne magnetic-radiometric survey covering a broad area to look for the structures controlling Nolans that could be focusing similar mineralisation elsewhere and subtle radiometric anomalies undetected by the previous surveys.
- Orientation vegetation and soil/lag sampling using Mobile Metal Ion techniques to see if mineralisation can be detected under shallow cover. (Nolans is also a vegetation anomaly).
- Remodelling of the AEM data focusing on the basement for evidence of structures and alteration.
- Structural-geochemical targets would be scout drilled.
Figure 12. Bores and drillholes groundwater sampled.
Arafura Resources Exploration Activities Completed, Year 5, (21/04/10 – 20/04/11)

Arafura conducted a preliminary office-based review of NuPower’s AEM data and the regional magnetic and geological datasets across the Ailleron-Reynolds project area, and identified a number of potential target areas for water within the Ti Tree Basin on EL 24741 to support the nearby Nolans REE Project.

Arafura then engaged Mr Graham Ride to thoroughly review all available data and to develop an exploration strategy to meet the water requirements for the upcoming Nolans Bore mine. Mr Ride ultimately recommended a number of priority targets within the Ti Tree Basin on EL 24741.

An exploration drilling program was devised to intersect aquifers within the Ti Tree Basin as previously identified by NuPower during an AEM survey and scout rotary mud drilling for sandstone-hosted secondary uranium mineralisation. Access tracks to all proposed drill sites were constructed in 2010 just prior to a major rain event. The drilling program was postponed for the remainder of the 2010 due to the wet conditions.

Arafura again contracted Mr Graham Ride to plan and oversee an exploration drilling program by H2O Pty Ltd in 2011 in early 2011. Access tracks were upgraded and total of two water production bores were completed. Samples of drill cuttings have been collected for analysis. Mr Ride’s report, geological logs and maps are included in Rafferty and Davey (2011). These holes were on areas previously relinquished.

Arafura Resources Exploration Activities Completed, Year 6, (21/04/11 – 20/04/12)

In Year 6, Arafura Resources engaged Mr Graham Ride, with respect to the development their Nolans Bore REE-P-U deposit, to continue with hydrological and environmental monitoring and investigations within the Ti Tree Basin on EL 24741 and adjacent areas. Mr Ride was also engaged to explore for suitable deposits of clay and gravel on EL 24741 and adjacent areas. A summary of Mr Ride’s activities are outlined below.

1. Baseline water level monitoring existing bores within tenements, graphs and cross sections, clearing access tracks
2. Groundwater sampling and baseline trace element and groundwater chemical quality monitoring
3. Limited soil sampling and basic soil tests
4. Basic geological mapping outcrop areas
5. Land system mapping
6. Hydrogeological assessments: basement aquifers, Ti Tree Basin aquifer, deep Ti Tree Basin Aquifer; bore cross sections, Stratigraphy, location of deep paleochannels Ti Tree Basin
7. Research of lignite deposits identified in drilling logs
8. Hydrological assessments surface catchments; rainfall and runoff
9. Mapping and pegging southern extent of Ti Tree Basin
10. Collection of data, data collation and synthesis uranium in groundwater, mapping known occurrence
11. Assessment of potential locations of clay deposits, pegging sites for scout hole investigations, clearing access roads and drilling pads
12. Assessment of potential locations of gravel deposits
13. Climate studies,
14. Preliminary geochemical studies
15. Collection, collation and data synthesis existing bores within region.

Mr Ride’s detailed reports and maps for year 6 exploration activities are presented in Hussey (2012a)
Mr Ride recommended a number of potential scout drilling sites for clay deposit exploration by Arafura in 2012/2013.

**Arafura Resources Exploration Activities Completed, Year 7, (21/04/12 - 20/04/13)**

Arafura acquired detailed low-level airborne geophysical survey data over parts of EL 24741 as part of its multi-tenement Aileron East survey. The data and the specifications for this survey are provided in Hussey (2013b).

Large parts of EL 24741 covered by thick Ti Tree basin sediments were relinquished and Arafura’s water exploration efforts shifted to the southern basins (i.e. Whitcherry and northern Burt Basins).

**Arafura Resources Exploration Activities Completed, Year 8, (21/04/13 – 20/04/14)**

Arafura Resources commissioned Southern Geoscience Consultants (SGC) to merge all geological and geophysical datasets and to work together with Arafura to develop a regional geological interpretation and synthesis for the Aileron-Reynolds project area focusing on the basement geology (Hussey, 2014a).

As part of this project and to support groundwater exploration in the southern basins; SGC also modelled depths to magnetic features for all airborne surveys in the Aileron-Reynolds region. SGC provided a large number of modelled solutions using a number of different methods and the results of this work can be found in Hussey (2013b). Arafura’s and SGC’s multi-tenement desktop geological interpretation and synthesis project entailed several months of office-based work and included four visits to SGC Perth office to review and discuss progress on geological interpretations and proposed targets. The aim was to provide the best possible background geological framework using all available geological information and to generate exploration targets for future work. While Arafura is focused on REE exploration, SGC were asked to provide other targets where possible. For example, a number of base metal targets have been proposed. These targets are outlined in Appendix 1 of Hussey (2014a).

The geological synthesis and the selection of preliminary exploration targets were completed during this reporting period and the data can be found in Appendix 1 of Hussey (2014c). Figure 13 displays a solid geology map derived from the geophysical synthesis undertaken along with generated REE targets within EL 24741. 3D inversion modelling of the merged magnetic data using Geosoft’s VOXI software was subsequently undertaken by SGC in an attempt to highlight regions undercover which have a similar magnetic signature to the Nolans bore deposit. Numerous magnetic susceptibility values were modelled and shells for each were created. A modelled magnetic susceptibility of -0.01 was found to best represent the magnetic signature of the Nolans Bore deposit. The VOXI automated targeting identified a number of prospective areas which were followed up in the following field season. VOXI Nolans-style targets within EL 24741 can be seen in Figure 13 and the data for this work can be found in Appendix 1 of Hussey (2014c).

**Arafura Resources Exploration Activities Completed, Year 9, (21/04/14 - 20/04/15)**

Work undertaken by Arafura Resources on Woodforde (EL 24741) consisted of follow-up fieldwork over targets generated in the previous year. The work was undertaken over two weeks from the 25th of August to the 5th September 2015 by Arafura Resources staff, Jeremy Grose (senior field supervisor) and Rodney Dean (geologist). Field work comprised investigations of outcropping REE targets generated from the SGC regional synthesis and VOXI targets generated from the 3D inversion
modelling also performed by SGC. For undercover targets a biogeochemical sampling program was undertaken across the VOXI targets and within SGC regional synthesis REE targets which had favourable magnetic structure. In total 15 traverses were undertaken over the project area which comprised 311 foliage samples collected approximately every 25m along each traverse. Approximately one in twenty samples were had a field duplicate sample collected for sampling QAQC purposes. The sample traverses can be seen in Figure 13. The sampled plants consisted primarily of Mulga trees (Acacia aneura), and to lesser extent undifferentiated Proteaceae trees along with undifferentiated Eremophila shrubs. The samples comprised of primarily of leaves or phyllodes (in the case of the Mulga samples) with minor amounts of twigs, flowers and very minor fruit or seed pods. The samples were air-dried in the field office at Aileron and of the 311 samples collected; 115 were sent to Northern Territory Environmental Laboratories (NTEL) for assaying using an in-house nitric acid digestion and ICPMS or ICPOES determination. The remaining lower priority samples were retained and may be assayed in the future.

The assay results failed to indicate any anomalous REE concentrations or distinctive Nolans-style REE ratios and no other anomalous metal concentrations were identified. These results can be found in Appendix 2.

CONCLUSIONS AND RECOMMENDATIONS

Due to the lack of anomalous REE and other metals identified in the 2014 biogeochemical sampling program, it is suggested that the Woodforde exploration licence (EL 24741) be further reduced based on these results. Further work on Woodforde will involve the assaying of the remaining biogeochemical samples for potential drill target generation.
Figure 13. Solid geology map, REE targets, -0.01 magnetic susceptibility isosurfaces (VOXI targets) and sampling locations.
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