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Northern Land Council (1)
SUMMARY

This is the fifth year of tenure for Namarrkon Project. It consists of a single exploration Licence, EL23700, with a total area of 100.6km². The license is located in western Arnhem Land in the East Alligator Rivers uranium field approximately 250km east of Darwin and approximately 75km northeast of the Jabiru township. The tenement was granted for an initial period of six years to Cameco Australia Pty Ltd (Cameco) on 31 May 2005. The project is operated by Cameco in Joint Venture with Uranium Equities Limited (UEL) who currently holds 40% interest in the tenement. During the fifth year of tenure covered by this report, the JV partners conducted exploration for uranium mineralisation. The exploration program consisted of the collection of 3 outcrop samples along the Quarry Fault and selected geochemical spot samples from the historical drill hole NAM-010 (Figure 1). From the 2009 outcrop sampling one sample returned elevated in uranium at 62 ppm U (C010503). This sample was taken on a sandy flat with ferricrete boulders and rubble. The elevated sample is also associated with elevated As, Co, Cu, Mo, Ti and several other elements. Two samples from the NAM-010 drill hole returned values that are slightly elevated compared to background values, 6 to 7.5 ppm U. Both samples are associated with strongly chloritized sandstone near the unconformity. Total eligible expenditure for the exploration program for 2009 was AUD$46,517.22.
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INTRODUCTION

This report describes exploration activities carried out by Cameco on EL23700 (Namarrkon Project), during the reporting period from 31st May 2009 to 30th May 2010.

EL23700 is located on Aboriginal Land and the exploration program was carried out under the terms of consent documentation agreed with the NLC pursuant to the Aboriginal Land Rights (Northern Territory) Act 1976. Exploration work clearance was given by the NLC on behalf of the Traditional Owners following the Work Program Meeting held on 12 May 2009 at Oenpelli.

Location and Access

The Namarrkon Project is located in West Arnhem Land, entirely within Aboriginal Land (Figure1). The project is approximately 50km east north east of Jabiru and 15km south east of the rehabilitated Nabarlek mine site. Darwin lies approximately 250 kilometres to the west. The project is within the 1:250000 Alligator Rivers (SD-5301) and the 1:100000 Oenpelli (5573) map sheets.

Figure1: Project Location Map

The rugged nature of the sandstone plateau that almost entirely covers EL23700 necessitates the use of a helicopter, based out of Cameco’s Myra camp, for most exploration activities. Vehicle access is limited with access from adjacent tenements to small areas in the west, and northern parts of the project area.

Access to Cameco’s Myra Camp from Darwin is via the sealed Arnhem Highway to the Oenpelli-Maningrida road turnoff just west of Jabiru, and then north-east along the Oenpelli-Maningrida road past Oenpelli to the Nabarlek road, and along the Nabarlek road to the Myra Camp access track turnoff just west of the mine site.

Tenure

Application for EL23700 was lodged on 27 March 2003 and grant of title was given to Cameco Australia on May 31 2005, for an initial period of six years. The original area of grant is 100.6 km² (30 blocks). Approximately 3.1 km² of EL23700 is designated as ‘no-go’ and various other archaeological sites are excluded from exploration access.

In December 2006 a Joint Venture agreement was signed between Cameco and UEL allowing UEL to earn a 40% interest in EL23700, providing expenditure obligations were met. UEL has met the expenditure requirements, and currently holds 40% interest in the Namarrkon Project. Cameco remains manager and operator of the project.

As the exploration licence is located on Aboriginal land the work program was carried out under the terms of consent documentation agreed with the Northern Land Council, pursuant to the Aboriginal Land Rights (Northern Territory) Act.

An archaeological survey of the proposed work areas was conducted by Earth Sea Heritage Surveys (Earth Sea) prior to commencement of ground disturbing exploration activities. Indigenous archaeological sites are considered significant within the terms of the NT Heritage Conservation Act 1991 (HCA), and are afforded protected under Section 39 of the HCA. Instructions for the proposed exploration works to avoid these
archaeological places were recommended by Earth Sea, and the exploration program was conducted under those guidelines.

**Regional Geology**

The Namarrkon project area is located within the eastern margin of the Neoarchaean and Palaeoproterozoic Pine Creek Orogen, and is in the, in a region that has been subdivided into the Nimbuwah Domain of the Alligator Rivers region.

**Figure 2: Simplified geology of the Pine Creek Orogen showing the location of selected mineral deposits**

This section is largely based on the work by (Needham 1988), (Needham, Crick, and Stuart-Smith 1980; Needham 1990; Needham, Stuart-Smith, and Page 1988). Information that is not based on these references is indicated below.

**Figure 3: AGSO Pine Creek Orogen 1:500,000 Geology**

The Bureau of Mineral Resources (now Geoscience Australia) completed 1:250 000-scale geological maps of the Pine Creek Orogen between the 1940s and 1960s following the discovery of uranium at Rum Jungle. The Alligator Rivers region was systematically mapped by the Bureau of Mineral Resources and the Northern Territory Geological Survey between 1972 and 1983. This later work produced 1:100 000-scale geological maps and reports for the region from Darwin to Katherine to the Alligator Rivers region (Figure 3).

The oldest exposed rocks in the Alligator Rivers region are included in the Neoarchaean (ca. 2500 Ma) Nanambu Complex. The complex consists of paragneiss, orthogneiss, migmatite, and schist forming domical structures that are unconformably overlain by Palaeoproterozoic metasedimentary and metavolcanic rocks, which were formerly included in the Pine Creek Geosyncline. Recent collaborative research work by the NTGS and Geoscience Australia indicates that SHRIMP U-Pb age dating of an area of previously mapped Myra Falls Metamorphics outcropping within the Myra Inlier is Neoarchean in age and these quartzofeldspathic gneisses are named the ‘Kukalak Gneiss’ (Hollis, Carson, and Glass 2009, 2009). Palaeoproterozoic rocks in the Alligator Rivers region are amphibolite-facies psammites assigned in 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 Neoarchaean basement highs, but gneissic variants are also thought pass transitional into paragneiss of the Nanambu Complex.

The Cahill Formation of the Namoona Group conformably overlies the Kudjumarndi Quartzite. The lower part of the Cahill Formation (informally referred to as the Lower Cahill Formation) hosts the Nabarlek, Ranger and Jabiluka uranium deposits. The Lower Cahill Formation consists of a structurally lower calcareous marble and calc-silicate gneiss, which is overlain by pyritic, garnetiferous and carbonaceous schist, quartz-feldspar-mica gneiss, and minor proportions of amphibolite.

The informally named Upper Cahill Formation is psammitic and consists of feldspar-quartz schist, quartzite, lesser proportions of mica-feldspar-quartz-magnetite schist, and
minor proportions of metaconglomerate and amphibolite. The Upper Cahill Formation is magnetic and significantly so at the base of psammitic unit in what is informally known as ‘hangingwall sequence’. The magnetic characteristic of this unit is due to the presence of mafic sills or magnetite and it is a useful characteristic used to distinguishing the Cahill Formation from surrounding less magnetic rocks (Kendall 1990). Mafic sills and dykes assigned to the Goodparla and Zamu Dolerites intruded the Cahill Formation prior to metamorphism.

The Nourlangie Schist overlies the Cahill Formation and consists of 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 Palaeo- to Mesoproterozoic Kombolgie Subgroup (Thomas 2002). The rocks have also been locally migmatisation during the ca. 1847-30 Ma Nimbuwah Event. In addition, there is a broad trend of increasing 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.

The Kombolgie Subgroup is the basal unit of the late Palaeo- to Mesoproterozoic Katherine River Group of the McArthur Basin (Sweet, Brakel, and Carson 1999; Sweet et al. 1999). The subgroup consists of sandstone units called the Mamadawerre Sandstone, Gumarrimbang Sandstone, and Marlgowa Sandstone, which are divided by thin basaltic units called the Nungbalgarri Volcanics, and Gilruth Volcanics. 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 and is the youngest Proterozoic rock unit exposed. It intrudes various units Neoarchaean and Palaeoproterozoic units, and the Kombolgie Subgroup, forming magnetic sills, dykes, lopoliths, and laccoliths. The Oenpelli Dolerite has a SHRIMP U-Pb baddeleyite date of 1723 ± 6 Ma (Ferenczi, Sweet, and authors 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. Localised effects in the sandstone include silicification, desilicification, chloritisation, sericitisation, 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 Palaeozoic 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

EL23700 is almost completely covered by Palaeoproterozoic sedimentary and volcanic Kombolgie Subgroup. Basement rocks are present in the far northeastern corner of the tenement at the base of the Stevens fault-bound Mamadawerre Sandstone escarpment, although these are largely obscured by Quaternary cover. Figure 4 displays the local project geology of the Namarrkon project.

Figure 4: Namarrkon Project - Local Geology

The Mamadawerre Sandstone, the oldest formation of the Kombolgie Subgroup, occupies most of the tenement, where it forms a deeply dissected plateau surface. This area is composed largely of bare rock with sparse areas of shallow sandy soil supporting spinifex and scrub. Plateau escarpments are developed to the north of the tenement along the Stevens Fault.

Mamadawerre Sandstone is unconformably overlain by the Nungbalgarri Volcanics. The unconformable contact is expressed locally as 100 – 500m diameter circular depressions (‘dome and basins’), with the upper sandstone surface interpreted to represent the palaeotopographic surface of giant lunate current ripples or aeolian sand dunes with the volcanics draped over the top ((Nott and Ryan 1996)). It may also represent large dewatering structures formed as a result of hot volcanic rocks draped over water-saturated sediments, which were deposited in estuarine conditions ((Needham 1978)). The dome and basin structures dominate airborne imagery of the southern-central part of the tenement with it’s unique dimpled pattern.

The Nungbalgarri Volcanics itself consists of multiple vesicular and amygdaloidal basaltic flows approximately 100 – 200m thick. Following airborne radiometric surveys by BMR in 1971-72 ((Horsfall and Wilkes 1975)) it was noted that ferricrete developed downslope of the outcropping Nungbalgarri Volcanics displays elevated U/Th ratios and forms prominent radiometric anomalies ((Needham 1988)).

The Gumarrirnbang Sandstone disconformably overlies the Nungbalgarri Volcanics forming restricted outcrop occurrences in EL23700. The sandstone comprises fine to coarse-grained quartz arenite with scattered pebbly units. Sedimentary structures include planar and trough cross-stratification, ripples and horizontal planar stratification, suggesting a proximal to distal fluvial braided stream and estuarine depositional environment.

Oenpelli Dolerite intrudes the Mamadawerre Sandstone as sills and outcrops at several localities, most notably along the arcuate Spencer Thrust extending from the centre to
the west of the tenement and into the adjacent Nabarlek Project (EL 10176). Oenpelli Dolerite is also present along the Stevens Fault in the north east of the tenement.

Previous explorers (AFMEX), with later modifications by Cameco, have developed a detailed stratigraphy correlating metasedimentary rocks of the Myra Falls Metamorphics with the lower-grade Cahill Formation. In Western Arnhem Land the AFMEX stratigraphy correlates the Upper Cahill formation with the ‘Upper Arkosic Unit,’ which consists of alternating meta-arkose (quartz–biotite–muscovite gneiss) and biotite–muscovite–quartz schists.

The Lower Cahill formation correlates with three units, the upper ‘Amphibolitic Unit,’ the middle ‘Lower Arkosic Unit’ and the basal ‘Calc-silicate Unit.’ The ‘Amphibolitic Unit’ is characterized by para- and ortho-amphibolites (~40%) interbedded with biotite-muscovite schists. The ‘Lower Arkosic Unit’ consists of biotite-muscovite schists, some with garnet and/or sillimanite and rare graphite alternating with fine-grained meta-arkose and occasional amphibolite beds. The ‘Calc-silicate Unit’ contains amphibolites, garnet-mica schists, calc-silicate gneisses marbles and cherts.

A number of large structures pass through the tenement. The Spencer thrust runs west – northwest through the central part of the tenement and exhibits a north-side-up movement ((Kastellorizos, Moreau et al. 1999)). The Quarry fault runs north – south through the tenement, passing through Kukalak Valley to the south of Namarrkon and disappears under cover to the north. To the north of the Spencer thrust, the Quarry fault has a surface expression of silicified sandstone breccias.

The Stevens fault in the northeast of the tenement strikes east – west through Namarrkon and the adjacent Cadell project (ERL 25896) to the east. Two well-defined faults, the Lightning and Thunder faults run west-north-westerly through the northern half of the tenement and continue into the adjacent Nabarlek (EL10176) and Cadell projects.

The Namarrkon lineament is a regional lineament originating near the northeast corner of Namarrkon and striking west-southwest for over 50km. The extent of movement, if any, on this feature is not known.

**Exploration Target**

The focus of exploration in the Namarrkon Project area is the discovery of unconformity-style uranium deposits. The prospective nature of the Alligator Rivers region is demonstrated by the presence of economic uranium occurrences at Ranger, Jabiluka, Koongarra and Nabarlek. In addition, significant gold, platinum and palladium resources are present at existing uranium occurrences in the Alligator Rivers Uranium Field (Ranger, Jabiluka, Koongarra and Coronation Hill/South Alligator Valley-style deposits) suggesting that economic Au and PGE (Platinum Group Element) mineralisation, associated with economic or sub-economic uranium may also be present in the project area.

Recent research into the Proterozoic Westmoreland District uranium deposits, from the Northern Territory – Queensland border suggests that the same broad physiochemical processes that govern unconformity-style uranium deposits also produce Westmoreland-style deposits, and indeed other basin/unconformity associated precious
and base metal deposits (Wall 2006). ‘Westmoreland-style’ uranium mineralisation may pose an exploration target in the dolerite and volcanic units of project area, although only sub-economic uranium occurrences have been discovered associated with these units in West Arnhem Land.

Despite local variations in structures, host rocks, element associations, all uranium deposits in the Alligators River region are located close to the unconformity between basement rocks and the Kombolgie Subgroup. In several examples, down-faulted blocks of the Kombolgie Subgroup, such as at the Ranger No 3 Orebody and the Hades Flat Prospect, are present adjacent to mineralisation. This common association of sandstone and uranium mineralisation is considered to be indicative of a favourable setting for the concentration of mineralising fluids, irrespective of the deposit-style model being invoked.

**PREVIOUS EXPLORATION**

Exploration in the Alligator Rivers region of the Northern Territory can be divided into two phases. The first phase of exploration commenced in 1970 and continued until September 1973 when a Federal Government moratorium on mineral exploration on Aboriginal Land halted exploration activity. Exploration in West Arnhem Land recommenced in 1986 and on the Namarrkon Project area in 1996.

**EL3589 – Afmex, Namarrkon Joint Venture: 1996-2002**

Details of exploration conducted by AFMEX on EL3589 can be found in the respective annual reports ((Kastellorizos 1998; Kastellorizos, Moreau et al. 1999; Fabray 2000; Wollenberg 2001; Fabray 2002)). A brief summary of this activity follows.

Afmex conducted various airborne geophysical surveys including radiometrics, magnetics, electromagnetics (DIGHEM and TEMPEST), and helicopter supported gravity; small ground geophysical surveys including electromagnetics (NanoTem), induced polarisation (IP) and radiometrics; ground radiometric follow-up and outcrop sampling, and stream sediment sampling; and helicopter-supported diamond drilling of 12 holes (NAM-001 to NAM-012) for 3,691.2 m.

Outcrop sampling returned best uranium assay results of 368 ppm U₃O₈ (sample number 610089), and sample 610088 returned 314 ppm U₃O₈ and 214 ppb Au and were associated with ‘narrow gently dipping quartz veins’ hosted in dolerite at ARAD Anomaly 4 ( Cameco named this area Hot Dot). Sampling at ARAD Anomaly 7 returned an assay of 36 ppm U₃O₈ from quartz breccia in sandstone associated with a faulting. No results above expected background were returned from the stream sediment sampling of the area.

The diamond drilling was conducted over two years from 1998 to 2000. Eight holes (NAM-001 to NAM-008R) were planned to determine the geology of the basement rocks and determine alteration and/or mineralisation prospectivity of the targeted areas. Four holes (NAM-009 to NAM-012) drilled to follow up alteration and structural disruption intersected in NAM-002. Results from the drilling were disappointing with the highest result of 2.8 ppm U₃O₈.
EL3589 was relinquished on 26th July 2002.

**Cameco Exploration: 2005 - 2009**

Cameco Australia was granted EL 23700 on 31st May 2005 covering the same area as the former EL3589.

2005

- Reprocessed the 2001 TEMPEST survey data;
- Helicopter supported reconnaissance mapping and outcrop sampling, collected 36 samples and
- Reconnaissance along the Quarry fault.

2006

- Two helicopter-supported diamond drill holes (NMD0001 and NMD0002) for 893.3 m;
- One ground-based reverse-circulation drill hole (NMR0003) for 136 m;
- an airborne hyperspectral (HYMAP) survey and
- Helicopter supported reconnaissance, outcrop and water sampling.

2007

- Track construction for ground based reverse-circulation drilling access;
- Helicopter-supported ground reconnaissance, mapping and sampling with 18 samples submitted for geochemical analysis from 19 sites and
- Four helicopter-supported diamond-core drill holes (NMD0004 to NMD0007) for 1,697.2 m.

2008

- Archaeological survey clearance for areas of substantial disturbance;
- 3.2 km of track construction for drill rig access for three proposed ground based reverse-circulation (RC) holes;
- One RC drill hole for 150 m was completed and
- Helicopter-supported ground reconnaissance, mapping and sampling with 33 samples submitted for geochemical analysis.

**EXPLORATION PROGRAM: REPORTING PERIOD 2009 - 2010**

The 2009 exploration program consisted of track construction for drill rig access for three proposed ground based RC holes, the collection of three outcrop samples along the Quarry Fault and selected geochemical spot samples from the historical drill hole NAM-010. All data pertaining to the 2009 exploration program and Cameco’s Methodologies can be found in Appendix 1.

**Appendix 1- Exploration Data and Methodologies**

Exploration for the 2009 field season was to be focused on RC drilling to the north of the Black Bream Prospect along the Quarry Fault. The program was planned to test for mineralisation at the intersection of cross structures with the Quarry fault at the unconformity
Three outcrop samples were collected in 2009 along the Quarry Fault, C010501-C010503. For sample locations see Figure 5 and for sample details see Table 1. Samples C010501 and C010502 consisted of medium- to coarse-grained Kombolgie Sandstone with radiometrics up to 80cps on an RS-125, geochemical analysis revealed no anomalous uranium in either sample. Sample C010503 was taken on a sandy flat with laterite boulders and rubble with radiometrics up to 500cps on an RS-125. This sample also yielded elevated uranium which is also associated with elevated As, Co, Cu, Mo, Ti and several other elements.

NAM-010 reported strong chlorite alteration and brecciation associated with slightly elevated radiometrics within the basal portion of the sandstone. There were no historical assays of this interval recorded in the database, therefore, nine samples were taken from the sandstone and basement for multi-element geochemistry. Geochemical assays did not yield significant results, therefore, there is no further work necessary. The location of NAM-010 can be seen in Figure 5 and a strip plot illustrating the geochemical character of the drill hole can be found in Figure 6.

**Figure 5: Location of Work 2009**

**Figure 6: Strip Plot of NAM-010**

**Table 1: 2009 Sample Station Details**

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**CONCLUSIONS AND RECOMMENDATIONS**

It is suggested for 2010 that drilling is focused along the Quarry Fault. The analytical results from 2009 for NAM-010 indicate elevated uranium near the unconformity. Samples with elevated uranium are also associated with elevated Co, MgO, MnO and W, which are indicative of a hydrothermal system. The elevated zone consists of strong, pervasive, chlorite alteration and brecciation near the unconformity.

**EXPENDITURE**

Eligible expenditure for the Namarrkon Project in 2009-2010 was AUD$46,517.22 as shown in Table 2.

**Table 2: Eligible Expenditure Statement**
2010 WORK PROGRAM

Exploration for the 2010 field season will be focused on reverse circulation drilling in areas readily accessible from the ground. Follow-up drilling is planned to the north of the Black Bream Prospect along the Quarry Fault testing for mineralisation at the intersection of cross structures with the Quarry fault at the unconformity position. Of particular interest is the WNW structure which trends through U65, and the WNW trending Thunder fault and the intersection with the Quarry fault.
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