Cameco Australia Pty Ltd

EL24936

STEVENS NORTH PROJECT

NORTHERN TERRITORY

ANNUAL AND FINAL REPORT

Date: October 2010
Period: 2 September 2008 to 1 September 2010
Report No.: SN10-02
Target commodity: Uranium
Authors: Gavin Otto, Senior Project Geologist

Contact Details: PO Box 35921
Winnellie
NT 0821
Ph. 08 8947 3477

Email for further technical details: gavin_otto@cameco.com.au
Email for expenditure: ratih_sagung@cameco.com.au

Datum/Zone: GDA94 (Zone 53)

Map Sheets: 1: 250, 000: Millingimbi (SD-5302)
1:100, 000: Goomadeer (5673)

Tenement manager: AMETS

Copies: Cameco Australia Pty Ltd (1)
Department of Resources - Minerals and Energy (1)
Northern Land Council (1)
SUMMARY

Exploration License (EL) 24936, Stevens North Project, is a uranium exploration project located in western Arnhem Land, operated and managed by Cameco Australia Pty Ltd. EL24936, consisting of 5 blocks for an area of 15.5 km², was granted on the 2nd September 2008. The license was surrendered on 17th August 2010.

Exploration for unconformity style uranium deposits during the period of tenure consisted of outcrop sampling to determine the uranium mineralising potential of the license.

The best result from the outcrop sampling was returned from sample C010692 of Mamadawerre Sandstone with 9.22 ppm U₃O₈. Sampling of the Nimbuwah Complex granites was returned a best result from sample SN080402 of 7.42 ppm U₃O₈.

The results from the sampling are not considered to be above the expected background values for the respective lithologies and no further work is warranted for the area.
TABLE OF CONTENTS

Summary.................................................................................................................................... i

Introduction .................................................................................................................................. 1
  Location and Access .................................................................................................................. 1
  Tenure ..................................................................................................................................... 1

Regional Geological Setting ...................................................................................................... 2
  Local Geology ........................................................................................................................... 4
  Exploration Target .................................................................................................................... 5

Previous Exploration .................................................................................................................. 5

Exploration During Period of Tenure ......................................................................................... 6
  Regional Outcrop Sampling and Reconnaissance .................................................................. 6

Results and Conclusions ........................................................................................................... 6

References .................................................................................................................................... 8

TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>Location of Samples Sites</td>
<td>6</td>
</tr>
<tr>
<td>Table 2</td>
<td>Sample Descriptions and Properties</td>
<td>6</td>
</tr>
<tr>
<td>Table 3</td>
<td>Outcrop Sample Structure Measurements</td>
<td>6</td>
</tr>
<tr>
<td>Table 4</td>
<td>Outcrop Sample Alteration</td>
<td>6</td>
</tr>
<tr>
<td>Table 5</td>
<td>Outcrop Sample TSA Clay Minerals</td>
<td>6</td>
</tr>
<tr>
<td>Table 6</td>
<td>Outcrop Sample Geochemistry Results</td>
<td>6</td>
</tr>
</tbody>
</table>

FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Stevens North Project (EL24936) Location Map</td>
<td>1</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Simplified geology of the Pine Creek Orogen showing the location of selected mineral deposits (after Pirajno and Bagas, 2008)</td>
<td>2</td>
</tr>
<tr>
<td>Figure 3</td>
<td>NTGS 1:500,000 Regional Geology</td>
<td>2</td>
</tr>
<tr>
<td>Figure 4</td>
<td>Local Geology of Stevens North Project</td>
<td>4</td>
</tr>
<tr>
<td>Figure 5</td>
<td>Location of Sample Sites</td>
<td>6</td>
</tr>
</tbody>
</table>

APPENDICES

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix 1</td>
<td>Cameco Standard Outcrop Sampling and Processing Procedures</td>
<td>6</td>
</tr>
</tbody>
</table>
INTRODUCTION

EL24936 (Stevens North Project) is a uranium exploration project in Western Arnhem Land, Northern Territory, operated by Cameco Australia Pty Ltd (Cameco). This report documents all exploration work completed by Cameco during the two years of tenure prior to surrender in August 2010.

The project area is underlain by granitic basement units of the Nimbuwah Complex which are unconformably overlain by Kombolgie Subgroup sandstone. The basement rocks and the Kombolgie Subgroup are intruded by sills and dykes of the Oenpelli Dolerite. Favourable structures and hydrothermal alteration occurs in the region with several uranium occurrences identified in the surrounding project areas, which are indicative of favourable uranium mineralising events.

Location and Access

EL24936 is located in western Arnhem Land, Northern Territory on the Millingimbi (SD-5302) 1:250 000 scale topographic map sheet and the Goomadeer (5673) 1:100 000 scale topographic map sheet.

The tenement is centred approximately 85 km northeast of Jabiru and 24 km east of the old Nabarlek mine site (Figure 1). Access is either by air to the Nabarlek or Mamadawerre airstrips, or by road via the Arnhem Highway to Jabiru and then via Cahill’s Crossing and unsealed roads towards Mamadawerre outstation.

Figure 1: Stevens North Project (EL24936) Location Map

The remote and rugged nature of the sandstone covering most of the Stevens North tenement resulted in 2008 exploration activities being helicopter supported. Helicopter access was based from a semi-permanent exploration camp located on Tin Camp Creek, named ‘Myra Camp’. Road access to Myra Camp is via the Arnhem Highway to Jabiru and bitumen road to Cahill’s crossing, then by dirt road via Oenpelli and Nabarlek.

In 2005, Cameco constructed a track linking Nabarlek to the back road into Mamadawerre from the Oenpelli-Maningrida Road, and then a track south passing through the western portion of EL24936. This track was closed out and rehabilitated in 2009.

Tenure

Application for EL24936, covering an area of 5 blocks for 15.4 km², was submitted on the 14th September 2005. The license was granted to Cameco on 2nd September 2008. EL24936 was surrendered on 17th August 2010, following two years of exploration.

The license is located within the Arnhem Land Aboriginal Reserve and is subject to an Exploration Consent Deed with the Northern Land Council (NLC) on behalf of the Traditional Owners. Stevens North contains areas that are sensitive or have cultural and/or social significance to the Traditional Owners, ‘No Go Areas’. These areas are excluded from exploration access and have been excised from the license.
The proposed exploration work was presented to the Traditional Owners and Northern Lands Council (NLC) at the Work Program Meetings held at Oenpelli. Clearance to conduct the program was given by the NLC on behalf of the Traditional Owners.

REGIONAL GEOLOGICAL SETTING

The Stevens North project area is located within the eastern margin of the Neoarchaean and Palaeoproterozoic Pine Creek Orogen, and is in a region that has been subdivided into the Nimbuwah Domain of the Alligator Rivers region (Figure 2).

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

This section 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 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: NTGS 1:500,000 Regional Geology

The oldest exposed rocks in the Alligator Rivers region are within the Neo-Archaean (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 Northern Territory Geological Survey (NTGS) and Geoscience Australia (GA) indicates that SHRIMP U-Pb age dating of an area of previously mapped Myra Falls Metamorphics outcropping within the Myra Inlier is Neo-Archaean in age (Hollis et al., 2009a). This quartzfeldspathic gneiss is now referred to as the ‘Kukalak Gneiss’ (Hollis et al., 2009b).

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 onlap Neoarchaean basement highs, with gneissic variants thought to pass transitionally 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 ‘hanging wall 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 migmatised 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 et al., 1999a; Sweet et al., 1999b). 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 Neo-Archaean, Palaeoproterozoic, and the Kombolgie Subgroup units, forming magnetic sills, dykes, lopoliths, and laccoliths. The Oenpelli Dolerite has a SHRIMP U-Pb baddeleyite date of 1723 ± 6 Ma (Ferenczi et al., 2005). Geochemical and geophysical data suggests 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, and northeast strikes, giving rise to the characteristic linearly dissected landform pattern of the Kombolgie Plateau. Another significant structural trend strikes east – west which 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. 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**

The geology of the region can be divided into two geological domains, a north-western domain of crystalline basement, bounded from the McArthur Basin sedimentary succession to the south-east by the north-east-trending Goomadeer Fault (Figure 3). The project lies at the western extremity of the main surface expression of the Nimbuwah Complex, which occupies coastal plains and escarpment country west of the tenement. It is likely that the boundary between Nimbuwah Complex granites and the high-grade metamorphics of the Pine Creek Orogen (i.e. the ‘transitional zone’ of the Nimbuwah Complex; ((Needham, 1988) is located just to the west of the tenement.

![Figure 4: Local Geology of Stevens North Project](image-url)

The transitional zone of the Nimbuwah Complex is represented by amphibolite to granulite facies pelitic to psammopelitic gneiss and migmatite of the Myra Falls Metamorphics. The NTGS 500 K scale GIS compilation for the Pine Creek Orogen specifies that these metamorphics belong to the Cahill Formation, based largely on geophysical character. However, this cannot be substantiated in outcrop by the presence of characteristic lithologies, suggesting the more general Myra Falls Metamorphics may be a more appropriate classification.

Sedimentary rocks of the Lower Kombolgie Subgroup (Sweet et al., 1999a) unconformably overlie (and obscure) basement in the central and eastern parts of the tenement (Figure 4). The basal formation, the 100-250 m thick Mamadawerre Sandstone, 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. Sandstone is quartzose to lithic and fine- to very coarse-grained with a variety of fluviatile to shallow high-energy marine bedforms, including trough and planar cross-beds (Ojakangas, 1979).

Mamadawerre Sandstone is unconformably overlain by the Nungbalgarri Volcanics. The contact is expressed locally as 100-500 m diameter sub 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 volcanic 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 Nungbalgarri Volcanics consist of multiple vesicular and amygdaloidal basaltic flows. The regional stratigraphic thickness of the volcanic unit is variable between 50 m and 130 m, however, it may also be locally absent (Carson et al., 1999).
Sills and dykes of Oenpelli Dolerite occur within basement in the Stevens North project area (Figure 4). In outcrop, the dolerite ranges from fresh magnetic coarse-grained subophitic dolerite to pervasively altered chlorite-hematite rock. The most visibly obvious structures in the tenement are deeply incised linear gorges of various orientation and significance, including fractures, joints and small faults.

**Exploration Target**

The focus of exploration in the Stevens North 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**

EL24936 lies within the area of historical AP 2046 and later EL243 which were explored by Queensland Mines Limited (QML) between 1970 and late 1973. No exploration work was conducted by Queensland Mines Limited in the EL24936 area as the focus of exploration was on basement inliers to the west.


EL2508 was granted to Queensland Mines Limited on the 29th of June 1988. Exploration focused on basement outcrop areas further to the west of the license. The area covered by
EL24936 was excluded from exploration access by heritage or cultural ‘No-Go’ zones. EL2508 expired in September 1998.

No other exploration work is documented for the area covered by EL24936 prior to granting of the license to Cameco on 2\textsuperscript{nd} September 2008.

**EXPLORATION DURING PERIOD OF TENURE**

EL24936 was granted to Cameco on 2\textsuperscript{nd} September 2008. Two years of exploration were conducted on the licence. The exploration programs have solely consisted of ground reconnaissance, sampling and mapping of the license area. The EL was surrendered effective of 17\textsuperscript{th} August 2010.

**Regional Outcrop Sampling and Reconnaissance**

Helicopter supported and ground based outcrop sampling, mapping and reconnaissance has resulted in 25 outcrop samples in total collected from the license area, with seven collected in the final year of tenure. Refer to Figure 5 for the location of the sample sites and a summary of the locations and lithologies is given in Table 1.

![Figure 5: Location of Sample Sites](image)

**Table 1: Location of Samples Sites**

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**

The following tables details the data and results from samples collected during the program.

**Table 2: Sample Descriptions and Properties**

**Table 3: Outcrop Sample Structure Measurements**

**Table 4: Outcrop Sample Alteration**

**Table 5: Outcrop Sample TSA Clay Minerals**

**Table 6: Outcrop Sample Geochemistry Results**

**RESULTS AND CONCLUSIONS**

The Mamadawerre Sandstone in the Stevens North project is characterised by several distinct 0.1 to 2 m thick conglomerate beds and several narrow (0.1 m) intervals of laminated fine-grained lithic sandstone beds within the overall quartz-rich arenite comprising the formation.
The Mamadawerre sandstone is weakly to moderately hematite altered / weathered and has been affected by diagenetic quartz overgrowth during post-depositional silica rich fluids. Strong red brown hematite is common along the sedimentary bedding and fracture planes.

Outcrop sampling returned a maximum uranium result of 9.22 ppm U$_3$O$_8$, from sample C010692 of cross bedded, hematite altered / weathered Mamadawerre Sandstone. This sample and others were in follow up of sample SN080409 which returned 7.42 ppm U$_3$O$_8$ from Mamadawerre Sandstone. These results, while weakly elevated for sandstone uranium content, are not considered to warrant any further work.

The basement Nimbuwah Complex granitoids are deeply hematite and clay weathered. In areas devoid of outcrop, termite mounds were sampled as these may provide an insight into the sub-surface geochemistry of the obscured geology with potential of identification of uranium anomalies related to mineralising processes in the underlying rocks. The uranium content, from analytical results, of the granitoids and termite mounts has returned a maximum of 6.54 ppm U$_3$O$_8$ with an average of 3.5 ppm U$_3$O$_8$. These results are within the expected background range for the Nimbuwah Complex granites. The termite mound sampling data set is very small, however the geochemical results are not anomalous within the current regional sampling data set.

The results from the exploration work are within expected background values for the sampled lithologies, and no further work is considered warranted for the area.
REFERENCES


Needham, R.S., 1988, Geology of the Alligator Rivers uranium field, Northern Territory, Bureau of Mineral Resources, Geology and Geophysics.


Ojakangas, R.W., 1979, Sedimentation of the basal Kombolgie Formation (upper Precambrian-Carpentarian), Northern Territory, Australia; possible significance in the genesis of the underlying Alligator Rivers unconformity-type uranium deposits, US Dept. of Energy.


Thomas, D., 2002, Reconnaissance structural observations: Myra-Kukalak Project, Arnhem Land, Northern Territory, Cameco Australia.