EL29830
Calvert Hills Project
Final Technical Report and Annual Report

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Tenements: Exploration License 29830 Calvert Hills
Map Sheets: 250,000 scale SE-5308 Calvert Hills
100,000 scale 6363 Calvert Hills
6262 Coanjula
6263 Surprise Creek
6362 Nicholson River

Period: Ending 01.02.2015
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Key Words: Uranium, Vanadium, Westmoreland Conglomerate
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CONTENTS

1. SUMMARY ................................................................................................................................. 1
2. INTRODUCTION .......................................................................................................................... 2
3. LOCATION AND ACCESS ......................................................................................................... 3
4. TENEMENTS .............................................................................................................................. 5
5. GEOLOGY .................................................................................................................................. 6
   5.1 REGIONAL GEOLOGY ......................................................................................................... 6
   5.2 LOCAL GEOLOGY ............................................................................................................... 6
6. PREVIOUS EXPLORATION ......................................................................................................... 12
   6.1 1960-1980 .......................................................................................................................... 12
       AP2299 – Planet Management and Research in 1972 ......................................................... 12
       AP3401, EL2111, EL886 – Esso 1972 ................................................................................ 12
       EL1235 – Mines Administration (MINAD) 1980 ............................................................. 12
       EL1339 – Mines Administration (MINAD) 1978 ............................................................. 13
   6.2 1980-1990 .......................................................................................................................... 13
       EL2111, EL2136 and EL2137 – AFMECO 1979-1981 .................................................. 13
       EL4342, EL4352, EL4359 and EL4360 – Ashton Mining 1983-1989 ............................ 14
       EL4438 and EL4470 – Stockdale Prospecting 1988 ....................................................... 14
   6.3 1990-2000 .......................................................................................................................... 15
       EL6916 – Caprentaria Exploration 1991 .......................................................................... 15
       EL7219 – MIM Exploration 1993 .................................................................................... 15
       EL8095 – Ashton Mining Ltd 1998 .................................................................................. 15
       EL9493 – Aberfoil 1998 .................................................................................................... 15
   6.4 2000-2006 .......................................................................................................................... 15
       EL9989, EL9990, EL9991, EL10350, EL10365 – Plenty River Corporation Ltd. 2002 ... 15
       EL22754 – Gravity Diamonds Ltd for Diamond Mines Australia Pty Ltd and Ashton Exploration 2005...... 15
   6.5 2006 TO PRESENT .............................................................................................................. 16
       EL27425, EL27426 and EL28166 – Universal Splendour Investments (USI) and Predictive Discovery Ltd.... 16
       EL26181 - Northern Australia Diamonds and Top End Uranium 2012 ................................ 16
       EL24645 - Lagoon Ck Resources Pty Ltd 2007–2012 ..................................................... 17
       EL28494 – Predictive Discovery Ltd 2012 ....................................................................... 18
       EL28568, EL28570 – Plasia Pty Ltd and Redbank Copper ............................................. 18
       EL24837 - Southern Uranium/Investigator Resources (SNU/IVR) 2006 to 2012 .............. 18
7. RECENT NEIGHBOURING EXPLORATION ............................................................................... 21
   7.1 TORO – EL28750, EL28751, EL28752, EL28054, EL28840, EL28806, EL28750, EL29476 ................................. 21
   7.2 UXA RESOURCES LTD and RIL AUSTRALIA PTY LTD – EL24565 ............................................ 21
   7.3 RIO TINTO - EL9414 .......................................................................................................... 22
   7.4 RIO TINTO MURPHY PROJECT ...................................................................................... 22
   7.5 BOND MINING (TRADING AS MURPHY URANIUM) – EL24694 ........................................ 22
8. METALOGENICS AND PROSPECTS ..................................................................................... 24
8.1 REGION OVERVIEW .......................................................... 24
8.2 URANIUM ........................................................................ 24
8.3 OTHER COMMODITIES ..................................................... 27
    Gold ............................................................................. 27
    Base Metals .................................................................. 27
    Diamonds ...................................................................... 28
    Manganese ..................................................................... 28
    Tin and Tungsten ........................................................... 29
    Phosphate ...................................................................... 29
8.4 CALVERT HILLS PROSPECTS .......................................... 29
    Vanadis .......................................................................... 29
    Molly ............................................................................ 31
    North East Ridge ............................................................ 31

9. EXPLORATION ACTIVITIES DURING TENURE ...................... 33
9.1 DATA REVIEW .................................................................. 33
    Drilling .......................................................................... 33
    Magnetic and Radiometrics ............................................ 39
    Gravity ........................................................................... 40
    Airborne Electromagnetics ............................................. 41
    Satellite Imagery ......................................................... 41
    Geochemistry - Chips .................................................... 42
    Geochemistry - Streams ................................................ 42
    Geochemistry - Soils ..................................................... 42
9.2 ROCKLAND FIELD VISIT AND COMMENTS ....................... 43

10. SUMMARY ......................................................................... 45
    10.1 PROJECT SCALE ASSESSMENT .................................... 46
    10.2 SURFACE GEOCHEMISTRY ....................................... 46
    10.3 DRILLING ................................................................. 47

11. CONCLUSION ..................................................................... 47

12. REFERENCES ..................................................................... 48
FIGURES

Figure 1  Regional Location of the Calvert Hills Project ................................................................. 3
Figure 2  Tenure with 1:250,000 Scale Auslig Topography and Prospects .................................. 4
Figure 3  Regional Geology and Calvert Hills Project (after Ahmad and Wygralak, 2014) ............ 6
Figure 4  Stratigraphic Section of the Westmoreland Conglomerate (after Ahmad and Wygralak, 1989) ...................................................................................................................... 9
Figure 5  Calvert Hills Simplified Project Geology and Drilling (after Ahmad and Wygralak, 2014)..... 11
Figure 6  AFMECO drilling Section Showing Thin Westmoreland Conglomerate between Seigal Volcanics and shallow Basement (after Orridge, 1980) .................................................................................. 14
Figure 7  Southern Uranium Drilling Section after Chand & Willott (2009b) .................................. 20
Figure 8  Schematic Geological Settings - Westmoreland-Murphy Region (after Ahmad 1987) ....... 26
Figure 9  Drill Hole Locations with Holes sized by the Depths (EOH) and Basic Lithology Summaries Tabulated ................................................................................................................................. 35
Figure 10  Geology (excluding young cover) overlying Magnetics (second vertical derivative) and Gravity (tilt derivative) with Inferred Geology and Structure .......................................................................................... 36
Figure 11  Same as previous figure with overlying TEMPEST Tau .................................................. 37
Figure 12  Sampling: Stream in Pink, Chips in Blue, Soils in Light Green and Niton pXRF (Dark Green) 38
Figure 13  Airborne Magnetic / Radiometric and Electromagnetic Survey Locations ....................... 40

TABLES

Table 1  Original Tenement Schedule for Calvert Hills Tenements ..................................................... 5
1. SUMMARY

This is the final annual and technical report for EL29830. The tenement was previous part of group report (GR327) for the Calvert Hills Project, consisting of EL29830, EL29831 and EL29835. The tenements were granted to Oz Uranium (NT) Pty Ltd, a wholly owned subsidiary of Rockland Resources Pty Ltd, in 2013. They are situated in the Calvert Hills locality approximately 150 km south of Borroloola in the Northern Territory. Rockland Resources is primarily exploring for Proterozoic unconformity style uranium deposits and local variants similar to the Westmoreland Deposits. The main work undertaken has been compilation of geophysics, geology, geochemistry and drilling. Some integrated targeting has been completed along with a brief field reconnaissance visit. Historical TEMPEST and an airborne magnetic/radiometric survey have been sourced directly from a previous explorer and submitted in the first annual report for the project (Beckitt, 2015).
2. INTRODUCTION

The tenements were granted to Oz Uranium (NT) Pty Ltd, a wholly owned subsidiary of Rockland Resources Pty Ltd, in September of 2013. They are situated in the Calvert Hills locality approximately 150 km south of the Borroloola (Gulf of Carpentaria) and approximately 100 km west of the Northern Territory - Queensland border. Rockland Resources is exploring for Proterozoic unconformity style uranium deposits and local variants similar to the Westmoreland Deposits. These deposits are hosted in the Westmoreland Conglomerates and Seigal Volcanics, breccia zones and fractured basement rock.
3. LOCATION AND ACCESS

ELs 29830, 29831 and 29835 are located within the Calvert Hills area of the Northern Territory, about 100 km west of the Northern Territory - Queensland border. The project is located 300 km north west of Mt. Isa and 150 km south of the Borroloola (Gulf of Carpentaria). A location map is presented below as Figure 1.

Mt. Isa is the largest town in the region having a population of over 20,000 people, and is a major mining centre. It is serviced by daily flights from Brisbane and is linked to adjoining areas by sealed roads, unsealed access routes and rail. Access to the project area is via the sealed Barkly Highway and then the Tablelands Highway to Calvert Road (dirt) which traverses the exploration licence area.

![Figure 1](image-url)  
**Figure 1** Regional Location of the Calvert Hills Project

The exploration licences are located on the Calvert Hills (SE53-08) 1:250,000 scale map sheet and on portions of the Calvert Hills (6363), Coanjula (6262), Surprise Creek (6263) and Nicholson River (6362) 1:100,000 scale map sheets.

The licences are located in remote, sparsely populated hilly country. Topographical features range from open woodlands in broad valleys containing ephemeral drainages to low rocky hills. Vegetation is dominated by open woodland Eucalyptus species and grasses. Average rainfall is variable but can be as
high as 800 mm/year during the 'wet season', which lasts from approximately November to April. Travel along unsealed roads is generally not possible during this time since watercourses are ephemeral. Maximum temperatures range from an average of 36°C in summer (wet season) to milder conditions in the winter months (dry season) averaging minimums of 19°C. Figure 2 shows the tenement outline overlying the Auslig 250,000 scale topography.

Figure 2  Tenure with 1:250,000 Scale Auslig Topography and Prospects
4. TENEMENTS

Exploration Licences EL29830, EL29831 and EL29835 were originally granted to Oz Uranium Pty Ltd (a wholly owned subsidiary of Rockland Resources Pty Ltd), on the 4th of September 2013 for a period of six years as summarised by Table 1. The tenements consisted of a total of 534 sub-blocks covering an area of 1,748.8 km$^2$. Group reporting status was granted as GR327 with reports ending 1st February. The tenements EL29830 and EL29835 were fully surrendered on the 4/8/2015, whereas EL29831 was only partially surrendered.

Table 1  Original Tenement Schedule for Calvert Hills Tenements

<table>
<thead>
<tr>
<th>EL</th>
<th>Name</th>
<th>Licensee</th>
<th>Sub Blocks</th>
<th>KM$^2$</th>
<th>Permit Period</th>
<th>Grant Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>29830</td>
<td>Calvert Hills</td>
<td>Oz Uranium (NT) Pty Ltd</td>
<td>249</td>
<td>815.6</td>
<td>6</td>
<td>04.09.2013</td>
</tr>
<tr>
<td>29831</td>
<td>Molly</td>
<td>Oz Uranium (NT) Pty Ltd</td>
<td>238</td>
<td>779.4</td>
<td>6</td>
<td>04.09.2013</td>
</tr>
<tr>
<td>29835</td>
<td>Nicholson</td>
<td>Oz Uranium (NT) Pty Ltd</td>
<td>47</td>
<td>153.8</td>
<td>6</td>
<td>04.09.2013</td>
</tr>
</tbody>
</table>
5. GEOLOGY

5.1 Regional Geology
The regional geology is depicted in Figure 3 and is best described by Ahmad and Wygralak (1989), Ahmad et al. (2013) and Polito et al. (2005). The Calvert Hills-Westmoreland region covers the south-eastern section of the Proterozoic McArthur Basin and the north-western section of the Proterozoic Mt Isa Block. The east-west striking Lower Proterozoic Murphy Inlier effectively separates these two major Proterozoic basins or domains. The Murphy Inlier comprises the Murphy Metamorphics, Cliffdale Volcanics and the intrusive Nicholson Granite Complex (Ahmad & Wygralak 1989, 1990; Ahmad 1998). Unconformably overlying the igneous and metamorphic rocks of the Murphy Inlier is the oldest unit of the Tawallah Group (1700-1710 Ma), the Westmoreland Conglomerate comprising a sequence (up to 1,800m thick) of locally derived fluvial arkosic conglomerate and quartz arenite (Rheinberger et al. 1998). This unit is conformably overlain by the Seigal Volcanics followed by the other upper Tawallah Group units consisting of dolomite, sandstone and basic and acid volcanics (Ahmad & Wygralak 1989).

![Figure 3 Regional Geology and Calvert Hills Project (after Ahmad and Wygralak, 2014)](image-url)

5.2 Local Geology
The local geology is based on a) the 1:250,000 scale map produced by Ahmad and Wygralak (2014), b) explanations by Ahmad and Wygralak (1989) and Ahmad et al. (2013), and c) integrated compilation of geology, drilling and geophysics. The majority of the project is covered by Cenozoic soils, unconsolidated sands and laterite. Cretaceous Carpentaria Basin outcrops in the north and western parts of the project consisting of siltstone, sandy siltstone, quartz sandstone and pebble and boulder conglomerates of the early Mullaman Beds. These overly the Cambrian Georgina Basin which outcrop further to the north and also within southern parts of the project, consisting of feldspathic sandstone, fine-coarse grained quartz sandstone, pebble to cobble conglomerates of the Bukalara Sandstone.
To the north of the project is the mid-upper sequences of the McArthur Basin Tawallah Group. The Sly Creek Sandstone is well exposed just north of the project. The sequence reaches a maximum thickness of 900 m in the Batten Range, on Bauhinia Downs. The Sly Creek Sandstone has a blanket-like geometry, and is characterised by lateral and vertical uniformity. The sediment consists of fine to medium grained, laminated sandstone, subangular to subrounded and well sorted, occasionally containing coarser bands with dark-purple, flat, clayey clasts. It gradually changes into the younger glauconitic sandstone of the Aquarium Formation to the north. To the east of the Calvert Fault it conformably overlies the carbonate rocks of the McDermott Formation, however, north of the Calvert Hill project it overlies Seigal Volcanics suggesting that in this area the McDermott Formation either lenses out or was eroded before the deposition of the Sly Creek Sandstone (Sweet and Slatter, 1975).

The Seigal Volcanics unconformably overlies the Westmoreland Conglomerate. The Seigal Volcanics does not outcrop within the project, however, it can be clearly inferred from the magnetics and there are a number of intercepts in the historical drilling up to 350 m (hole CHRCD001 by Southern Uranium). The unit consists predominantly of basic lavas, though minor tuff interbeds are also present. Numerous thin interbeds of siltstone and fine sandstone are also present and one sandstone interbed has been identified towards the Qld border called the Carolina Sandstone Member (up to 20 m thick). The lavas occur as flows, generally less than 20 m thick. The tops of the flows are finer grained than the centres and contain abundant vesicles filled with quartz, chalcedony, hematite and celadonite. Below the Carolina Sandstone Member the Seigal Volcanics are generally more massive and are dominated by basaltic flows but above it the volcanics consist of amygdaloidal basalt, tuffaceous siltstone, micaceous siltstone and agglomerate.

The Seigal Volcanics unconformably overlies Westmoreland Conglomerate, which is the basal arenites of the Tawallah Group of fluviatile origin (1600-1800 ma). The Westmoreland Conglomerate is reported to be up to 1,800 m thick and is divided into five fining-upward units termed Ptw1, Ptw2a, Ptw2b, Ptw3, and Ptw4 (Ahmad and Wygralak, 1989). Each unit comprises proximal fluvial deposits typical of debris flows, alluvial fans, and braided river systems that are overlain by medium to coarse grained, well-sorted sandstone (Wygralak et al., 1988; Ahmad and Wygralak, 1989). Breaks in sedimentation are indicated by angular unconformities or disconformities, with each new cycle of pebble or boulder conglomerate commonly defining the beginning of a new unit (Wygralak et al., 1988). Cobble and coarse sand grains within the basal conglomerate are dominated by reworked quartz veins, chert, and clasts of felsic to mafic volcanic rocks that were likely derived from the Murphy tectonic ridge or similar basement rocks that once existed to the north (Wygralak et al., 1988; Ahmad and Wygralak, 1989; Croaker, 1996). A west east section of the Westmoreland Conglomerate by Ahmad and Wygralak (1989) across the NT/Qld boarder shows the Ptw4 unit may lens out towards the west (Figure 4).

Within the project area government mapping (Ahmad and Wygralak, 2014) has identified isolated outcrops of Westmoreland Conglomerates broadly trending north west in the south east part of EL29830 and the east part of EL29831, along with the north part of EL29835. The mapping has not differentiated sub-facies, however, some differentiation has been made of units 2 km east of the project where several of the units outcrop. The outcrop within the project can be considered as two separate south east trending domains (sub-basins?), which come together in the north west but are apparently split by Seigal Volcanics in the south east potentially fault bounded. The north eastern Westmoreland
domain has a dip direction towards the south (Ahmad and Wygralak, 2014), which indicates the presence of an anticline consistent with inferred geology from the magnetics. Drill hole BEN-SD60 is located in the central part of EL29831 and is possibly located within the north east Westmorland domain. The hole has important implications for the project since it intersected only 15.68 m of Westmoreland Conglomerate between the Seigal Volcanics and Nicholson Granitic Complex, thus implying a large component of the Westmoreland sequence is missing with possible implications of a sub-basin. Elsewhere, drill holes within the project indicate the Westmoreland Conglomerate is likely to be greater than 300 m in thickness, however, these holes have not reached basement and the lithofacies has not been divided. Although not outcropping, the airborne magnetics readily identifies Seigal Volcanics as being prevalent throughout approximately half of the tenement which implies significant underlying sequences of Westmoreland Conglomeratic sequences.

Historical drilling within the project and the outcrop mapping has not subdivided the specific litho-facies units of the Westmoreland Conglomerate. This aspect still needs to be understood better, especially since most of the Westmoreland uranium mineralisation found to date is within the upper Ptw4 unit of the Westmoreland Conglomerate. Barry Willot initially worked for Rockland Resources and also previously worked for Investigator Resources. He states (pers. Comm. 2014) that “the second sub-unit of the Westmoreland Conglomerate (Ptw3) is cropping out in the southern part of EL29831. In addition, inspection of core photos from the NTGS core facility from previous explorer drillhole BEN-SD60 and knowledge of SNU drillhole CHRC001 confirms the presence of the Westmoreland Conglomerate Ptw4 sub-unit immediately below the Seigal Volcanics. Hematite and minor chlorite alteration together with weak radiometric anomalism has been observed in identical stratigraphic position to the Westmoreland deposits which is highly significant and provides a driver for future exploration.”
Westmoreland Conglomerates unconformable overly the Murphy Inlier basement rocks, which crop out in the southern part of the project within EL29835. The east northeast-trending Murphy Inlier of Early Proterozoic 'basement' rocks formed an intra-basinal high which separated the McArthur Basin from the Lawn Hill Platform and South Nicholson Basin throughout the Middle Proterozoic.

The Nicholson Granite Complex is part of the Murphy Inlier and intrudes the Murphy Metamorphics. It consists of porphyritic, medium to coarse grained biotite granitoids divided into two main groups according to Ahmad and Wygralak (1989). Group A “granodiorite” is an in-equigranular, coarse- to medium-grained hornblende and/or biotite-bearing granite, adamellite and granodiorite. Mafic xenoliths rich in hornblende, biotite and plagioclase are common including large K-feldspar phenocrysts, often up to 70 mm long. The groundmass includes quartz, plagioclase, perthite, hornblende and biotite with accessory sphene, apatite, zircon and monazite. Group B “granite” comprises equigranular biotite and/or muscovite-bearing adamellite, granite and alkali granite emplaced into the epizone. Hornblende is rare, mafic xenoliths and K-feldspar phenocrysts are usually absent. Myrmekitic quartz-K-feldspar intergrowths are common suggesting simultaneous crystallisation. Zircon, apatite and fluorite are common accessory minerals, sphene is rare. Drill hole BEN-SD60 indicates that the basement (likely Nicholson Granite) is present at shallow depths in the central part of the project and the majority of the remainder of the project’s basement rock type is unknown. The Clifdale Volcanics is also part of the Murphy Inlier, which is mapped 70 km to the east.
According to Ahmad et al. (2014) the Cliffdale Volcanics is also part of the Murphy Inlier which is coeval with the Nicholson Granite Complex and unconformably overlie the Murphy Metamorphics. The succession is over 4 km thick and comprises rhyolite, alkali rhyolite and dacitic lavas, ignimbrites and intrusions. Minor andesite and sedimentary intervals also occur within the succession. Orth (2009) has described the complicated relationship between the Nicholson Granite Complex and the Cliffdale Volcanics. At some locations, the Cliffdale Volcanics are intruded by granite and they even form roof pendants in the granite. Although the Cliffdale Volcanic has been mapped 70 km to the east of the project, the unit is inferred in southern and central parts of the project according to the magnetics, albeit extremely similar in response to the Seigal Volcanics.

According to Ahmad and Wygralak (1989) the Murphy Metamorphics are essentially a sequence of shale, siltstone, greywacke and volcanics deposited in geosynclinal conditions and metamorphosed to greenschist facies schist and gneiss. Two units have been mapped the first being a meta-pelite described as a metasiltstone and metashale, and the second is a meta-psammite described as immature metasandstone, poorly sorted, fine- to coarse-grained and micaceous. The rocks exhibit isoclinal folding along east west axes, dip vertically or steeply due north. Murphy Metamorphics lithologically resemble the Yaringa Metamorphics in the Mt Isa Block and the Burrell Creek Formation in the Pine Creek Geosyncline.

The Murphy Inlier sequence is intruded by both acid and basic dykes. The acid dykes are confined to the Murphy Inlier but the basic dykes extend into the younger McArthur Basin’s sequence and may be considerably younger and probably constitute feeders for the Seigal Volcanics (Sweet and others, 1981).

Wall (2006) describes the faulting at Westmoreland which is similar to that found at the Calvert Hills project. Generally shallowly dipping, the post unconformity succession forms broad open folds with west northwest and north south axes, respectively inferred to be the products of Isan D1 and D2-deformations. The north east and north west to north northwest conjugate fault sets are considered a regional network which developed at low strains, apparently in response to west northwest – east southeast directed compression, the faults transecting and postdating Isan D1 and D2 fold systems but in part reactivating older basement faults. The post-D2 (~1550Ma) timing inferred for Westmoreland uranium mineralisation is within the age brackets provided by Polito et al. (2005). The most well known fault in the region is the Calvert Hills fault which is oriented towards the north west and is located 44 km east of Rockland Resources project. At the Calvert Hills project the magnetics shows significant faulting (particularly oriented north west) which likely post-dates the Seigal Volcanics due to sharp terminations in the magnetics. Significant faulting is confirmed by holes CHRCDD002 and CHRCDD001 which implies a vertical offset of more than 284 meters – most likely due to a north west inferred fault from the magnetics.
Figure 5  Calvert Hills Simplified Project Geology and Drilling (after Ahmad and Wygralak, 2014)
6. PREVIOUS EXPLORATION

In the past decade basic uranium exploration has been undertaken in the area by SNU/IVR (Southern Uranium later named Investigator Resources), Top End Uranium, Bondi Mining (Trading as Murphy Uranium), Lagoon Resources, Predictive Exploration and Toro Energy. Esso, Mine Administration and AFMECO has also explored the region in the late 1970s and early 1980s. The primary focus of the exploration has been for Westmoreland style uranium (and gold). Significant exploration has also been conducted for diamonds and limited exploration has been undertaken for manganese, base metals and gold.

6.1 1960-1980

AP2299 – Planet Management and Research in 1972

AP2299 covers the majority of the Calvert Hills project and extends from Coanjula Creek in the east to Seigels Creek in the west. No open file reports are available on this work, however, Uawley (1974) states that uranium stream sediment anomalies were detected in areas of laterite-covered Westmoreland Formation in the headwaters of Coanjula Creek. These were apparently not followed up.

AP3401, EL2111, EL886 – Esso 1972

These licences are located just to the south of Calvert Hills project. In 1972 Esso held A to P 3401 which covers approximately the same ground as EL2111 (Old Benmara). They carried out an airborne radiometric survey with a line spacing of 300 m. A fluxgate magnetometer was also used but results were not compiled. Follow up was carried out with vehicle and helicopter borne scintillometry. High background radiometrics were recorded over laterites, Nicholson Granite and "phonolites" in the Benmara Beds but no significant uranium anomalies were detected.

Esso sampled all available water bores at Benmara (34 in total), some were down hole logged and drill cuttings were analysed where available. Highly anomalous uranium values were reported in several bores with values between 115 and 1,500 ppb U. However, subsequent rigorous check sampling by Mines Administration in 1978 did not confirm the anomalies and it seems that Esso's results were unreliable due to sampling or analytical errors.

A small area (EL886) of 26 square miles, covering "windows" of Benmara Beds south of Old Benmara, was prospected by T.W. Cawley in 1974. He reported high scintillometer counts of up to 30 x background in rhyolites but did not detect any mineralisation.

EL1235 – Mines Administration (MINAD) 1980

EL1235 was explored by Mines Administration (Mason, 1980) for uranium and clips the southern part of EL29835. Airborne radiometric and magnetic surveys led to the identification of four primary targets which were followed up by sampling, mapping, ground radiometrics, magnetics and alpha-meter surveys. Five diamond drill holes were completed on Anomaly I and a total of 69 (or 65?) percussion holes were completed on four anomalous areas. All radiation was associated with hematised fault
breccias with the mineralisation attributed to apatite and not to primary or secondary uranium. It is unknown what the best geochemistry results are.

Radon failed to identify any anomalies and neither sulphides nor copper mineralisation was identified. The Murphy Metamorphics were felt to be similar to the Pine Ck Geosyncline. Lower Proterozoic rocks were recommended to be assessed for carbonaceous units.

Extensive rock chip sampling, stream sediment sampling and drilling exists, however at the time of writing the locations could not be recovered.

EL1339 – Mines Administration (MINAD) 1978

EL1339 is just south of the Calvert Hill project. In 1978 Mines Administration explored EL1339 which covered the areas around New Benmara Homestead where Esso had reported anomalous bore waters. MINAD's target was sedimentary uranium in superficial sediments (Mesozoic to Quaternary). MINAD resampled all bores, and the waters were analysed by ACS Adelaide by fluorimetry. Only two bores proved to be weakly anomalous namely Benmara 12 and Benmara 3 which respectively contained 97 and 12 ppb U.

In addition, MINAD drilled 13 vertical holes (869 m in total) which were logged for gamma ray, SP and resistivity. The drilling was aim at identifying roll-front type uranium in channelling within the sedimentary section to the west of the Benmara metamorphic Block. The majority of Benmara bores drilled were less than 30 m deep. There were 5 BEN holes over 100 m deep. They concluded that the lack of a suitable sandstone section precluded the possibility of sedimentary uranium.

6.2 1980-1990

EL2111, EL2136 and EL2137 – AFMECO 1979-1981

EL2137 overlaps the southern parts of Rockland Resource’s EL19830 and EL29831, whereas EL2136 is off property to the west and EL2111 is off property to the south.

AFMECO Pty Ltd carried out a uranium search at the Benmara Project: EL's 2111, 2136 and 2137, from 1979 to 1981 (Orridge, 1980). In 1979 they undertook a magnetic and radiometric aerial survey as well as an aerial photography survey. They also carried out stream sediment and water bore sampling programmes. The radiometric survey showed an elevated response over the Nicholson Granite and laterite, but none could be related to uranium mineralisation. In 1980 they undertook ground magnetic surveys and drilling of a 2,422.6 m (1,010 holes). Most of the drilling was RC but diamond was used for holes BEN-SD60 and BEN-S100. Holes were analysed for Cu, Pb, Zn, U and Th. No anomalous uranium results were identified.

Only lithology logs for the deep drilling is available of which, Drill hole BEN-SD60 is within the Rockland Resources Calvert Hills project. This hole encountered: 7.5 m of Cover, 60.2 m of Cretaceous, 36.78 m of Seigal Volcanic, 15.68 m o Westmoreland Conglomerate and ended in Nicholson granite (at 140.8 m). A
drill section is included below as Figure 6, which shows the Westmoreland Conglomerate may be very thin in the area and that the basement is relatively shallow compared to other areas within the project.

![Figure 6](image.png)

**Figure 6  AFMECO drilling Section Showing Thin Westmoreland Conglomerate between Seigal Volcanics and shallow Basement (after Orridge, 1980)**

**EL4342, EL4352, EL4359 and EL4360 – Ashton Mining 1983-1989**

EL4360 and EL4359 cover the southern portions of the Cavert Hills project. Ashton Mining Limited explored the Coanjula Project between 1983 and 1989 for diamonds (and partially gold) at EL4342, EL4352, EL4353, EL4359, EL4360, EL4361, EL4372 and EL4374. At the project there has been airborne magnetics, airborne input electromagnetics, photo interpretations, gravel and loam sampling, diamond drilling (13,000 m), RAB drilling (38,500 m) and drill spoil sampling (5,000). Twenty one small intrusive pipes were located but none are diamondiferous (Ashton, 1985).

Of the diamond and RAB holes drilled by Ashton Mining, the following holes are within the Rockland Resource’s Calvert Hills project: DDH-CJ21, DDH-CJ22, DDH-CJ23 and DDH-CJ27. Drill hole CJ21 is within EL29830 and appears to have intersected approximately 30 m of volcanics (i.e Seigal Volcanics) with possible Cambrian sandstone (i.e Bukalara Sandstone) above and Proterozoic sandstone (i.e Westmoreland Conglomerate) below, but did not reach basement. Whereas holes CJ22-23 located 1.4 km to the north west did not intersect the Seigal Volcanics and intersected Cambrian sandstone (i.e Bukalara Sandstone) overlying Proterozoic sandstone (i.e Westmoreland Conglomerate) and ending in basement igneous rocks (i.e Nicholson Granite).

**EL4438 and EL4470 - Stockdale Prospecting 1988**

EL4438 (Joyce, 1990) overlaps the eastern third and EL4470 overlaps the northern part of the Calvert Hills project. Stockdale Prospecting undertook some sampling, airborne magnetics and also drill tested several magnetic anomaly with RAB drilling for diamond indicators (Berryman, 1989a and 1989b). Several of the holes are within Rockland Resource’s Calvert Hills project. The holes were all RAB and for the most part did not penetrate through the cover sequences. Hole W12-H1 did penetrate cover but ended at a depth of only 20 m within sandstone. Several other holes do not have down hole lithological logs available.
6.3 1990-2000

EL6916 – Caprentaria Exploration 1991

EL6916 covers the southern part of EL29835. The tenement was explored by Caprentaria Exploration for one year (Hitchman, 1991) focussed on gold exploration utilising stream sediment sampling and rock chips sampling, which failed to identify any significant results.

EL7219 – MIM Exploration 1993

EL7219 covers the western half of the Calvert Hills project (esp. EL29830) and is discussed by Bruce (1993). Stream sediment sampling was carried out for gold and base metals. MIM reprocessed and interpreted previous magnetics by Ashton Mining Ltd and flew a 500 m spaced Geotem II (CR19930785) and magnetic survey in 1992. Follow up geophysics (4 line km) consisting of resistivity and ground magnetic traverses were carried out over an interpreted fault but failed to identify a target. It is noted that the GEOTEM survey covers the Molly prospect.

EL8095 – Ashton Mining Ltd 1998

EL8095 covers the eastern part of the Calvert Hills project. A total of 82 stream samples were collected where several returned positive results for microdiamond and chromite (Kammermann, 1998). Follow up sampling failed to identify any commercial diamonds and exploration was not continued despite the anomaly not fully being explained.

EL9493 – Aberfoil 1998

EL9493 covers the north western half of the Calvert Hills project. Henry (1998) explains: “The tenement was pegged to explore for Zn-Pb-Cu mineralisation in the Middle Proterozoic lithologies of the McArthur Basin. It was felt that Aeromagnetic (public domain data) interpretations suggest continuation of regionally important structures into these tenements. If these structures come into contact with favourable lithologies, sediments of the McArthur Group, the main ingredients for a SEDEX style base metal deposit are present (Henry, 1998). Work completed on the tenement in the two years to May 30, 1998 centred around a major airborne Geotem survey. Selected areas within EL9493 were covered, at the inferred intersection of two regional structures. No highly rated EM conductors were interpreted from the data.” This GEOTEM data was not able to be sourced from the NTGS.

6.4 2000-2006

EL9989, EL9990, EL9991, EL10350, EL10365 – Plenty River Corporation Ltd. 2002

EL9990 is within the southern part of EL29830 and the remaining tenure is off property. The tenements were explored for diamonds by Plenty River Corp, however, the only work carried out was a Landsat TM interpretation by Earth Scan.

EL22754 – Gravity Diamonds Ltd for Diamond Mines Australia Pty Ltd and Ashton Exploration 2005
EL22574 covers the majority of EL29831. EL2574 was operated by Gravity Diamonds (2005) who identified numerous anomalies using sampling methods for diamond kimberlites, but were of low priority and never fully followed up. Falcon gravimetry was flown on other tenure to the north and west of EL2574. CRAE and Ashton had collected a large number of surface samples from within the larger McArthur Diamonds Project area, however, the sampling density in EL22754 was substantially less than for most of the project area. A large area within the license was not tested with any form of sampling. No major diamond prospects have been identified but there are several interesting indicator mineral occurrences and clusters that remain for potential follow up.

6.5 2006 to Present

**EL27425, EL27426 and EL28166 – Universal Splendour Investments (USI) and Predictive Discovery Ltd**

EL27425, EL27426 and EL28166 were explored for manganese by Universal Splendour Investments (USI) as Group (GR228) covering the north east 1/3 and eastern parts of the of the Calvert Hill project (Lovegrove, 2012). A review of their entire Gulf tenement package rated these tenements low and no on ground exploration was carried out apart from a few limited rock chips.

In 2011 Predictive Discovery signed a farm-in agreement with Universal Splendour Investments for uranium along with copper, gold and rare earths rights for EL27426. Target identification for uranium was based on processed aeromagnetics and geology. A ground gravity survey was conducted on one selected target area to assist with 3D models of the geology. The ground gravity survey was conducted by Haines Surveys Pty Ltd, based in South Australia.

A total of 5 RC holes (for 323 m) was drilled along a north south transect within EL27426. A total of 10 samples were collected consisting of 5 metre composite RC chips. All drilled samples were measured for radioactivity. No anomalous mineralisation was detected in any of the drilling. In each of the holes Predictive Discovery intersected sandstone above dolerite which constituted the end of the hole. Although no stratigraphic interpretation was provided, it seems possible that the drilling intersected sandstone units above the Seigal Volcanic (i.e. Bukalara Sandstone, Sly Creek Sandstone or Mullaman Beds) and failed to test the Westmoreland Conglomerates below the Seigal Volcanics, which was the reported drilling target?

**EL26181 - Northern Australia Diamonds and Top End Uranium 2012**

EL26181 covers the northern 1/3 of Rockland Resource’s EL29830 and EL29831. EL26181 has been explored for diamonds by North Australian Diamonds Ltd. and then in 2009 for uranium by Top End Uranium (TEU). Kammermann, (2012) states: “TEU commenced exploration for buried uranium mineralization Of the Westmorland style by way of a RadonX survey in 2009. This reconnaissance survey identified anomalous Radon responses associated with some of the targeted structures which were interpreted to intersect the underlying Seigal Volcanics/Westmoreland Conglomerate unconformity. During the previous reporting period 311 geochemical soil samples were taken from areas identified by the RadonX survey. A small loam sampling program was undertaken to test the surface for uranium indicator minerals with one loam sample collected. A geochemical sampling program was also undertaken to test changes in the geochemical response with depth using the enzyme leach analytical method with 151 samples being collected.”
There is no interpretation presented by the annual or final report, however, the surface rock chip samples have been reviewed by Rockland Resources and are not anomalous. Radon X results have not yet been reviewed.

**EL24645 - Lagoon Ck Resources Pty Ltd 2007–2012**

EL24645 (Benmara Project) overlaps the eastern 1/3 of Rockland Resources EL29831 and EL29835. The exploration was shared as a Joint Venture between Lagoon Resource Pty Ltd and Predictive Discovery Pty Ltd, primarily focused on the discovery of uranium as discussed by Lagoon Resources (2012):

“In 2008, field work was undertaken with an initial focus on geological outcrop mapping running alongside a stream sediment, soil, and rock chip sampling program. Additionally, a scintillometer (radiometric) survey was completed over potential targets. The focus in EL24645 was to concentrate sampling in two specific areas to test for potential mineralisation associated with the intrusive Nicholson granite complex. The fieldwork was carried out in August 2008 by a 6-man team over a period of 12 days. During 2008, The Aboriginal Areas Protection Authority, on behalf of Lagoon Creek Resources, conducted a search within the area in order to identify any areas of significant cultural importance to Traditional Landowners. During 2009 work was curtailed due to the uncertainty for corporate financing resultant from the Global Financial Crisis. A MMP was lodged and drilling scheduled for late in 2009 to test upper Westmoreland unconformity targets. This drilling was postponed due to access difficulties caused by wet conditions. A further 6 soil samples were taken from the vicinity for reference purposes Switzer Geological Consultants undertook a desktop study of EL24645. The study involved an interpretation of the existing geological data and UTS airborne magnetic survey to interpret the covered Westmoreland – Siegals unconformity and the basal Westmoreland unconformity and fault geometries.

Work by Predictive Discovery to November 2010 consisted of geophysical data analysis, gravity surveys and geological mapping. This was focused on obtaining the required information in order to plan drilling for concealed Westmoreland-style targets beneath Cambrian and Recent cover in the northern half of the EL. Ground gravity surveys were conducted on two selected target areas. These were designed to provide another potential field data set to complement the existing high resolution aeromagnetic data in order to enable construction of representative 3D models of the geology in the target areas. Examination of this data by Predictive Discovery’s geophysical consultant, Bob Smith, has indicated that magnetic remanent effects are strong. The purpose of the survey was therefore to use a different method to help interpret the location of high density dolerite and/or Siegal Volcanics and determine the shape of their contacts. Geological mapping was conducted by Mark Winterbotham of Satellite Mapping, a Cairns-based consultancy, and the ground gravity survey by Haines Surveys Pty Ltd, based in South Australia.

Targets were based on geophysical interpretation of aeromagnetic and gravity data, (described in the previous annual report) and were selected to provide optimum likelihood of intersecting the contact zones between Westmoreland Conglomerate (Ptw) and mafic intrusive/extrusive rocks of the Seigal
Volcanics. Pilot holes were drilled vertically in all areas as a precursor to angled holes to determine the depth of overlying sediments (Clb – Bukulara Sandstone) and adjust collar positions accordingly.

Work completed by Predictive Discovery from November 2010 to November 2011 consisted of drill target selection, drilling and assay. A total of 12 holes were drilled and 66 samples were assayed. All drilled samples were measured for radioactivity. No mineralisation was detected. Despite drilling through numerous contacts between sediments and mafic intrusives or lavas, there has been no anomalous uranium or gold detected. No anomalous radioactivity was detected during the campaign. Samples of the most interesting looking sulphidic (pyrite veinlets and sulphide blebs) core reported assays of no interest. Further drill targeting will require a reassessment of all the available geophysical and geological data."

There were 1,165 RC percussion metres drilled in 12 holes of which four were pre-collars for diamond tails. Diamond core drilling consisted of 549 metres of NQ in these four holes. The drilling by Predictive Discovery is between Rockland Resources EL29813 and EL29835 at three locations. At Location B1 and B2 the hole intersected Bukalara Sandstone, Seigal Volcanics and ended in Westmoreland conglomerate; whereas B3 intersected Bukalara sandstone overlying Westmoreland Conglomerate without Seigal Volcanics. The holes did not intersect basement and were drilled to a maximum depth of 312 m.

**EL28494 – Predictive Discovery Ltd 2012**

EL28494 is a small licence in the bottom corner of EL29831 explored by Predictive Discovery Ltd for uranium and gold. The licence was applied for based on synergies with the adjoining EL24645; however, the lack of exploration success at EL24645 resulted in dropping the licence before any work was carried out.

**EL28568, EL28570 – Plasia Pty Ltd and Redbank Copper**

EL28568 and EL28570 are within eastern portions of the Calvert Hills project. Schwann (2012ab) explains that “The Redbank South Area was acquired by Plasia Pty Ltd (Plasia) as a copper study identified good structure and geology with previous exploration indications of mineralisation in the area. 39 graticular blocks was identified from the authors experience at the Redbank Mine and Company some 6 years ago. The intention was to fly the area with Hyvista Mineral Mapping to look for alteration similar to the pipes at Redbank.” A JV was formulated between Plasia and Redbank Copper, however, in 2011 Redbank Copper went into receivership. The tenements were relinquished without any on-ground work or the planned flying of Hymap.

**EL24837 - Southern Uranium/Investigator Resources (SNU/IVR) 2006 to 2012**

EL24837 spans the southern half of Rockland’s EL29830 and EL29831. Southern Uranium changed their name to Investigator Resources in 2011. Willott (2011) and Ion (2013) describes the previous exploration:

“The Northern Territory Geological Survey (NTGS) Geophysics and Drilling Collaboration 2009 program co-funded the initial drill testing of the Westmoreland style targets. The program consisted of (4) RC pre-collared
diamond drill holes totalling 1,218 metres that were completed in August 2009 at the Big Foot Prospect. The holes were successful in intersecting the target Westmoreland Conglomerate and Seigal Volcanics, although no uranium mineralisation was identified. Three vertical holes were down hole gamma logged, which detected slight anomalism in clay altered zones within the medium to coarse sandstone units. The fourth hole angled at −60° had to be abandoned short of the target due to the intersection of a confined aquifer which created difficult drilling conditions.

In addition, further reconnaissance mapping and sampling was conducted to investigate the northeast trending structures and follow-up of anomalous rock chip sampling carried out in Year 3. A further eighteen (18) rock chip samples were collected mostly over the north eastern portion of the tenement which confirmed the earlier discovery of economic grade vanadium cropping out at the Vanadis Prospect. The outcrop extent of Vanadis was preliminarily mapped to 250m² with a portable XRF and handheld GPS. A petrographic analysis was also conducted on selected high grade samples from the Vanadis Prospect to confirm and identify the host rock type. The rock samples were described to be a regolith product, but the high levels of vanadium present in this geological setting remains enigmatic.

Work carried out in Year 5, following recognition of the Vanadis Prospect, consisted of a detailed targeting exercise to assess the multi commodity (including uranium) potential of the Calvert Hills project area at the start of the reporting period. This involved a regional and project scale synthesis of all available geophysical data (also including new regional NTGS gravity data), assessment of previous explorer geochemical sampling and a revision of previous geological interpretations. Six highest priority areas were identified and these areas were considered highest priority for field investigation in the 2010 field season.

Five of these six areas (Vanadis, CJ1, CJ2, Molly and Northeast Ridge at Area 5) were visited in the field by SNU/IVR in early-mid October 2010. Work comprised detailed geological mapping (Vanadis), portable XRF (Niton) surveying and orientation geochemical sampling at the selected prospects. An orientation geochemical survey was also carried out from samples of surface ferruginous lag and soil at Molly, CJ1 and CJ2 prospects.

Following assessment of the most recent exploration work carried out by SNU/IVR on EL24837 and a reappraisal of our exploration strategy, three (3) areas, Vanadis, Molly and Northeast Ridge prospects are recognised as being highest priority and prospective for uranium, base metals and precious metals ± platinum group metals.

During Year 6 of EL24837, following a review of its exploration priorities, Investigator reported to the Calvert Hills JV that it intended to seek expressions of interest from potential new JV partners or purchasers. Investigator Resources at that time was changing their exploration focus to South Australia to concentrate on the Paris high-grade silver discovery and had changed its name from Southern Uranium. Although there was some initial interest, potential third parties declined to take the matter further. Investigator then advised Uranium West that it wished to dissolve the Calvert Hills JV and it left the decision to Uranium West as to whether to apply for the Renewal of EL24837. After discussion, Uranium West decided to take on the management of EL24837.

In 2012 Uranium West carried out only limited compilation of the IVR data before a significant corporate and shareholder change resulted in a revision of strategy in its parent company. On 30th November 2012, Focus Minerals Limited, the parent company of Focus Minerals (Laverton) Limited (formerly
Crescent Gold Limited of which Uranium West is a wholly owned subsidiary), announced that shareholders had approved a fund raising placement to Shandong Gold International Mining Corporation Limited. On 21st December, Focus Minerals announced completion of the placement that saw Shandong Gold become a 51% shareholder. Initial use of the funds was planned to be targeted on the company’s gold assets and to compliment this strategy a decision was made prior to the placement to divest some non-gold projects, including EL24837. EL24837 was surrendered on 14th December 2012.”

The drilling results are discussed by Chand & Willott (2009b) and their drill section is reproduced in Figure 7. All holes ended in Westmoreland Conglomerates without reaching basement. Although hole CHRCD002 did not intersect basement it did have the thickest intercept of Westmoreland Conglomerate of 300 m. Based on the drilling a major fault offset has been interpreted of more than 284 meters. It is noted that a shortly after the drilling a fire destroyed the core which was supposed to be provided to the NTGS. No anomalous uranium was identified by the drilling.

![Figure 7 Southern Uranium Drilling Section after Chand & Willott (2009b)](image-url)
7. RECENT NEIGHBOURING EXPLORATION

7.1 Toro – EL28750, EL28751, EL28752, EL28054, EL28840, EL28806, EL28750, EL29476

In the years leading up to 2013/14 Toro Energy has been exploring for uranium at the Benmara Project: EL28750, EL28751, EL28752, EL28054, EL28840, EL28806, EL28750 and EL29476. These licences are to the south of the current Calvert Hill project, and in particular EL29476 immediately adjoins the Calvert Hills project. Most licences have been dropped due to budget constraints. There is a surrender report for EL28806 and EL29476 by Trandy, (2014):

“A reconnaissance visit took place during 2012 to determine ground conditions and access to proposed drill lines/targets. This was a worthwhile exercise, as many tracks and fences were in disrepair or had been shifted, thus would have an impact on future works. The pastoralist at Benmara Station was quite helpful as well. He reminded us of the Coanjula Diamond Project corestack that resided within our licences. This stack was visited and a rough inventory done; details were then sent to NTGS for their appraisal of what to do with the valuable resource.

While Toro has not conducted any drilling on the two tenements being surrendered it has analysed previously recovered core from two locations to assess these tenements for their suitability for uranium prospecting. Minor uranium anomalism was identified in the Mine Admin core (max 332 ppm), within the thermal aureole of a Nicholson Granite pluton, confirming historic assay results. U is likely refractory skarn type and not of great interest as a genuine target.

The best assay result in the Benmara historic core is 332 ppm U over 0.7 m, in BDH5. This is accompanied by elevated phosphate. With declining budgets in a difficult uranium market, Toro recommends focussing exploration on higher priority targets to the south and so consequently, Toro has decided to rationalise the tenure, including relinquishment of ELs 28806 and 29476.”

7.2 UXA Resources Ltd and RIL Australia Pty Ltd – EL24565

EL24565 adjoins Rockland Resource’s Calvert Hills project immediately to the east. It was maintained as a granted tenement in 2015. The commodity being sort is most likely uranium. UXA Resources is in receivership and the status of RIL Australia company is not known (India’s largest company, Reliance Industries). On the Proactive Investors Australia web site (dated June 19, 2012) it states that: “UXA has identified strong uranium channel anomalies following the completion of a 5,900 line km airborne radiometric and aeromagnetic survey. These anomalies will be analysed prior to the start of a field program, which will include ground checking and geochemical follow-up to identify drill targets.”
7.3 Rio Tinto - EL9414

EL9419 adjoining Rockland ground immediately to the south east. The exploration rationale is unknown but perhaps is focussed on diamonds rather than uranium?

7.4 Rio Tinto Murphy Project

Rio Tinto’s Murphy uranium project is located 40 km to the east of Rockland Resources Calvert Hills Project. The Murphy Project is part of a JV with Laramide Resources who own the Westmoreland Deposit.

7.5 Bond Mining (trading as Murphy Uranium) – EL24694

EL24694 was explored by Bondi Mining trading as Murphy Uranium Pty Ltd, which adjoins Rockland Resource’s Calvert Hills project to the west. The project includes a number of other tenements stretching further to the west as far as the Stuart Hwy (ELs 24694, 24841, 25708, 25709, 25710, 26138, 26139, 26140).

EL24694 was relinquished in 2012 and is discussed by Esser (2012 and 2013): “This exploration license was acquired because it is considered to have good potential for hosting unconformity type uranium deposits, similar to those located in the Alligator Rivers Uranium Field at the northern end of the McArthur Basin and sandstone hosted uranium mineralisation, similar to the Westmoreland deposit located to the east in Queensland. Concealed southern extensions of the highly prospective Emu Fault Zone are also interpreted to transect the area. Bondi Mining has been carrying exploration on this tenement since acquiring the licence from Buffalo Gold in 2007. This work has included geological and geophysical interpretations with targeting, alpha track sampling over major faults zones, Ionic leach soil sampling, close spaced RAB drilling over alpha track anomalies and wide spaced RAB drilling targeting phosphate deposits in the Georgina Basin limestone. In 2009 three RC holes were drilled on anomalous uranium in soils targets. In 2010 part of a GEOTEM survey designed to locate conductive hosts for uranium mineralisation in the Proterozoic basement, was flown over part of the EL. Exploration activity during the 2011 field season included an environmental audit and drill hole rehabilitation. No significant uranium mineralisation was located on EL24694 during the period of tenure and the geophysical and geochemical techniques used are not considered effective in locating uranium mineralisation under cover in the Proterozoic basement. However, much of this lease, particularly to the south-east appears to be ‘floored’ by the Nicholson Granite and therefore is not an attractive target. Due to the low prospectivity of the granite and the high cost of exploration under cover the decision was taken to let the EL lapse. There are a number of geological targets defined by Haynes that have not been tested (Esser, 2010).”
“Exploration during the 2012 to 2013 field season included an RC / diamond drilling program at the UC19 prospect to test ground TEM anomalies (defined in 2012) soil geochemical anomalies and extensions to low order Cu - U mineralisation defined by RC/ diamond drilling in 2009. The program consisted of six (6) drill holes (MURD017 - 022) for a total of 2,485.2m (449.5m RC and 711m diamond) and 90 samples for analysis. Down hole TEM was conducted on MURD017 to test for an off-hole conductor and down hole gamma log surveys were conducted on all the drill holes to test for uranium mineralisation. No conductor was detected and maghemite within 20m of surface, which is a super ‘para-conductor’, is interpreted to explain the conductive response in the ground EM survey. The 2012 drilling did not define any uranium, Cu or Au mineralisation and has adequately tested the TEM anomaly, which was associated with maghemite and not sulphides. There is no encouragement at the UC19 prospect for follow-up drilling, and previous ‘Track etch’ and Ionic leach geochemical anomalies adjacent to the NW trending fault have proved unreliable. On this basis the Murphy joint venture partners; Uranium Pty Ltd and JOGMEC have decided to surrender EL24841. If a low cost, effective exploration technique for buried uranium targets is developed in the future then this region will again be prospective. However, at this point in time Murphy Uranium believes deep drilling (greater than 200m) of geophysical, or geological, targets to be a high risk strategy with limited chance of success.”

The drilling, magnetics/radiometrics and GEOTEM are all beyond Rockland Calvert Hills project and have therefore not been compiled or reviewed.
8. METALOGENICS AND PROSPECTS

8.1 Region Overview

“The McArthur Basin is one of the most significant base metal provinces of Australia and forms part of the Carpentaria Zinc Belt, extending from Mount Isa in the south to Milingimbi in the north. A number of world-class base metals deposits are known from this belt, including Mount Isa, Hilton, George Fisher and Century in Queensland and McArthur River (formerly HYC: ‘Here’s Your Chance’) in the Northern Territory. The McArthur Basin hosts over three hundred mineral occurrences, but significant mining activity has taken place only at McArthur River, Merlin and Redbank. Mineral commodities include base metals (lead, zinc, silver, copper), uranium, iron ore, manganese, barite and phosphate. Diamondiferous kimberlite pipes (Merlin, AB021 and E.Mu) intruded the succession during the Palaeozoic. Deposit types include:

A. Stratiform, sedimentary base metals deposits hosted in pyritic organic rich shale and siltstone eg McArthur River;
B. Stratabound, discordant base-metals deposits, eg Coxco, Cooley and Ridge;
C. Copper-bearing breccia pipes, eg Redbank;
D. Copper in shear zones and veins;
E. Uranium deposits within sandstone or volcanic rocks, eg Westmoreland deposits;
F. Stratiform oolitic ironstone occurrences within the Sherwin Formation eg Roper River iron ore;
G. Irregular manganese occurrences associated with the Karns Dolostone and Echo Sandstone, eg Calvert Hill deposits;
H. Sedimentary phosphate occurrences within the Echo Sandstone/Karns Dolostone; and
I. Hard-rock heavy-mineral concentrations in dolerites, and associated eluvial and colluvial deposits.” (Ahmad M, et al., 2013)

8.2 Uranium

The primary exploration target at Calvert Hills is for unconformity uranium. The Westmoreland uranium deposits (Redtree, Junnagunna and Huarabagoo) are considered this style and are associated with the eastern extension of the Westmoreland Conglomerates 100 km from the Cavert Hills project within Qld. The deposits have a total combined TSX compliant (NI 43-101) resource of 51.9Mlbs U₃O₈ (including 36Mlbs U₃O₈ Indicated), with an average grades of around 0.089% U₃O₈. The Westmoreland deposit is also noted for its locally high grades, with results of up to 10 m at 0.66% U₃O₈ (WDD08-096) and drill core studies confirming the presence of a high proportion of metallurgically favourable uraninite in the ore zones. A majority of uranium occurrences are auriferous and carry free gold as well as PGEs.

The main Westmoreland deposits are located along the north east trending Redtree dyke zone dated at 812 ± 55 Ma and hosted by the Westmoreland Conglomerate. Most of the uranium mineralisation found to date is within the upper Ptw4 unit of the Westmoreland Conglomerate, an 80-90 thick, partly conglomeratic, porous, coarse grained sandstone sub-unit. It has previously been identified that the primary conduits for the uranium bearing fluids are the major north east structures and migration of uranium-bearing fluids away from the structures is controlled mainly by the porosity of the host sediments. This mineralisation model involves precipitation of uranium oxide adjacent to mafic rocks when oxidising fluid is reduced upon reaction with iron bearing minerals such as hornblende and biotite releasing Fe²⁺ into solution, reducing the uranium in solution and then precipitating hypogene uraninite and hematite. The primary source of uranium is debatable in this model and other models have been proposed. More recent workers, e.g. Polito et al. (2005) invoke a diagenetic model involving circulating
basinal brines forming uranium deposits in structural and chemical traps with initial fluid migration as early as 1680 ± 18 Ma, continuing beyond 1645 ± 40 Ma and later overprinted at ca. 878 Ma. The disparity between these models remains problematic, but what is certain is that there has been hydrothermal remobilisation from probable deep-seated sources, where uranium has been introduced to migrating fluids which later precipitated uranium ore minerals and alteration phases related to physico-chemical barriers or in permissive sedimentological environments adjacent to favourable northeast trending structures.

Polito et al. (2005) draws genetic links between the Westmoreland deposits in the south east part of the McArthur Basin and the larger Alligator Rivers Deposits in the north west part of the McArthur Basin. Apart from size, a major difference is that the latter are hosted within Proterozoic basement rather than volcanics or sandstone. It is proposed that the absence of major uranium deposits in the Westmoreland basement or around the unconformity is most likely is due to limited local sources of reductants since the basement primarily consists of felsic metavolcanic and granitoids (Cliffdale Volcanics and Nicholson Granite).

Ahmad (1987) classified the Westmoreland uranium occurrences on both sides of the Northern Territory–Queensland border into five types, based on their hydrological and geological settings (Figure 8). Within each class, the Westmoreland Conglomerate was considered to be the most permeable unit:

- **Type A:** At the reverse-fault contact between the Cliffdale Volcanics (hangingwall) and Westmoreland Conglomerate (Type A1), or at the contact between the Seigal Volcanics and the conformably overlying Westmoreland Conglomerate (Type A2).
- **Type B:** Near a contact between impermeable vertical mafic dykes and the Westmoreland Conglomerate.
- **Type C:** Hosted by the Cliffdale Volcanics, beneath an exhumed unconformable contact with the overlying Westmoreland Conglomerate.
- **Type D:** Hosted by fractures in the Seigal Volcanics, at some distance above the contact with the Westmoreland Conglomerate.
- **Type E:** Hosted by the Murphy Metamorphics.

In all the models, reduction of oxidised fluids carrying uranium was interpreted as the principal method of ore formation. This mechanism would certainly explain Type A and Type B occurrences, but not Type C and Type D. Eva (Type C) is hosted by alkali rhyolitic volcanic rocks, which are not reducing. However, a model similar to that for Coronation Hill (Mernagh et al. 1994) could be invoked, in which K-feldspar-bearing rocks caused uranium precipitation by neutralising an acidic mineralising fluid. Type D occurrences are more difficult to explain in the same model, but presumably, pre-existing fractures in the Seigal Volcanics allowed fluids to access a higher stratigraphic level before being reduced.

It is interesting to note that Ahmad (1987) states that “The mineralised areas, in most cases, are situated along the presumed groundwater discharge sites”. Hence finding springs and undertaking radon/Pb isotopes on the springs may be important for exploration.
Ahmad et al. (1989) presents the geochemical analysis of random ore samples from Westmoreland deposit：“Strong enrichment in vanadium and copper is apparent; silver and gold are present in most of the samples and might be an important by-product of uranium mining. It must be noted that the samples analysed were randomly selected and precious-metal values may be higher in certain portions of the orebodies. The presence of mercury and arsenic in the ores could have considerable utility in exploration, since, these elements may be used as pathfinders. Selenium and molybdenum are present in some occurrences.” It is noteworthy that rock samples analysed by SNU/IVR show anomalous As and Se in almost all target areas and at the Molly prospect is where anomalous Mo has been observed. The high vanadium values observed in the Westmoreland uranium deposits area appear to be associated with Seigal Volcanics. For instance the El Hussen deposit contains high vanadium is hosted in the contact zone below the Seigal Volcanics with the Westmoreland Conglomerate.

In his review of Igneous uranium potential for Australia, Schofield (2010) ranked the Nicholson Granite Complex – Phase A as high potential and Phase B as medium-high potential. Also within the Nicholson Suite, the Cliffdale Volcanics is ranked as medium-high. These units are import for both primary uranium and also as a uranium source for secondary uranium such as sandstone hosted deposits.

In 1978 Mines Administration explored the area around New Benmara Homestead for sedimentary uranium in superficial sediments (Mesozoic to Quaternary). They concluded that the lack of a suitable sandstone section precluded the possibility of sedimentary uranium. In the north and west parts of the project is outcropping Cretaceous Carpentaria Basin consisting of siltstone, sandy siltstone, quartz sandstone and pebble and boulder conglomerates of the early Mullaman Beds. These overly the Cambrian Georgina Basin which outcrop further to the north and also southern parts of the project,
consisting of feldspathic sandstone, fine-coarse grained quartz sandstone, pebble to cobble conglomerates of the Bukalara Sandstone. These are not known to consist of suitable reduced and carbonaceous units to trap uraniferous fluids.

It is noted that Toro Energy and others have recently been exploring the Breccia Pipes for uranium, since they are considered similar to the Arizona Strip in the USA. Redbank Copper project, adjoining tenure (ENE) of EL29831.

8.3 Other Commodities

Gold

Ahmad et al. (2013) explains that small amounts of gold (and PGEs) has been identified at Tin Hole Ck, Eva Mine Uranium Mine and associated with Westmoreland uranium occurrences. These are more than 90 km to the east of the Calvert Hills project. One example is a hole at the Westmoreland Deposits in 2012 (Laramide, 2013) which intercepted 2 metres at 6.1 g/t Au from 33 metres, and 4 metres at 30.9 g/t Au from 55 metres.

Base Metals

Ahmad et al. (2013) explains that copper occurrences are hosted within the Nicholson Granite Complex and Cliffdale Volcanics as fracture fillings, generally following faults and shear zones. The Norris Copper mine located 80 km east of Calvert Hills project is the only known significant deposit, where copper is associated with a northwest trending fault parallel to the major Calvert Hill Fault. The deposit is within the Cliffdale Volcanics and produced about 150t o of concentrate averaging about 14% Cu. Ahmad et al. (2013): “The Palaeozoic successions of both the NT and Queensland portions of the Georgina Basin contain base metals mines, prospects, occurrences and anomalies that can be assigned to several styles of Cu and Pb-Zn mineralisation, including Mississippi Valley-type (MVT), stratiform sediment-hosted and sandstone-hosted. The basin is also very prospective for phosphate over large areas of its central and northern parts and hosts several substantial deposits, including Wonarah in the NT. The southern Georgina Basin is widely regarded as one of the more prospective areas for onshore petroleum in the NT, but substantial oil/gas pools are yet to be identified and the basin remains underexplored. Other prospective commodities within the Georgina Basin include diamonds, manganese and uranium. Neoproterozoic and/or Palaeozoic successions of the southern Georgina Basin have also been explored for gold and platinum group elements, but without success”.

Ahmad et al. (1989) discusses the presence of Breccia pipes in the Redbank Copper Field (RCF) 95 km east northeast of Calvert Hills project: “Breccia pipes are only seen in the Redbank Copper Field (RCF) where they occur as essentially steeply plunging cylindrical structures up to 75 m in diameter and with a vertical extent of about 350 m. Often the only surface expression of pipes is a circular capping of brecciated Masterton Sandstone. Pipes of smaller size, down to a diameter of about 4 m, are also known. The majority of pipes occurs in the Gold Creek Volcanics, but in the area close to the Wollogorang homestead, breccia pipes have also been observed piercing through the Wollogorang Formation and the Settlement Creek Volcanics. A volcanic plug piercing the Seigal Volcanics, about 2 km north of the King’s Ransom prospect, probably also belongs to this category. It thus appears that pipes have pierced the
entire stratigraphic section from the Seigal Volcanics to the Hobblechain Rhyolite. Not all of them, however, carry copper mineralisation."

At Redbank Copper the current resources of 96,000t copper, comprising indicated resources of 2.765Mt at 1.6% Cu for 43,100t, and inferred of resource of 3.479Mt at 1.5% Cu for 52,700t of copper.

It is noted that Toro Energy and others have recently been exploring the Breccia Pipes for uranium, since they are considered similar to the Arizona Strip in the USA.

**Diamonds**

Ahmad et al. (1989) explains that: “A systematic exploration program is currently carried out over most of the sheet area and detailed work by the Australian Diamond Exploration N.L. (1985) has resulted in the identification of several pipe-like bodies west of Benmara Homestead. Scattered microdiamonds are also common in the drainage samples collected from this area. Ashton Mining Ltd (1986) also referred to a sedimentary rock abundant in microdiamonds, but no other details were given.”. According to Gravity Diamonds (2005), Rio Tinto completed a thorough review of the geology, geomorphology, geophysics and historic sampling data in the region:

- “The McArthur Diamonds Project area is located within a favourable tectonic terrain that contains a variety of diatreme-like breccia pipes, including diamond-bearing kimberlitic intrusions. Prospective areas within the terrain remain under explored.
- Exploration persistence in the region has resulted in the discovery of diamond-bearing kimberlitic intrusions.
- Sinkhole or crater-like depressions that overlie diatreme breccia pipes in the region are filled by Cretaceous sediments. This reduces the chances of detecting diamond-bearing kimberlites using surface sampling techniques. The kimberlites are however, detectable using detailed geophysical surveys.
- The McArthur Diamonds Project area and surrounds has a significant history of diamond exploration mainly utilising reconnaissance surface sampling. Although sampling has resulted in the discovery of some exposed kimberlitic pipes in the region it has been less successful at detecting others covered by Cretaceous sediments.”

**Manganese**

Lovegrove (2012) explains that Universal Splendours licence’s in the Calvert Hills areas were selected due to their availability, their location within the Cretaceous shoreline and the presence of manganese mineralisation approximately 50km to the northeast. The local geological setting in the licence area is very similar to that at Groote Eylandt and there is no information available to suggest there is or is not buried mineralisation present. The Lovegrove (2012) report provides an excellent overview of the manganese mineralisation models as presented by International Geoscience: “The manganese ore deposit style is sedimentary in origin and consist of pisolites and oolites rich in Mn minerals such as pyrolusite, cryptomelane, romanchehite, todorokite and vernadite. Figure B2 is a representative cross-section displaying the Mn mineralization with respect to the lower Cretaceous and basement Proterozoic quartzite for the Groote Eylandt deposit. The genesis of the Groote Eylandt deposit is considered to have taken place in three major stages. The first stage involved the
deposition of primary Mn minerals in sediments in a shallow-marine near-shore environment, producing thick layers of Mn-bearing pisoliths andoolites. The second stage, diagenesis, produced pyrolusite that cemented the pisoliths andooliths. The third stage was a supergene and pedogenic process that modified the deposit in a terrestrial environment due to intense chemical weathering (Figure B3). The manganese mineral cryptomelane is thought to have formed during this third stage as a result of a large potassium influx into the ores from ground waters during the Tertiary.

Tin and Tungsten

Ahmad et al. (2013) explains that there are some small occurrences of tin+/-tungsten within the Nicholson Granite Complex and Cliffdale Volcanics. The Crystal Hill occurrence is the largest of these hosted within greisenised Nicholson Granite Complex.

Phosphate

Ahmad et al. (2013) explains: “The Palaeozoic successions of both the NT and Queensland portions of the Georgina Basin contain base metals mines, prospects, occurrences and anomalies that can be assigned to several styles of Cu and Pb-Zn mineralisation, including Mississippi Valley-type (MVT), stratiform sediment-hosted and sandstone-hosted. The basin is also very prospective for phosphate over large areas of its central and northern parts and hosts several substantial deposits, including Wonarah in the NT. The southern Georgina Basin is widely regarded as one of the more prospective areas for onshore petroleum in the NT, but substantial oil/gas pools are yet to be identified and the basin remains underexplored. Other prospective commodities within the Georgina Basin include diamonds, manganese and uranium. Neoproterozoic and/or Palaeozoic successions of the southern Georgina Basin have also been explored for gold and platinum group elements, but without success”. The Georgina basin does extend through the northern parts of the project.

8.4 Calvert Hills Prospects

According to the MODAT and MINLOC government databases Vanadis is the only prospect within the Calvert Hills project. Within 10 km of the southern part of EL29835 are minor uranium occurrences Anomaly 1, Anomaly 30 and Anomaly 4901 within the Murphy Inlier. Ahmad and Munson (2013) point out that these are different to those in the eastern uranium occurrences of the more traditional Westmoreland type since they are hosted by the Murphy Metamorphics near the contact of the Nicholson Granite Complex. Billington (1981) states that the radioactivity is due to the presence of apatite and no primary or secondary uranium minerals were recorded in the drilling at Anomaly 1.

Vanadis

Reconnaissance portable x-ray florescence (pXRF) and chip sampling in 2008 by Southern Uranium identified the Vanadis Prospect, which has highly anomalous vanadium. The area was investigated due to a magnetic anomaly indicating Seigal Volcanics below surface, which was also accessible by road (within 1 km). By the end of 2009 Southern Uranium had collected 19 chips samples, and 18 of these had in excess of 2,500 ppm V and up to .7 % V with an averaging 0.4% V. They were collected from an area of approximately 400 x 400 m. No grid based soil or chip sampling has been conducted at Vanadis.
Regularly spaced traverses of pXRF readings exist over parts of the prospect; however, 2/3 of this data is missing (according to comparisons with report figures).

Jones (2010) has mapped the Vanadis prospect and states: “The sandstone and claystone are interpreted to be part of the Mullaman Beds of Cretaceous age as mapped by the NT Geological Survey, the worm casts being conclusive evidence of a post Proterozoic age. The Mullaman beds are described as comprising quartz sandstone and conglomerate at the base, overlain by interbedded fine clayey sandstone and siltstone. The beds are recorded as being up to 70m thick. Neither the top nor bottom of the sequence is exposed at Vanadis.

It is significant that the linear zone of fracturing and iron enrichment trending 310 degrees through 709650E, 8065200N marks a boundary between iron enriched claystone to the SW and iron poor claystone to the NE. It is possible that minor movement along pre-existing basement structures has developed structures that penetrated the Cretaceous. During the Cainozoic meteoric waters circulating through the basement (Seigal Volcanics) have probably migrated to near surface along these minor structures carrying the iron and vanadium and depositing it in the claystone near surface. The fact that no iron filled fractures occur in the claystone east of the linear 310 striking zone suggest the meteoric fluid flow during development of the iron enrichment was south westerly. The elevated vanadium is probably a result of geochemical enrichment, possibly, but not necessarily, an indication that there is vanadium mineralisation at depth.

Vanadum is a relatively common element in the earth’s crust and apparently there are some 65 ore minerals, it is usually obtained commercially as a by-product of other processes. In WA/NT significant vanadium (and titanium) deposits occur in magnetite in layered gabbro. I am not aware of any lateritic deposits.

The highly anomalous vanadium at Vanadis may be an indication that the basement is enriched in vanadium (associated with uranium?)”

The petrography work by Ashley (2010) described the samples as a product of strong weathering, with variable fragmentation and re-cementing of regolith materials. The strong Fe- enrichment in several samples has been described to be consistent with surficial, weathering derived ironstones, but the origin of the anomalous vanadium and less prominent and patchy anomalous values of As, Cr, Mo, U and Sb remains enigmatic. The petrography failed to identify any discrete vanadium minerals (or other ore minerals), apart from oxides after possible secondary pyrite in cracks and fractures. It was surmised that the vanadium was probably accommodated in the iron oxides, which is consistent with the mapping observations by Jones.

There is no evidence of weathered Proterozoic basement outcropping. The nearest drilling is at least 10 km away (hole BEN-SD60). Seigal Volcanics is inferred from the magnetics bounded by north west trending faults 3.4 km to the south west and 1.6 km to the north east. Further to the south is likely shallow Westmoreland Conglomerate as indicated by the magnetics and hole BEN-SD60. Compared to other samples for the project, there are moderately elevated As (to 195 ppm), S (to 1,100 ppm) and Ca (to 800 ppm) with weakly elevated Cu (to 72.2 ppm) and Zn (to 29 ppm). Half the samples had more limited analysis which did not include REE, Hg or Se. Compared to the anomalous elements for
Westmoreland U-Au mineralisation by Ahmad et al. (1989); V, As and Cu are known positive indicators, however, there is no U or Au; therefore a genetic link is partial.

**Molly**

The Molly Prospect is located on a weak magnetic feature trending north east. The area is situated on the edge of a lateritic plateau where claystones of Cretaceous age have undergone iron enrichment similar to what has occurred at Vanadis. The prospect was located by stream sediment sampling.

There are presently only two rock chips collected at the prospect in 2008, which compared to the overall database produced highly elevated Mo (98-156ppm), P (1400-1610ppm), Sr (613-784); with high La (110-130), As (119-142), V (1710-2620ppm) Pb (61-84), Sb (7-11) and detectable Pt (0.0029-0.0044ppm) and Pd (0.006-0.008ppm). There is also potentially weak Cu. Compared to Westmoreland U-Au occurrences (Ahmad et al, 1989) the association of Mo and V with weak Cu are positive indicators and other elements such as Se and Hg were not analysed by Southern Uranium. The Sb-Pt-Pd association can be an indicator of Au/Ag mineralisation, however, and were below detection in the Westmoreland Analysis.

Two 700 m orientation soil lines have been conducted over Molly along with Niton pXRF. Soil samples collected were analysed by partial leach and total digest leach methods. According to the assessment report by Hornabrook (2010), high Mo was identified and correlation of Mo, Cu and K are interpreted to potentially be indicating porphyry Cu-Mo mineralisation, whilst the minor gold could be evidence of a possible epithermal system (possible near porphyry deposits) or secondary enrichment in origin. As iron once again is not correlating with the gold the element suite may be of primary origin, however, it is also recognised that manganese is known to scavenge gold in weathering environments as well as epithermal environments.

Analysis of the Niton readings along two traverses show there is a good correlation between the Mo, As and V values. Analysis of these elements and others, indicate that a soil survey utilizing a pXRF is a viable first pass exploration approach. The geochemistry patterns could possibly be associated with the interpreted north east structural trend, or possibly the intersection with a north northwest structure, as identified in the 400 m line spaced aeromagnetic data. More extensive grid based soil sampling is needed.

**North East Ridge**

The North East Ridge prospect corresponds with mapped Westmoreland Conglomerate (undifferentiated?). According to Chand and Willot (2011) the target was identified due to a prominent high in the aeromagnetic imagery and field checking revealed a low, north easterly trending ridge of sandy ironstone exposed within flat lying Cretaceous sandstones. The ironstone is likely developed on a post Cretaceous structure which has channelled meteoric fluids during the Cainozoic. The ironstone is anomalous in vanadium and other elements.

There are five rock chip samples at the prospect. The most interesting sample is weakly elevated Au (.004 ppm) which compared to the overall database is highly elevated in Pt (.0061ppm) and is moderately elevated in Pd (.003 - just above background), As (79 ppm) and Sb (6 ppm). These elements are generally considered good pathfinder for gold mineralisation. The uranium value of 9 ppm was
claimed by SNU/IVR to be the highest on the property, however, is actually just below the detection limit of 10 ppm for the method that was used at the time.

Further sampling is required at this prospect. The prospect is situated at the intersection of prominent north west and north east structures inferred from the magnetics, which need further assessment.
9. **EXPLORATION ACTIVITIES DURING TENURE**

Since granting of the Calvert Hills Project, Rockland Resources has undertaken significant due diligence work. This work has involved assessment and compilation of the previous geological, geochemical and geophysical exploration data provided by the Northern Territory Geological Survey (NTGS).

The Calvert Hills project was briefly visited by Rockland Resources in 2014 to make contact with the landowners and visit prospects. Only the Vanadis Prospect was found to be accessible within the time frame. No samples were collected, since at the time much of the project data was still being compiled.

9.1 **Data Review**

It was found that there were significant historical datasets missing from the NTGS exploration reporting system (GEMIS) and open/closed file geophysics compilations. As a consequence Rockland Resources has made considerable efforts to locate the data. In the end the previous explorer (SNU/IVR) was kind enough to supply the data directly. The missing data includes a 1946.1 linekm TEMPEST airborne electromagnetic survey and a 3035.3 linekm detailed magnetics and radiometric survey. The missing geophysical surveys will be submitted with the forthcoming annual technical report so that the NTGS has a proper record of these important surveys.

**Drilling**

There are relatively few drill holes within the Calvert Hills project. Figure 9 shows the drill hole distribution, end of hole depths (EOH) and summary of lithologies. SNU/IVR completed the most recent drilling for uranium exploration in 2009, consisting of four holes up to 416.4 m deep. Five holes were drilled for uranium exploration by AFMECO in 1980 which were all very shallow Aircore. The remaining 11 holes were drilled to a maximum depth of 154.7 m by Ashton Mining and Stockdale Ltd as part of their diamond exploration which were not assayed for uranium. No anomalous uranium has been intersected by any of the drilling.

The drilling by SNU/IVR shows a large fault offset of up to 284 meters near CHRCH001. The fault most likely strikes to the north west which separates two blocks where the south west block has shallow Westmoreland Conglomerate and the north east block has shallow Seigal Volcanics. Thickness of the Westmoreland conglomerate in the south west block is at least 300 m, however the basement has not been reached by any of the SNU/IVR drilling. It is noted that SNU/IVR did not attempt to differentiate the Westmoreland Conglomerate sub-units, however, B. Willot (pers comm., 2014) suggests the unit Ptw4 (immediately below the Seigal Volcanics) has been intersected by CHRCD001 and the AFMEX hole BEN-SD60.

Hole BEN-SD60 is located in the central part of EL29831 and was drilled by AFMECO in 1980. It is possibly located within the north east Westmorland Conglomerate domain. The hole has important implications for the project since it intersected only 15.68 m of Westmoreland Conglomerate between Seigal Volcanics and Nicholson Complex, thus implying a large component of the Westmoreland sequence is
missing with possible implications of a sub-basin. This is the only hole which has reached basement within the project.

A total of five RC holes (for 323 m) was drilled along a north south transect within the south east part of EL29831 by Predictive Discovery / Universal Splendour. Although no stratigraphic interpretation was provided, it seems plausible that the drilling intersected sandstone units above the Seigal Volcanic (i.e. Bukalara Sandstone) and failed to test the Westmoreland Conglomerates below the Seigal Volcanics.
Figure 9  Drill Hole Locations with Holes Sized by the Depths (EOH) and Basic Lithology Summaries Tabulated
Figure 10  Geology (excluding young cover) overlying Magnetics (second vertical derivative) and Gravity (tilt derivative) with Inferred Geology and Structure
Figure 11  Same as previous figure with overlying TEMPEST Tau
Figure 12  Sampling: Stream in Pink, Chips in Blue, Soils in Light Green and Niton pXRF (Dark Green)
Magnetic and Radiometrics

Figure 13 shows the airborne geophysics survey locations for the project.

Airborne magnetic and radiometric surveys flown by companies which overlap the Calvert Hills project include:

- SNU/IVR flew a survey in 2006 over a portion of EL24837 at a spacing of 100 m;
- Stockdale Prospecting flew a survey in 1986 over the eastern part of the project at a spacing of 250 m;
- Bondi Mining flew the “Murphy” survey in 2007 at a spacing of 100 m which clips the western part of the project; and
- Lagoon Creek Resources flew the “Benmara” survey in 2006 which over the eastern part of the project at a line spacing of 200 m.

Several regional government magnetic/radiometric surveys have been conducted over parts of the tenement as summarised below:

- Barkley – Brunette covers the south west parts of the project at a spacing of 300 m, which was flown in 1984; and
- Barkly Area 1 covers the north and east parts of the project at a spacing of 400 m which was flown in 2001.

The survey by SNU/IVR was completed by Fugro Airborne Surveys for a total of 3035.3 linekm. This dataset was not available through the NTGS and instead was sourced directly from SNU/IVR. This survey was submitted with the 2015 annual technical report, however, the logistics report could not be located.

There are some ground magnetic surveys which have been undertaken to assist with historic drill targeting.

It is unclear to what degree the airborne radiometric anomalies within the project have been followed up by the previous explorers. It is therefore recommended that radiometric anomalies be reviewed and followed up. The project is large with limited access and therefore follow up most likely should be assisted by a helicopter. Minty Geophysics Pty Ltd has a new method for identifying radiometric anomalies using the GAMMA_Target approach which would provide useful targets especially in areas where there is coarse line spacing using the raw line data.

The airborne magnetics is dominated by the Seigal Volcanics. The volcanic sill has a variable response best interpreted by assessing the texture of the 2nd vertical derivative and analytical signal. The Clifftdale Volcanics also has a similar response. The data has been used in a cursory manner to infer the extent of the Seigal Volcanics, Westmoreland Conglomerate and Clifftdale Volcanics. Figure 10 shows the potential field data with older geology units and inferred geology/structure.
Government 4 km spaced gravity data is available for the project. The gravity shows large lows associated with deepening McArthur Basin (towards the north) and outcropping Nicholson Granite in the south. Residual and filters highlight localised increases associated with the outcropping Westmoreland Conglomerate most probably due to the shallow basement as is the case at drill hole BEN-SD60. It is noted that the weakly elevated gravity may also indicate areas where the basement is less likely to be Nicholson granite such as Murphy Metamorphics. One such instance is at the Molly Prospect where the basement may be shallow and/or consist of a denser basement such as the Murphy Metamorphic.

In some cases, small gravity surveys have been undertaken to assist with drill targeting including a survey by Lagoon Ck Resources in the south east part of EL29831.

Figure 10 shows some of the potential field data with older geology units and inferred geology.
**Airborne Electromagnetics**

In 2008, SNU/IVR undertook a TEMPEST airborne electromagnetic survey conducted by Fugro Airborne Surveys over the entirety of their EL24837. The lines were oriented north-south and 500 m apart, for total of 1,900 linekm. This dataset was found to be missing from the NTGS exploration reporting system (GEMIS) and open/closed file geophysics compilations. As a consequence the previous explorer (SNU/IVR) was kind enough to supply the data directly and was submitted with the 2015 annual technical report so that the NTGS has a proper record.

Interpretation reports were completed by McInnes in 2008 and 2009. McInnes states that the underlying premise of the interpretation was “the Tempest system maps the palaeo-topography of the crystalline basement due to the significant electrical contrast between the younger overlying unconsolidated sediments (conductors) and the crystalline basement units (resistors). Through modelling the data, the contact between the crystalline basement and overlying sediments can be accurately mapped, thus variations/displacements in the basement can be interpreted. The Data and its modelling also enables the identification of basement structures due to structures generally having a higher conductivity then crystalline basement.”

This interpretation is somewhat simplistic since it does mention the effects of the Westmoreland Conglomerates, Seigal Volcanics or Bukulara Sandstone. Figure 11 show the TEMPEST (Tau = Time Constant) overlying the compilation of potential field geology for the project. The conductive response appears to be largely controlled by the Seigal Volcanics and secondly by unconsolidated cover. Based on the Conductive Depth Sections (CDIs), it is the conductivity rather than thickness which is the strongest influence. Resistive zones are largely due to shallow/outcropping Westmoreland Conglomerate, although in the south the Bukalara Sandstone may also be possible. There are no strong conductors indicative of base metal or basement carbonaceous units. In areas of outcropping Westmoreland Conglomerate some of the CDIs show a conductive layer at depth which may be the unconformity interface with basement similar to what exists in the Alligator Rivers region of the McArthur Basin (Beckitt, 2003); albeit less defined and less continuous.

Rockland Resources has worked with Core Geophysics to better displaying 2D inversion (Conductivity Depth Images – CDIs) results in the GIS as pseudo referenced grids. This approach has facilitated interpretation/targeting since it can be viewed more readily with other datasets, and the colour ranges can be modified easily to highlight localised features.

It is noted that there is a GEOTEM I survey by MIM which clips the eastern part of the project including the Molly prospect. This data has not been utilised yet since the format is difficult to manipulate.

**Satellite Imagery**

A report by Earthscan (Wilson, 2009) utilises Landsat TM to map surface geology and identify structural targets. “The multiple ratioed datasets processed to highlight the classifying signatures for Westmoreland Conglomerate and Seigal Volcanic lithologies was systematically scanned; firstly around the basin margins and secondly over known uranium occurrences. Some mineral occurrences were initially located by drillhole and well examinations within the basins and away from the edges. Examination of the reprocessed magnetic and gravity data indicates a basin uplift to the east of EL24837 with the
Westmoreland Conglomerate outcropping in major NW trending structural corridors and fault blocks. Crosscutting NE trending fault zones and a north trending radiating fault system extending from the Nicholson Granitoid into the sedimentary units are structure related with marked corridors trending NE and NW across the basins. “. Targets where identified from CH1 to CH40, which were the focus of subsequent field follow up by SNU/IVR.

ASTER data is now available through Geoscience Australia but has not yet been reviewed for the Calvert Hills project.

**Geochemistry - Chips**

The main uranium exploration rock chip sampling has been completed by SNU/IVR, which totals 69 samples assayed for a broad suite of elements including gold. All uranium result are less than 10 ppm U₃O₈. It is noted that much of the analysis utilises a laboratory method with a detection limit of 10 ppm which is unlikely to be sufficient to detect subtle enrichment of uranium within sandstones.

Weak As has been detected (100-200 ppm) at Molly, Vanadis, and NE Ridge. High Mo to 156 ppm has been detected at the Molly prospect. A number of locations have V values in excess of 1,000 ppm, however, at the Vanadis prospect there are four assays which exceed 5,000 ppm to 7,070 ppm.

Extensive rock chip sampling has been completed by North Australia Diamonds in the far west portion of Rockland Resource’s EL29830 near Plenty River totalling 462 samples. Sampling has been for Ag, base metals, V and U. No anomalous results have been identified.

Two rock chip samples were collected by Lagoon Resources (Predictive Discovery) within the southern portion of Rockland Resources EL29835. These samples were analysed for a broad suite of elements including gold and uranium, however, no anomalous results were identified.

Historical samples by AFMECO are not described in the historical reports.

**Geochemistry - Streams**

The NTGS stream sediment database captures a number of samples along the Coanjula (goyaniala) River (and tributaries) and near the Nicholson River; in the southern parts of EL29830, EL29831 and EL29835. The samples were collected by AFMECO and Mt Isa Mines during the 1980’s and early 1990’s. No samples are anomalous down-stream from the Molly Prospect yet it was this data which apparently led to its identification? Molybdenum is anomalous 6 km south west of North East Ridge.

**Geochemistry - Soils**

Approximately 200 Niton portable XRF (pXRF) samples have been read by SNU/IVR at Molly, Vanadis, North East Ridge and various sites other prospects of interest. The readings have been generally along traverses rather than grids. At Molly elevated Mo has been identified at times with Cu, Sr and Co. At Vanadis there is elevated V at times with elevated Sn, Fe, Sr. At times elevated Te, Sb and Ag are
present which sometimes has affinities with gold mineralisation. At North East Ridge the Niton shows elevated Sc.

Trial soil surveys have been conducted at Molly prospect and CJ1 anomaly, which are discussed by Hornabrook (2010). A partial leach and total digest was tested. High Mo was found to correlate with Cu and K, which was interpreted to potentially indicate a porphyry Cu-Mo mineralisation. Minor gold was proposed to be evidence of a possible epithermal system (possible near porphyry deposits) or secondary enrichment in origin.

9.2 Rockland Field Visit in 2014 and Comments

The Calvert Hills project was briefly visited by G. Beckitt and J. Parks in 2014 to make contact with the land-owners and visit prospects as access allowed. Only the Vanadis Prospect was found to be accessible within the time frame. No samples were collected, since at the time much of the project data was still being compiled. Field observations confirmed the conclusions by Jones (2010) that the prospect is most likely a result of lateritic enrichment of the vanadium in Cretaceous.

Vanadium is generally a by-product and not mined in its own right since it typically occurs in the trivalent state in Fe/Ti oxides (i.e. it is very hard to get out hence expensive). The world’s largest mines of vanadium are from titaniferous magnetite reserves in such regions as the Bushveld of South Africa, the Kachkanar Massif of the Ural Mountains, and China’s Szechwan province. Even vanadium only mines (~30% of current mines) are optimise to also extract the Fe and Ti (e.g. Windimurra which is potentially huge ~176.59 Mt at 0.46% \( V_2O_5 \), using a lower cut-off of 0.275% \( V_2O_5 \)).

To an extent the vanadium market can be manipulated by extracting more from iron-ore slag on an as needs basis. Unlike other commodities, there is no market quote for vanadium. Vanadium is traded by contract directly between the producers and consumers. Presently the price is estimated at approximately $26/kg. There is scope for more markets in the future and especially batteries being developed for green technologies.

Vanadium minerals such as patronite \((VS_4)\), carnotite \([K_2(UO_2)_2(VO_4)_2]\), and vanadinite, \([Pb_2(VO_4)_3Cl]\) have not been recognised at Vanadis or fit with the known geochemistry. Ore deposits mined solely for vanadium are rare because much of the vanadium in igneous rocks occurs in the relatively insoluble trivalent state, substituting for ferric iron in ferro-magnesium silicates, magnetite (an iron ore), ilmenite (a titanium ore), and chromite. At this stage these do not seem to be present at Vanadis, rather the vanadium is thought to be related to iron oxides in a supergene scenario. QEMSCAN analysis should be undertaken to better understand the metallurgy of the prospect.

In terms of back of the envelope calculations the ore is within the oxidised portion of the regolith and therefore likely to be easily mined. The dimension of Vanadis are not know but assuming a deposit of 500 x 500 x 50 m using an average grade of 4,000 ppm \( V \) (0.7% \( V_2O_5 \)) then there could 31.3 Mt @ .7% \( V_2O_5 \). For comparison other mines in Australia include:
- **Windimurra Mine (WA):** Australia’s only producing vanadium mine. Indicated and Inferred Resource of 242.6 Mt at 0.48% V₂O₅, representing 654 000 tonnes of contained vanadium. Hosted in the Windimurra intruded layered gabbro complex.

- **Speewah (WA):** 4712 Mt at 0.3% V₂O₅, 2.0% titanium (Ti) and 14.7% iron (Fe).

- **Balla Balla (WA):** Total resources are currently 456 Mt at 45% Fe, 0.64% V₂O₅ and 13.7% TiO₂.

- **Barrambi (WA):** Current resources total 65.2 Mt at 0.82% V₂O₅ and 17.3% TiO₂.

- **Gabanintha (WA):** 125.8 Mt at 0.7% V₂O₅, 8.6% TiO₂ and 32% Fe. Anorthositic gabbro host that is known to strike North West. The gabbro hosts a series of titaniferous magnetite bands and these are the main focus for vanadium magnetite titanium mineralization.

- **Mount Peake (NT):** 158 Mt at 0.28% V₂O₅, 5.06% TiO₂ and 22% Fe for the Mount Peake project. **Julia Creek (QLD):** 5308 Mt at 0.37% V₂O₅ and 312 grams per tonne molybdenum. Hosted by calcareous oil shales in the Toolebuc Formation.
10. SUMMARY

In the past decade basic uranium exploration has been undertaken in the area by SNU/IVR, Top End Uranium, Bondi Mining (Trading as Murphy Uranium), Lagoon Resources, Predictive Exploration and Toro Energy. Esso, Mine Administration and AFMECO has also explored the region in the late 1970s and early 1980s. The primary focus of the exploration has been for Westmoreland style uranium (and gold). This first past exploration has not been successful at identifying uranium deposition. Significant exploration has also been conducted for diamonds and limited exploration has been undertaken for manganese, base metals and gold.

Since granting of the Calvert Hills Project, Rockland Resources has undertaken significant due diligence work. This work has involved assessment and compilation of the previous geological, geochemical and geophysical exploration data provided by the Northern Territory Geological Survey (NTGS). The compiled data has been utilised for integrated targeting analysis although further analysis is ongoing.

There are some significant historical datasets missing from the NTGS exploration reporting system (GEMIS) and open/closed file geophysics compilations; as consequence Rockland Resources has undertaken considerable efforts to locate the data. In the end the previous explorer (SNU/IVR) was kind enough to supply the data directly. The missing data includes a 1,946.1 linekm TEMPEST airborne electromagnetic survey, and a 3,035.3 linekm detailed magnetics and radiometric survey. The missing geophysical surveys are submitted with the present annual technical report so that the NTGS has a proper record.

Drill hole BEN-SD60 and interpretations of the geophysics indicates the architecture of the basin is very complicated with compartmentalization (even sub-basin?). Some of the Westmoreland facies are not present. This is important especially since most of the uranium mineralisation at Westmoreland is within the upper Ptw4 unit of the Westmoreland Conglomerate. B Willot per. Comm. (2014) suggests the south west domain of outcropping Westmoreland is the mid Ptw3 unit, and that the upper Ptw4 unit is present in both drill hole BEN-SD60 and CHRCD001. The SNU/IVR core was unfortunately lost to a fire, however, efforts should be made to better understand the litho-facies by visiting outcrops and also assessing any of the available core held by the NTGS. Infra-red spectrometry could be useful to identify variations in clays such as illite/dickite.

In addition to the above basin architecture there is also significant faulting of the Westmoreland and Seigal Volcanics. This aspect appears to be different to the Westmoreland Deposit area and needs further consideration as to the effect on fluid flow of uraniferous basinal brines proposed by Polito etal. (2005). The disruption of the basin architecture complicates the ability to target permissive depositional positions. A review of the regional tectonics, magnetics and Westmoreland Deposits, should be undertaken with the aim of identifying mineralisation timing in the context of the basin architecture. If the extensive faulting post-dates mineralisation then this activity may remobilize or obliterate mineralisation.

Reduced lithologies for precipitating uranium are generally carbonaceous and/or Fe$^{2+}$ rich. Wall (2009) points out that the absence of major uranium deposits in the Westmoreland basement or around the unconformity may reflect limited sources of reductant which is largely felsic metavolcanic and
granitoids (Cliffdale Volcanics and Nicholson Granite). Rather, the main Westmoreland deposits and prospects, are localised around mafic dyke & volcanic contacts where Fe$^{2+}$ could serve as the prime reductant. The same basement is interpreted in the Calvert Hills area based on the gravity lows, drilling and also the outcrop to the south of the project. Some limited occurrences of Murphy Metamorphic metasedimentary rocks do exist which may provide reduced lithologies, however, carbonaceous sub-units have not been recognised at this stage. It is noted that a higher probability of Murphy Metamorphics basement exists in the Molly prospect area from high gravity, although shallow basement could give a similar response.

10.1 Project Scale Assessment

It is unclear to what degree the airborne radiometric anomalies within the project have been followed up by the previous explorers. Based on surface sampling locations, it appears that previous airborne radiometric anomaly follow up may have been limited by vehicular access. It is therefore recommended that radiometric anomalies be reviewed and followed up. The project is large with limited access and therefore such endeavours should most likely utilise a helicopter in order to be cost effective. Minty Geophysics Pty Ltd has a new method for identifying radiometric anomalies using the GAMMA_Target approach, which would provide useful targets particularly using the raw line data. It is recognised that caution needs to be exercised in interpretation of the radiometric results as previous exploration experience at Westmoreland has shown that leakage through the Cretaceous sandstone cover in the range of up to 100-200ppm uranium frequently does not coincide with uranium mineralisation at depth (pers. comm. Rhys Davies, Laramide Resources 2009). It is interesting to note that Ahmad (1987) states that mineralisation is often situated in areas of presumed groundwater discharge sites. Hence finding springs and sampling water for radon/Pb isotopes could also be undertaken.

10.2 Surface Geochemistry

Three prospects are recommended for further investigation by Rockland Resources: Vanadis, Molly and North East Ridge. These prospects require grid based soil sampling. The best approach is likely to utilise a portable XRF backed up by laboratory analysis of soil samples and also rock chips samples. Hornabrook (2010) suggests follow up total digest ICP-MS on selected +200 micron samples. North East Ridge may best be approached with traditional soil sampling given the low levels of gold and other trace elements.

Vanadis should first be focused on to ensure optimal understanding of the geology. Multiple pXRF readings of individual sites of interested would be helpful as well as some bulk composite sampling. Sampling should include a proper interpretation of the regolith since failure to do so may result in sampling the wrong level in the profile (i.e. would expect little vanadium in pisoliths and in the white bleached zone?).

Vanadis appears to be new style of vanadium mineralisation and remains the highest priority target on the project. Rockland Resources could be a first mover for this style. The mineralisation is near-surface and therefore should be relatively easy for mining. Although uranium is not present at the prospect, there are some possible genetic links with Westmoreland style of mineralisation. Understanding Vanadis is likely to also help with interpreting other prospects within the project including Molly.
At this stage it is unclear whether sampling results at Vanadis are representative or have been biased at all by the sampling size and media. For instance it is unclear whether the pXRF point readings were taken on outcrop rock chips or as representative sieved soil fractions at a specific regolith horizon. Similarly it is unclear whether the pXRF was used to guide rock chip sampling and how large and representative are the rock chip samples. Some samples should be selected for QEMSCAN type analysis to understand the microscopic mineralisation and geochemistry, which in turn will help with understanding the metallurgy.

10.3 Drilling

The NTGS should be contacted to determine whether there are holes which can be reviewed from the project and especially hole BEN-SD60. A particular focus should be to understand the unusually thin sequence of Westmoreland Conglomerate by comparing with other holes within the project. Willot pers. Comm. (2014) claims the litho-facies is the upper unit.

Subject to additional sampling at Vanadis, then Aircore (including hammer) drilling should be planned. The program should aim to understand the controls and distribution of the vanadium. In addition, possible basement structural positions should also be tested based on the magnetics. Gravity should be considered, to help map thickness changes in the Cretaceous as well as identify basement structures and controls.

Assuming the vanadium is a viable exploration target, it is worth considering how best to explore for it? For instance can ASTER satellite imagery or hyperspectral methods be used for targeting and how effective are stream sediment sampling methods?

11. CONCLUSION

The Calvert Hills project covers a large area and situated in a remote location. Exploration is difficult since there is extensive cover masking any buried deposits. Similar sub-surface geology is present to what occurs at Westmoreland Deposits (>100 km to the east), however, uranium deposition has not been confirmed at the project and the basin architecture is potentially more complex. The company has decided not to further pursue the uranium targets at the project but has retained a portion of EL29831 to assess the Vandadium potential and Vanadis. No field data has been collected at the project, however, historical geophysics (TEMPEST and an airborne magnetic/radiometrics survey) has been sourced directly from a previous explorer and submitted in the first annual report for the project (Beckitt, 2015).
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