



**Cameco Australia Pty Ltd**

**EL24017 and EL27059**

**WAIDABOONAR PROJECT**

**NORTHERN TERRITORY**

**ANNUAL REPORT**

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**Map Sheets:** 1: 250, 000: Alligator (SD-5301)  
1:100, 000: Oenpelli (5573)

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DRDPIFR - Minerals and Energy (1)  
Northern Land Council (1)

## SUMMARY

Waidaboonar Project is a uranium exploration project consisting of Exploration Licences 24017 (EL24922) and 27059 (EL27059). Tenements were granted on the 3<sup>rd</sup> September 2010 for initial period of 6 years, operated and managed by Cameco Australia Pty Ltd (Cameco). This report documents exploration work conducted during the first year of tenure. EL27059 consists of 4 blocks with a total area of 8.3 km<sup>2</sup> and EL24017 consists of 5 blocks with a total area of 15.66 km<sup>2</sup>.

Exploration for unconformity style uranium mineralisation consisted of all-terrain vehicle supported outcrop sampling and reconnaissance work. During five days of work 35 rock samples were collected and 72 points were mapped during the 2010 program. All samples were collected from EL24017 only, since no out crop for sampling were encountered during one day of mapping work on EL27059. 12 mapping stations were recorded on EL27059 and 60 mapping points were recorded on EL24017. Two thin-sections were taken from EL24017 surface samples for petrologic analyses.

On tenement EL24017, outcrops dominantly consist of quartz-muscovite schist (Nourlangie Schist). Topographic highs show intense quartz veining and quartz breccia was encountered as a surface expression of faulting. No anomalously high radiometric were associated with described structures. Porphyritic Oenpelli dolerite prevails in outcrops on the eastern side of EL24017. The south-eastern part of tenement contains foliated amphibolite (interpreted as Zamu dolerite) as described in several localities.

Due to the late start of fieldwork on tenements no geochemical assay results and petrologic report are available at this time.

The total reportable expenditures on EL24017 and EL27059 for the reporting period are \$7,225.00 and \$2,358 respectively.

The estimated total expenditure for EL24017 and EL27059 in 2012 is \$11,250 and \$11,000 respectively.

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## INTRODUCTION

Waidaboonar Project is a uranium exploration project in Western Arnhem Land, Northern Territory consisting of EL24017 and EL27059. The project is managed and operated by Cameco Australia Pty Ltd (Cameco). Tenements EL24017 and EL27059 were granted were granted on the 3<sup>rd</sup> September 2010 for initial period of 6 years. EL27059 consists of 4 blocks with a total area of 8.3 km<sup>2</sup> and EL24017 consists of 5 blocks with a total area of 15.7 km<sup>2</sup>.

3<sup>rd</sup> September 2011 marks one year of tenure. The exploration licence is located on Aboriginal Land and work program was carried out under the terms of consent documentation agreed with the Northern Land Council (NLC) pursuant to the Aboriginal Land Rights (Northern Territory) Act 1976. The program was presented at the liaison Committee meeting held on 29<sup>th</sup> June 2011 at Oenpelli, and approved by the NLC on behalf of the Traditional Owners.

The focus of the exploration strategy is the discovery of unconformity-related uranium deposits. The nearby economic deposits at Ranger, Jabiluka, Koongarra and the now depleted Nabarlek Mine serve as models for this strategy.

Exploration activities during the first year of tenure consist of surface sampling, mapping and reconnaissance.

### Location and Access

The tenements are located in western Arnhem Land, Northern Territory on the Alligator (SD-5301) 1:250 000 scale topographic map sheet and the Oenpelli (5573) 1:100 000 scale topographic map sheet. The tenements are centred approximately 50 km north-northeast of Jabiru and 25 km west-northwest of the Nabarlek Mine site (Figure 1).

#### Figure 1: Waidaboonar Project Location

Access to the tenement EL24017 is possible via Oenpelli-Maningrida road and to the tenement EL27059 via unsealed road leading from Oenpelli-Maningrida road towards Arrarra tenement. All-terrain vehicle was used to travel on tenement. Work was based from Cameco's King River Camp on the Cobourg Peninsula Road.

## REGIONAL GEOLOGICAL SETTING

The following regional geological overview is largely based on the work by Needham et al. (1988), Needham (1998, 1990), and Needham and Stuart-Smith (1980). Information that is not based on these references is indicated below.

The Waidaboonar project area is located within the eastern margin of the Neoproterozoic Pine Creek Orogeny, and is in a region that has been subdivided into the Nimbuwah Domain of the Alligator Rivers region (Figure 2 and Figure 3).

#### Figure 2: Simplified geology of the Pine Creek Orogeny showing the location of selected mineral deposits (after Pirajno and Bagas, 2008).

### Figure 3. Regional Geology of West Arnhemland

The oldest exposed rocks in the Alligator Rivers region are those of the Neoproterozoic (ca. 2500 Ma) Nanambu Complex, a group of paragneiss, orthogneiss, migmatite, and schist forming dome structures. The Nanambu complex is unconformably overlain by a Paleoproterozoic metasedimentary and metavolcanic sequence, formerly included in the Pine Creek Geosyncline (PCG). Recent U-Pb age dating by the NTGS and Geoscience Australia (GA) of rocks within the Myra Inlier, previously mapped as part of the Paleoproterozoic PCG and named the Myra Falls Metamorphics, indicates that they are in fact part of the Neoproterozoic Nanambu Complex (Hollis, et al, 2009). These rocks have thus been re-mapped as the Kukulak Gneiss.

Paleoproterozoic rocks in the Alligator Rivers region are amphibolite-facies psammites assigned to the Mount Howship Gneiss and the Kudjumarndi Quartzite. These formations are included in the Kakadu Group and are probably correlatives of the Mount Basedow Gneiss and Munmarlary Quartzite, respectively (Ferenczi et al., 2005). The group appears to on-lap Neoproterozoic basement highs, but gneissic variants are also thought to pass transitional into paragneiss of the Nanambu Complex.

The Cahill Formation of the Namoon Group conformably overlies the Munmarlary Quartzite. The Cahill formation can be separated geologically into two groups, the lower Cahill Formation consisting of calcareous marble and calc-silicate gneiss, overlain by pyritic, garnetiferous and carbonaceous schist, quartz-feldspar-mica gneiss, and minor proportions of amphibolite; and the more psammitic Upper Cahill Formation consisting of feldspar-quartz schist, quartzite, lesser proportions of mica-feldspar-quartz-magnetite schist, and minor proportions of metaconglomerate and amphibolite. The Lower Cahill Formation is host to all of the major deposits of the Alligator Rivers Uranium Field, including Jabiluka, Ranger, Koongarra and Nabarlek. Mafic sills and dykes assigned to the Goodparla and Zamu dolerites intrude the Upper Cahill Formation.

Overlying the Cahill Formation is the Nourlangie Schist, argillaceous to quartzose phyllite and quartz-mica schist that locally contain garnet and staurolite.

The supercrustal rocks of the region are structurally complex, having been affected by at least three deformation event before deposition of the late Paleoproterozoic to Mesoproterozoic Kombolgie Subgroup (Thomas, 2002). The rocks have also been locally migmatized during the ca. 1847 +/-30 Ma Nimbuwah Event. In addition, there is a broad trend of increasing metamorphic grade from southwest to northeast in the Nimbuwah Domain. This gradient is thought to reflect the synchronous emplacement of ca. 1865 Ma granites in the Nimbuwah Complex.

Overlying the Proterozoic metamorphics with a marked regional unconformity is the the Kombolgie Subgroup, the basal unit of the late Paleoproterozoic to Mesoproterozoic Katherine River Group of the McArthur Basin (Sweet et al., 1999a, b). The subgroup consists of sandstone units called the Mamadawerre Sandstone, Gumarrirrbang Sandstone, and Marlgowa Sandstone (oldest to youngest) which are divided by thin basaltic units called the Nungbalgarri Volcanics, and Gilruth Volcanics respectively. The Mamadawerre Sandstone has a minimum age of ca. 1700 Ma, which is the minimum age of the intrusive Oenpelli

Dolerite. Detrital zircon SHRIMP data from the GA OZCRON database constrain the maximum age of the sandstone at ca. 1810 Ma.

The Oenpelli Dolerite is the most pervasive mafic intrusive suite to affect the Alligator Rivers region. It intrudes various Neoproterozoic and Paleoproterozoic units, as well as the Kombolgie Subgroup, forming magnetic sills, dykes, lopoliths, and laccoliths. The Oenpelli Dolerite has a U-Pb baddeleyite date of  $1723 \pm 6$  Ma (Ferenczi et al., 2005), however, geochemical and geophysical data suggest several phases of intrusion throughout the region. These intrusive events had a pronounced thermal effect within the Kombolgie Subgroup, with the promotion of fluid flow and aquifer or aquitard modification. Localized effects in the sandstone include silicification, desilicification, chloritization, sericitization, and pyrophyllite alteration. A characteristic mineral assemblage of prehnite-pumpellyite-epidote has formed in the quartzofeldspathic basement rocks adjacent to the intrusions.

Deformation since deposition of the Katherine River Group includes transpressional movement along steep regional-scale strike-slip faults and possibly some shallow thrusting. These regional faults follow a pattern of predominantly north, northwest, north – northwest and northeast strikes, giving rise to the characteristic linearly dissected landform pattern of the Kombolgie Plateau. Another significant set trends east – west and includes both the Ranger and Beatrice Faults.

The Bulman Fault Zone is a principal regional feature and is considered to represent a long-lived deep crustal structure, with a large lateral component in rocks of the PCS. However, it appears that post-Kombolgie displacements along this and other faults have not been great, because the Arnhem Land Plateau is essentially coherent and offsets along lineaments are generally minor. Field investigations of many interpreted ‘faults’, including those with a marked geomorphic expression, show no displacement, and are best described as joints or lineaments (Thomas 2002).

Erosional remnants of flat-lying Paleozoic Arafura Basin and Cretaceous Carpentaria Basin are present as a veneer throughout the coastal zone of the Top End. Various regolith components are ubiquitous as cover throughout much of the region.

### **Local Geology**

Both tenements are located on Nourlangie schist outcrop, which in turn have been intruded by sill of Oenpelli dolerite, the latter is outcropping on eastern half of EL24017 (Figure 4). Tenement EL27059 has very flat topography and the most area of tenement is covered by recent silty sand sediments and ferricrete.

#### **Figure 4: Local Geology of Waidaboonar Project**

Nourlangie schist consists of pale brown to grey, strongly foliated and often crenulated quartz-mica schist, mica schist and quartz schist, which are often feldspathic. Micas in schist are observed as muscovite. Oenpelli dolerite intrudes the Nourlangie schist as fairly flat laying interpreted lopolith. Oenpelli dolerite is fresh medium grained with porphyritic texture. Outcropping Nourlangie schist and Oenpelli dolerite is underlain by Myra Falls metamorphics (Cahill Formation equivalent). Myra Falls metasediments are outcropping approximately 2 km north from Waidaboonar Project area and the depth of Myra Falls metamorphics on the tenements is unknown. North-north west trending

Dreadnaught Fault is interpreted to intercept western part of EL24017 as a main named structure in the area.

## PREVIOUS EXPLORATION

### Exploration 1971 – 2010

The area covered by EL 24017 and 27059 have not seen previous exploration activities. Union Carbide Exploration Company explored for uranium on the King River tenements immediately north of the project area during 1971 – 1972. PNC Exploration (Australia) Pty Ltd explored for uranium and diamonds on tenement EL734, located immediately north of Waidaboonar are between years of 1996 to 2000.

Cameco applied for EL24017, which covers area of both current tenements, EL24017 and EL27059, on 10<sup>th</sup> September 2003.

Regional geophysical surveys cover the Waidaboonar project area. The area is covered by airborne magnetic and radiometric surveys, which were collected by various Governmental organizations and exploration companies from the late 1950's to 1970's (Percival 2010). Geoscience Australia funded an AEM Survey project, the Pine Creek-Kombolgie VTEM (TM) 2010 survey. Survey line 20180 intercepts current EL24017 tenement and the survey lines north and south of current tenements are available. A regional ground gravity survey (2000) along Oenpelli – Maningrida road is available for the eastern part of EL24017.

## EXPLORATION DURING REPORTING PERIOD

### Outcrop sampling

Reconnaissance mapping and sampling was carried out over the tenements to assess ground on the tenements and inspect areas with weak airborne radiometric anomalies and regions with high topographic variance. Five days mapping and sampling were carried out with support of an all-terrain vehicle, four days on EL24017 and one day on EL27059. In total 72 mapping stations were recorded, where 35 rock samples were taken for geochemical, SWIR and petrologic analyses (Table 1 and Figure 5). All rock samples were collected from EL24017 and none from EL27059 since on the latter no outcropping rock was encountered during mapping. 12 mapping stations were recorded on EL27059.

[Figure 5. Field mapping tracks and mapping stations.](#)

[Table 1. Waidaboonar Area Exploration Summary](#)

The outcrop sampling and processing was performed using Cameco standard methodology, as outlined in [Appendix 1](#). This appendix details methodology used for reflectance spectroscopy, laboratory techniques and methods, and analysed elements. All samples were submitted to Northern Territory Environmental Laboratories (NTEL) in Darwin for geochemical analysis. The laboratory sample preparation, analytical methods and techniques and analysed elements can also be found within [Appendix 1](#).

[Appendix 1: Cameco Standard Outcrop Sampling and Processing Procedures and Rock Type Codes, NTEL Analytical Procedure and Analytical Suite](#)



The following tables detail the data and results from samples collected during the program. Geochemical analyses have not received from laboratory and data is not provided with this report.

Table 2. Mapping Stations coordinates

Table 3. Sample Descriptions

Table 4. Sample Alteration

Table 5. Structural measurements

Table 6. Magnetic susceptibility

Table 7. SWIR detected main minerals

## RESULTS AND INTERPRETATION

### SWIR results of outcrop sampling

Short wave infrared reflectance (SWIR) data from 2011 surface sampling was processed by The Spectral Geologist software, which produced two main detectible minerals for each surface samples (Table 7). List of detected minerals was following: muscovite, paragonite, illitic muscovite, kaolinite, montmorillonite, siderite, Fe-Mg chlorite, Mg chlorite and prehnite. Following was noticed in processed SWIR data:

- most of SWIR detected minerals in surface samples were not related to alteration (e.g. muscovite in mica schist is metamorphic mineral or like kaolinite most likely weathering product),
- alteration related minerals like chlorite were detected in amphibolite samples and in one case in dolerite
- siderite detected in some dolerite could be related to chemical weathering (breaking down pyroxenes and olivine) or as product of hydrothermal activity occurring when intrusive was cooling down.

### Geochemistry of outcrop sampling

Assay results for submitted samples were not received by the time of submission of current report.

### Petrologic study for outcrop sampling

Two foliated amphibolite samples (taken from mapping stations KR11RK\_096 and KR11RK\_102) were submitted to Pontifex and Associates Pty Ltd for petrologic studies. Petrology report for submitted samples was not received by the time of submission of current report.

### Mapping of EL24017 and EL27059 area

Three main rock types as Nourlangie schist, Oenpelli dolerite and Zamu dolerite were encountered in Waidaboona project area (Figure 6 and Figure 7).

Figure 6. Geological map of EL24017

### Figure 7. Geological map of EL27059

The most widespread rock type was Nourlangie schist. Nourlangie schist comprised foliated and fine to medium grained quartz rich felspathic muscovite schist and in places quartzite with some muscovite. In many topographically high areas quartz breccia, quartz reefs and strong quartz veining was encountered as expression of structure (Photo 1). However, no anomalous scintillometer counts were recorded on structures. Topographically lower areas were interpreted to be muscovite rich Nourlangie schist, which are more susceptible for weathering and erosion. Two localities of intensively weathered muscovite rich quartz-feldspar schists were recorded in creek bed on flat ground (Photo 2). Dip and dip direction of foliation varies significantly in EL24017, however general dip direction is either towards southeast or northwest.



Photo 1. Quartz breccia and intense quartz veining at topographically elevated area at mapping station KR11RK\_045.



Photo 2. Intensively weathered quartz-feldspar-muscovite schist in creek bed at mapping station KR11RK\_074.

Oenpelli dolerite was encountered mostly in the eastern part of EL24017 and at two localities in the central western part of EL24017 (Figure 6). Oenpelli dolerite is fresh, medium to coarse crystalline and porphyritic. In the eastern part of EL24014 dolerite has a sub-horizontal and parallel fracture pattern, which gives the impression of internal layering of the dolerite body (Photo 3). However, this fracture pattern does not affect dolerite intrinsic massive porphyritic texture. It was interpreted that fracture was formed at later stage of cooling of intrusive rock body and could be parallel to the dolerite contact. By measuring the described fracture pattern in three different localities it was noted that the dip directions point into central part dolerite outcrop area. The pattern of structural measurements leads to interpretation of geometry of dolerite body as a small lopolith. Interestingly the mapped Oenpelli dolerite body does not appear as single negative magnetic anomaly on the airborne magnetic map.



Photo 3. Oenpelli dolerite outcrop with internal sub-horizontal and parallel fracture pattern at mapping station KR11RK\_046.

Foliated fine to medium crystalline amphibolite outcrops were described immediately south of the Oenpelli dolerite lopolith. Foliated amphibolite is fresh and foliation dip and dip direction is roughly orientated the same way as Nourlangie schist foliation in the area. Due to foliation texture of rock, foliation pattern and metamorphosed igneous rock appearance, the amphibolite was interpreted to be Zamu dolerite.



Photo 4. Foliated amphibolite (Zamu dolerite) outcrop at left and sample of amphibolite at right from mapping station KR11RK\_102.

Most structural expressions as quartz breccia, intense quartz veining and quartz reefs, were encountered on topographic highs at central part of EL24017 (Figure 6). Structural measurements on faults yielded two groups of faults: northwest trending ( $\sim 310^\circ$ ) and northeast trending structures. Measured dips were moderate to steep. Northwest trending structures coincide with main northwest striking elongated features on airborne magnetic map. Northeast trending structures have similar orientation to short lineaments on airborne magnetic map. In few localities the sinistral fault movement were recorded for both fault trend groups. No clear information for vertical offsetting along faults was gained from outcrops during fieldwork. Main structural trend was interpreted to be northwest trend, which might be formed during east-west compressional tectonic event. The northeast trending structures were interpreted to be as either Riedel shears or faults from earlier deformation event.

The western part of EL24017 and all EL27059 tenements are flat areas covered by recent sediments as sand, silt or mud with or without rounded ferricrete pisoliths. No outcropping rocks were identified in named areas.

## CONCLUSIONS AND RECOMMENDATIONS

The following brief conclusions could be drawn from the 2011 field mapping data (no geochemical data included):

- ground reconnaissance did not produce samples with elevated radiometrics
- most structural complexity and possible fluid flow path were recognized in central part of EL24017
- main structural trend strikes northwest, second structural trend strikes northeast; both structures strongly silicified
- geochemical results need to be viewed prior to making important exploration decisions
- due to sediment coverage on EL27059 and EL24017 the geological mapping and outcrop sampling is not suitable for these areas
- consider extending a planned 2012 airborne electromagnetic (TEMPEST) survey over Waidaboonar area to explore ground under cover and potential conductors in underlying Myra Falls metamorphics or structures
- no additional mapping and outcrop sampling is recommended for area.

## EXPENDITURE

A summary of the expenditures for the reporting period is given in [Table 8](#) and [Table 9](#). The total reportable expenditures for 2010 is \$9,583, split as \$7,225.00 for EL 24017 and \$2,358 for EL 27059.

[Table 8: Summary of expenditure for EL 24017](#)

[Table 9: Summary of expenditure for EL 27059](#)

## WORK PROGRAM FOR 2011-2012 (YEAR 2)

Extend a planned King River project 2012 airborne electromagnetic (TEMPEST) survey over the Waidaboonar tenement area to examine ground under cover for potential conductors in underlying Myra Falls metamorphics or structures.

The estimated expenditure to complete the work program as planned on tenements for EL24017 and EL27059 in 2012 is \$11,250 and \$11,000 respectively.

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