Strangways Project

FINAL SURRENDER REPORT

For the period
13 June 2006 to 16 July 2013
FOR
EL 25055 and EL 25056

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SUMMARY

Flinders Mines Ltd originally (as Flinders Diamonds Ltd) applied for exploration licenses in the Strangways region to explore a series of discrete dipolar magnetic anomalies for diamondiferous kimberlitic or lamproitic intrusive pipes. EL10364 Mud Tank was granted on 6th December 2001 and ELs 22443 Strangways, 224446 Alcoota and 22623 Phlogopite were granted on 20th December 2001 all of which were for a term of 4 years. Then in 2005 FMS sold the non-diamond rights to Maximus Resources Ltd (MXR). The 4 original licenses were surrendered on 27th January 2006 in exchange for 2 SELs, 25055 and 25056 that were granted on 13th June 2006 each for a period of 4 years. NuPower then entered into a Joint Venture Agreement with MXR on 31st January 2008 to explore for the energy minerals uranium, thorium and coal, targeting secondary uranium mineralisation and coal in Cainozoic palaeochannels and sedimentary basins and primary uranium-thorium mineralisation in the Proterozoic metamorphic basement rocks of the Arunta Block/Strangways Metamorphic Complex associated with regional radiometric anomalies. In 2013 NuPower (then Central Australian Phosphate) and Maximus Resources Ltd withdrew from the joint venture.

The Strangways region hosts a broad range of mineralizing styles and base metal deposits that include Cu-Pb-Zn deposits at Gecko, Rankins, Gumtree, Utnalanama (Johanssen’s Phlogopite Mine), Edwards Creek and Glancroil, Cu-Au deposits at Johnnies Reward, Pinnacles and Turners and vermiculite-REEs deposits at Bleechmore Dykes and Mud Tank. However the region has never been explored systematically for uranium deposits.

Using a model adapted from South Australia NuPower became interested in the area following successful results of an airborne electromagnetic survey (AEM) in 2007 over its own tenements in the Aileron region that identified palaeochannel and basalial structures with considerable thicknesses of unconsolidated Cainozoic sediments. In South Australia secondary uranium deposits have formed in similar Cainozoic sediments of the Frome Embayment by dissolution of uranium under oxidising conditions from basement rocks of the adjacent Flinders Ranges and re-precipitation under reducing conditions that has been responsible for the formation of the very significant sandstone hosted Beverley and Four Mile deposits.

Similarly in central Australia uraniferous basement rocks are widespread in the Arunta Block of the Reynolds and Strangways Ranges. Limited previous exploration of the Cainozoic sediments in surrounding basins had identified locally thick sequences beneath the Burt and Ti Tree Plains that encouraged NuPower to undertake a regional AEM survey to explore them as potential hosts for secondary mineralisation. This successfully located extensive and deep sequences of prospective sediments that accumulated in part as a result of substantial neo-tectonics that has been largely underestimated.

In exploring for Cainozoic sediments in the vicinity of the Strangways Ranges, the northern part of the MXR tenements was targeted for potential southeast extensions of the structures, underlying plains in the headwaters of Mueller and Waite Creeks, controlling the southern margin of the Ti Tree Basin where the Cainozoic succession is over 300m thick in the Woodforde area of NuPower’s ground.

The licenses are underlain predominately by Palaeoproterozoic sedimentary, volcanic and intrusive rocks of the Strangways Metamorphic Complex (SMC), forming part of the eastern Arunta Block that has undergone a prolonged multiphase history of accumulation, metamorphism and deformation through a series of orogenies from the earliest Strangways Orogeny (1780-1720Ma), the Liebig Orogeny (1645Ma), the structural character of which dominates the area and the Chewings Orogeny (1590-1560Ma).

Later, carbonatites were intruded along the NW-trending Woolanga Lineament around 730Ma comprising a series of lenses emplaced along a ductile shear zone consisting of a carbonate core surrounded by mica-rich zones, emplaced into granitoid cataclasites and mafic granulites.

Further significant reworking continued from the Cambrian through to the Carboniferous, commencing with formation of the Harts Range Metamorphic Complex (510-460Ma) and north over south ductile thrusting of the SMC granulites (430-390Ma) when the Wallaby Knob Schist Zone was reactivated.
Compressional deformation continued, probably intermittently, until 300Ma, during the Alice Springs Orogeny.

Mapping of the Strangways Ranges has subdivided the rocks into a series of high grade metamorphic units including the Cadney, Hillsoak Bore, Erotonga, Ankala and Sliding Rock Metamorphics and Yambah Granulite consisting of calc-silicate rocks, marbles, sillimanite-biotite, garnet-biotite and quartzofeldspathic gneisses, felsic and mafic granulites, cordierite granulite, migmatites, quartzites and amphibolites. These rocks are cross cut by belts of retrogressed greenschist facies quartzofeldspathic, muscovite-biotite and kyanite schist, quartzite, amphibolite and calc-silicate rocks that include the Southern Cross and West Bore Schist Zones.

In the south these rocks are intruded in the Wuluma Hills and Utnalanama Range by two separate felsic bodies-the Wuluma Granitoid containing rafts of sillimanite gneiss and the Utnalanama Granulite interlayered with Johansen Metagabbro and Harry Anorthositic Gabbro. A small body of Late Proterozoic Gum Tree Granite is also present here consisting of porphyritic granite with numerous acidic dykes.

North of the Plenty Highway the Mt Bleechmore massif is underlain by Mt Bleechmore Granulite consisting of sillimanite-garnet-biotite quartzofeldspathic gneisses, garnet-K feldspar migmatites, mafic granulites, plutonic migmatites and rare calc-silicates. The massif also contains small bodies of mafic granulite and amphibolite and garnet plutonic migmatite.

Structurally the southern NT forms a ‘basin and range’ province with Proterozoic and Palaeozoic rocks forming prominent ranges separated by broad valleys containing thick sequences of unconsolidated Cainozoic sediments in at least twenty major basins of which the Strangways tenements cover a small area of the most eastern part of the Ti-Tree Basin. However the stratigraphy of the intermontane Cainozoic basins is generally poorly known except for the Hale Basin where exploration for lignite and sedimentary uranium during the late 1970’s and early 1980’s has provided the most knowledge, and although the succession is relatively thin here it is considered to represent a generalised Tertiary stratigraphy for the southern NT. This comprises a broad two-fold stratigraphic subdivision that corresponds well with the observed pattern of Cainozoic sedimentation elsewhere in southern Australia that consists of a restricted, fluvial palaeochannel dominated Palaeogene succession, the Hale Formation, overlain by a more widespread, dominantly lacustrine Neogene succession, the Waite Formation. Historical exploration indicates that the Cainozoic fill of the Burt Basin exceeds 200m, that the Sixteen-Mile Basin contains at least 180m of sediment, that the Whitcherry Basin and Waite Basins contain thicknesses in excess of 250m in thickness and that the sediment in the Ti Tree Basin is in excess of 300m deep. An additional stratigraphic unit, the Napperby Formation has since been recognised by NuPower as overlying the Waite Formation and represents the development of prograding alluvial fans shed from the ranges flanking the Cainozoic Basins. While the Cainozoic stratigraphic units were initially defined in separate, small and isolated Tertiary Basins, these units are now recognised as components of a much larger Tertiary palaeodrainage system, the extent and size of which has until now been vastly underappreciated.

Deposition of Cainozoic sediments was episodic and punctuated by hiatuses during which prolonged periods of weathering resulted in the formation of five well-developed weathered profiles (palaeosols and duricrusts) extending from the late Cretaceous and affecting the basement rocks through to the Quaternary. There are three Palaeogene weathering events which affected Arunta igneous and metamorphic basement rocks and the overlying Tertiary succession and two weathering events from the overlying Neogene succession that appear to correlate with similar periods of weathering and exposure evident in southern Australia.
INTRODUCTION
The Strangways Project comprises 2 tenements,

- EL25055 Strangways (100% Flinders Mines Limited)
- EL25056 Mud Tank-Alcoota (100% Flinders Mines Limited)

This group annual report is concerned with both tenements.

NuPower Resources Ltd (now Central Australian Phosphate), through the joint venture had the right to explore for the energy minerals uranium, thorium and coal and was therefore targeting secondary uranium mineralisation and coal in Tertiary palaeochannels and primary uranium-thorium mineralisation in the Proterozoic metamorphic basement rocks of the Arunta Block/Strangways Metamorphic Complex.

In 2013 NuPower (then Central Australian Phosphate) and Maximus Resources Ltd formally withdrew from the joint venture.

BACKGROUND
Flinders Mines Ltd (FMS) initially (as Flinders Diamonds Ltd) applied for exploration licenses in the Strangways Ranges region to explore discrete regional dipolar magnetic anomalies that were thought to be indicative of diamondiferous kimberlitic or lamproitic pipes. Four licenses were granted in December 2001 for four years.

Exploration for diamonds included regional interpretation, regolith map compilation, ground magnetic surveys, RAB drilling and heavy mineral sampling. Although the results were generally disappointing follow up of the source for indicator minerals from at least 2 samples and sampling of the catchments draining the Woolanga Lineament were recommended.

Exploration of the Bleechmore dykes highlighted the potential for vermiculite and FMS carried out a program of ground magnetic and gravity traverses, hyperspectral TM traverses, excavation of trenches, vacuum bedrock drilling, RAB/aircore drilling and core drilling. A significant vermiculite resource was defined over an area of 400mx50m to a depth of 42m and processing testwork was carried out. Further testwork and marketing studies were recommended.

Teck Cominco-BHP Billiton entered into a JV with FMS to explore for base metals, targeting Broken Hill style massive sulphides associated with the contact of major bimodal volcanic sequences and overlying sediments. The work comprised reviews of historical data, ground magnetic traverses and geological traversing with rock chip sampling. With the exception of the known base metal occurrences the work did not identify any base metal anomalies worth follow up.

In 2005 FMS sold the non-diamond rights to Maximus Resources Ltd (MXR). The original four licenses were surrendered for 2 substitution licenses and MXR intended to explore the base metal potential of the two areas.

NuPower became interested in the area following successful early results of an airborne electromagnetic survey (AEM) in 2007 over its own tenements in the Aileron region that identified palaeochannel and basinal structures that were believed to contain considerable thicknesses of unconsolidated Cainozoic sediments that could act as suitable hosts for secondary uranium deposits. NuPower had adapted as its exploration model one from South Australia where uraniferous basement rocks in the Flinders Ranges are the primary source areas for uranium. During the weathering process this uranium is dissolved in oxidized groundwaters and remobilised into the surrounding Cainozoic basins where it reprecipitates on encountering reducing conditions and has been responsible for the formation of the sandstone hosted Beverley and Four Mile deposits.
In central Australia,uraniferous basement rocks are widespread in the Arunta Block of the Reynolds and Strangways Ranges. Limited previous exploration for Cainozoic sediments to host secondary deposits had identified locally thick sequences beneath the Burt and Ti Tree Plains that encouraged NuPower to undertake regional AEM surveys to explore for them as potential hosts for secondary mineralisation. This successfully located extensive and deep sequences of prospective sediments that accumulated in part as a result of substantial neotectonics that has been largely underestimated.

In exploring for prospective Cainozoic sediments in the vicinity of the Strangways Ranges the plains in the northern parts of the MXR tenements were targeted for potential southeast extensions of the structures controlling the southern margin of the Ti Tree Basin where the Cainozoic succession is over 300m thick in the Woodforde area of NuPower’s ground.

**LOCATION AND ACCESS**
The Strangways area is located approximately 90 kilometres northeast of Alice Springs, in the Strangways Ranges region, (Figure 1) covering parts of Bushy Park, Yambah, The Gardens, and Mt Riddock stations and the Alcoota Aboriginal Corporation Station.

The Plenty Highway, that branches east from the Stuart Highway, runs east-west through the northern part of the area and is sealed for the most part. The Arltunga Tourist Drive Road runs east-west across the south and the Pinnacles Road (Binns Track) links the Arltunga Road and Plenty Highway through the eastern side of the area. A good graded road, the Delmore Downs road, provides access to the northeast of the area.

Local vehicle access is provided by a network of pastoral station bore tracks and fence line tracks. These are locally overgrown or eroded and while many tracks are shown on available topographic maps some are no longer accessible and there are some new tracks not shown.

Unsealed airstrips are located at Bushy Park and Mud Tank in the northern part of the area.
TOPOGRAPHY AND DRAINAGE

The southern part of the region, south of the Plenty Highway, is dominated by rugged mountainous terrain of the Strangways and Utnalanama Ranges rising to in excess of 900m ASL and the less mountainous Narbib Range in the southernmost part, (Figure 1). The highest point is Mt Pfitzner at 1066m ASL. North of the Highway the area is mostly flat at around 650mASL and incised by streams and tributaries of the Edwards, Mueller, Gillen and Anamarra Creeks draining northwards from the ranges. Weathering is more intense here and much of the area is covered by colluvium, sheetwash, silcrete, calcrite and laterite. This is punctuated in the northeast by Mt Bleechmore that rises to over 750m ASL.

In the south the ranges are drained by Harry, Hale and 17 Mile Creeks draining west south and east respectively, and the headwaters of Gillen Creek that drains to the north.

Figure 1 - Strangways Project, Location of Tenements
CLIMATE AND VEGETATION
The climate is mainly dry all year round with hot summers and cool to cold winters. Average annual rainfall, based on records from the nearest Bureau of Meteorology stations at Alice Springs and the Territory Grape Farm ranges from 280-305 mm, most of which falls in the October-March period. Average minimum and maximum temperatures in summer range from 21.4-37.6 degrees and from 4-19.7 degrees in winter.

Vegetation is highly variable from the plains to the mountain ranges. On the plains to the west and north tall open Mulga shrubland with open Woolybutt grassland understorey is dominant, giving way eastwards to tall open Mulga shrubland with open Fuchsia shrubland understorey on the high country with low open Ironwood and Whitewood, River Red Gum and Tea Tree woodland with open grassland understorey in the valleys. To the east this is replaced with Witchetty Bush Acacia shrubland with open Cassia (Fuchsia) shrubland understorey and tall sparse Mulga Shrubland with grassland understorey on the ranges.

TENURE
SEL25055 originally consisted of 375 blocks and covers approximately 1,118 square kilometres. SEL25056 consists of 173 blocks and covers approximately 520 square kilometres. Both licences were granted to Flinders Diamonds Ltd on 13th June 2006 for a period of four years.

Flinders Diamonds Ltd then joint ventured the non-diamond rights for the two licenses to Maximus Resources Ltd, (MXR).

In January 2008 NuPower Resources Ltd entered into an agreement with Maximus Resources to explore the licenses for energy minerals; uranium, thorium and coal.

In 2013 NuPower (then Central Australian Phosphate) and Maximus Resources Ltd withdrew from the joint venture.

In 2013 EL 25055 was subdivided following a change in the Mining Act which restricts the size of any licence to 250 blocks. The new licence, comprising the southern portion of EL25055 is EL 29904. No new work has been carried out on this tenement.

The licenses cover the following perpetual pastoral leases (Figure 2):

SEL25055,

NT Portion 4029, PPL 1032, Alcoota Aboriginal Corporation Station
NT Portion 687 PPL 1132, Bushy Park Station
NT Portion 3676 PPL 989, Mt Riddock Station
NT Portion 662 PPL 662, The Garden Station
NT Portion 641 PPL 904, Yambah Station.

The area excludes ELs 23592 and 26440, MCS227 and NT Freehold Land Parcel No. 3559.
Figure 2 - Strangways Project, SEL25055 & SEL25056, Pastoral Leases
NT Portion 4029 PPL 1032, Alcoota Aboriginal Corporation Station  
NT Portion 3676 PPL 989, Mt Riddock Station.  

The area excludes RO303, MLS165 and FA11 that include the Mud Tank Carbonatite Mine.

DRDPIFR approved NuPower’s request on 22nd June 2009 to combine the annual reports of these tenements on 30th June 2009.

NATIVE TITLE

A joint ILUA and Exploration Agreement for both tenements between the Central Land Council (CLC) and Flinders Diamonds Ltd (FMS), satisfying all Native Title requirements, was executed on 13th November, 2002. Subsequently a Deed of Assumption between CLC, FMS and MXR was executed on 10th October 2006. A Letter of Agency between MXR and NuPower was executed on 19th August 2008.

ABORIGINAL SACRED SITES

Prior to undertaking reconnaissance exploration in the area NuPower applied to the Aboriginal Areas Protection Authority (AAPA) on 09/09/08 for an Inspection of the Register of Sacred Sites that was issued on 01/10/08.

This shows numerous Sacred Sites and Restricted Works Areas throughout both tenements.

REGIONAL GEOLOGY AND MINERALISATION

REGIONAL BASEMENT GEOLOGY

The licenses are underlain predominantly by Palaeoproterozoic sedimentary, volcanic and intrusive rocks of the Strangways Metamorphic Complex (SMC), forming part of the eastern Arunta Block (Figure 3), that has a long accumulation and deformational history, the basal unit of which has been dated at 1810Ma (Claoue–Long et. al., 2005).

Deformation and metamorphism were multi-phase (Maidment et. al., 2005). The initial metamorphism and deformation took place around 1780Ma under amphibolite to granulite facies conditions of the Strangways Orogeny referred to as the Early Strangways Event. These rocks were then exhumed and eroded to form the basement on which the Ledan Package (Mendip Metamorphics, Leaden Schist and Utopia Quartzite) was deposited. The rocks of the Ledan Package and the underlying basement were then metamorphosed at amphibolite facies during the Late Strangways Event, at around 1720Ma.

According to Clerk et. al., (2007) the rocks of the SMC were reworked at around 1645Ma during the Liebig Orogeny, the structural character of which dominates the area. Further deformation then took place during the Chewings Orogeny, 1590-1560Ma.

Carbonatites were intruded along the NW-trending Woolanga Lineament around 730Ma. At Mud Tank the carbonatite complex comprises a series of lenses emplaced along a ductile shear zone. Each lens consists of a carbonate core surrounded by mica-rich zones, emplaced into granitoid cataclasites, mafic granulites and rare lenses of aluminous rocks (Currie et. al., 1992).

Further significant reworking took place from the Cambrian through to the Carboniferous, commencing with extensional deformation, mafic magmatism and high-grade metamorphism of the Harts Range Metamorphic Complex in the interval 510–460Ma. Compressional deformation continued, probably intermittently, until 300Ma, during the long-lived Alice Springs Orogeny (Scrimgeour, 2006). North over south ductile thrusting of the SMC granulites occurred around 430-390Ma when the Wallaby Knob Schist Zone, exposed south of Bushy Park homestead, was reactivated, (Goscombe, 1991).
LOCAL BASEMENT GEOLOGY

The Strangways Ranges in the southern part of the area consist mostly of units of the Cadney Metamorphics (pEsc) comprising calc-silicate rocks, marbles, sillimanite-biotite, garnet-biotite and quartzofeldspatic gneisses, felsic and mafic granulites, quartzites and amphibolites. This group also hosts the Southern Cross Schist Zone (Pzr/Prs) of retrogressed greenschist facies muscovite-biotite and kyanite schist with relict bodies of sillimanite quartzofeldspatic gneiss and amphibolite.

Separated from the Cadney Metamorphics by a major fault zone in the northeast are rocks of the Hillsoak Bore Metamorphics (pEu) that include quartzofeldspatic, biotite and sillimanite gneisses, migmatites, amphibolites, mafic and felsic granulites and calc-silicate rocks. These rocks host the West Bore Schist Zone (Pzr/Prw) that consists of retrogressed greenschist facies biotite, muscovite-biotite and quartzofeldspatic schist, quartzite, amphibolite, and calc-silicates.

The northwestern part of the Strangways Ranges here is composed of various quartzofeldspatic, felsic and mafic granulites and biotite and biotite-garnet gneisses, (pEsp). Here the Yambah Granulite (pEsy) also contains migmatites, cordierite granulite, quartzite and magnesian-rich rocks.

Figure 3 - Strangways Project, Regional Geology
In the southwest part of the Strangways Ranges units of the Erotonga Metamorphics (pEsr1,2) include cordierite gneiss, mafic granulite, and a layered sequence of felsic granulite and cordierite felsic granulite with rare calc-silicates.

Further south in the Wuluma Hills and Utnalanama Range the Erotonga Metamorphics are intruded by two separate felsic bodies. In the Wuluma Hills the Wuluma Granitoid (pEsw) contains rafts of sillimanite gneiss and in the Utnalanama Range tonalitic-dioritic hypersthene granofels of the Utnalanama Granulite (pEsu) is interlayered with mafic granulite of the Johanssen Metagabbro (pEsj) and meta-anorthositic gabbro of the Harry Anorthositic Gabbro (pEsh).

In the southwestern corner the Nabib Range is underlain by rocks of the Ankala (pEa) and Sliding Rock Metamorphics (pEi) comprising hornblende, sillimanite, garnet-biotite, and quartzofeldspathic gneisses, amphibolites, migmatites, calc-silicates and meta-ultramafics. These metamorphics also host retrogressive greenschist facies schist zones (Pzr). A small body of Late Proterozoic Gum Tree Granite (Pgg) is also present here consisting of porphyritic granite with numerous acidic dykes.

North of the Plenty Highway the Mt Bleechmore massif is underlain by Mt Bleechmore Granulite (pEe) consisting of sillimanite-garnet-boitite quartzofeldspathic gneisses, garnet-K feldspar migmatites, mafic granulites, plutonic migmatites and rare calc-silicates. The massif also contains small bodies of mafic granulite and amphibolite (pEea) and garnet plutonic migmatite, (pEeg).

CAINOZOIC REGIONAL GEOLOGY

The southern NT forms a ‘basin and range’ province with Proterozoic and Palaeozoic rocks forming prominent ranges separated by broad valleys. Cainozoic sedimentary basins are widespread and well-developed within these intervening topographic depressions with at least twenty major basins known (Senior et al., 1995). The Strangways Project covers a small area of the most eastern part of the Ti-Tree Basin (Figure 4), and its join with the Waite Basin.
Figure 4 - Strangways Project, Inferred Ti Tree-Waite Cainozoic Basin/Palaeochannel
The stratigraphy of the intermontane Cainozoic basins of the southern NT region is generally poorly known. This is attributed to a lack of outcrop, strong weathering overprints, the paucity of drillholes and a lack of attention paid to the ‘cover’ overlying crystalline basement. Knowledge of the distribution and extent of the Cainozoic has been largely gained through accidental intersections in water bores or in drillholes seeking mineralisation under cover.

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

Historical exploration in the Ti Tree Basin include a traverse of six drillholes in the western part of the Basin by CRA Exploration that indicated that, in places, the unconsolidated sediments are in excess of 300m deep. During the late 1970’s and early 1980’s the relatively small Hale Basin (Figure 5) was explored extensively for coal (lignite) and sedimentary uranium and is considered to be the best known Cainozoic basin in the NT. The stratigraphy of the Hale Basin is summarised (Figure 6) and although the succession is relatively thin (<100m), it can considered to represent a generalised Tertiary stratigraphy for the southern NT.
Figure 5 – Strangways Project, Geology, Cainozoic Basins
Based upon drilling in the Hale Basin, a broad two-fold stratigraphic subdivision was defined (Senior et al. 1994) that corresponds well with the observed pattern of Cainozoic sedimentation elsewhere in southern Australia. It comprises a restricted, fluvial palaeochannel dominated Palaeogene succession (Hale Formation) overlain by a more widespread, dominantly lacustrine Neogene succession (Waite Formation). An additional stratigraphic unit, the Napperby Formation has since been recognised by NuPower as overlying the Waite Formation and represents the development of prograding alluvial fans shed from the ranges flanking the Cainozoic Basins.

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

Whilst Cainozoic stratigraphic units were initially defined in separate, small and isolated Tertiary Basins (Senior et al. 1994), these units are now recognised as components of a much larger Tertiary palaeodrainage system, the extent and size of which has until now been vastly underappreciated.

Both historic and recent drilling results indicate that the apparently isolated Tertiary Basins contain very thick sedimentary packages. The Cainozoic fill of the Burt Basin exceeds 200m and the Sixteen-Mile Basin contains at least 180m of sediment. Similarly, the Whitcherry Basin and Waite Basins are known to exceed 250m in thickness in some locations, whilst minor tributaries feeding the Ti-Tree Basin contain up to 140m of sediments. The maximum thickness of the Cainozoic sediments in the Ti-Tree Basin is not currently known but thicknesses of 400-500m of sediments are considered to be likely in the deeper portions of the basin.

**DEPOSITION AND WEATHERING**

Deposition of Cainozoic sediments was episodic and punctuated by hiatuses during which prolonged periods of weathering resulted in the formation of well-developed weathered profiles (palaeosols and duricrusts). Deep weathering was an ongoing process during the Tertiary but was enhanced at particular times by the combination of periods of warm, humid climates, non-deposition and surface exposure. Three Palaeogene weathering events have been defined (Senior et al. 1995) which affected Arunta igneous and metamorphic basement rocks and the overlying Tertiary succession. An additional two weathering events have been recognised from the overlying Neogene succession and appear to correlate with similar periods of weathering and exposure evident in southern Australia.

Weathering Event A (Senior et al. 1994, 1995) occurred during the Late Cretaceous to Early Tertiary (Palaeocene). Trizonal weathering profiles were developed in basement rocks over a widespread area of the Arunta Region and at the base of surrounding Tertiary basins. The trizonal profile consists of a basal kaolinitic zone (up to 10 meters thick) that grades into a multicoloured mottled zone (up to 10 meters thick) and is then capped by a ferruginous or (laterite/ferricrete) zone up to 8 meters thick.
Following uplift and partial truncation of the deeply weathered basement rocks, sedimentation in the surrounding Tertiary basins began in the Palaeocene with deposition of thick colluvium including fanglomerates flanking the ranges. This was followed by deposition of fluvio-lacustrine sand, silt and clay (locally carbonaceous) and lignite of the Lower Hale Formation in the Ti-Tree and Burt Basins during the Early to Middle Eocene. Locally this includes a basal lacustrine green and grey pyritic mudstone, white mudstone and siltstone, and red iron oxide stained siltstone and siltstone. Fluvial sands of the Ambalindum Sandstone Member fine upwards into the paludal Claraville Mudstone and Ulgnamba Lignite Members.
Weathering Event B, recorded in the Hale Basin, occurred prior to the Middle Eocene, although there is little evidence elsewhere for this weathering event (Senior et al., 1995). This resulted in lithification and formation of a second ferricrete profile.

Deposition of sandstones of the Upper Hale Formation took place during the Late Eocene and these sediments were subsequently overprinted by Weathering Event C marking widespread exposure and surficial weathering in response to a prolonged period of non-deposition during the Oligocene.

Climatic amelioration during the Early Miocene rejuvenated the palaeodrainage systems and led to the deposition of fluvial sands at the base of the Waite Formation. A change from fluvial to lacustrine sedimentation then followed during the Middle to Late Miocene and resulted in the accumulation of over 300 meters of fluviatile and lacustrine limestone, sands, muds, and sandy conglomerate in localised depocentres.

The upper portions of the Waite Formation are regionally extensive and consist largely of clay and dolomitic clays that reflect the widespread development of broad, shallow evaporitic lakes throughout southern Australia as the continent drifted further northwards and became progressively more arid and seasonal. Two gradational upwards cycles from clays to dolomitic clays to dolomitic limestones (often capped by chalcedonic limestones and silcretes) are commonly observed, suggesting that deposition of the Waite Formation occurred in at least two phases. Weathering Event D was responsible for the formation of the inter-Waite Formation silcrete (possibly in the Middle Miocene).

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

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

Overlying these sediments are unconsolidated Quaternary sediments including quartz sands, silts, red earths and clayey and sandy soils that record a complex history of deposition, erosion and redeposition due to climate changes and gentle tilting. Large outwash fans from the Strangways Ranges have formed alluvial plains and overbank deposits alongside sandy drainage channels. In more distal locations, the development of aeolian sand plains was widespread. The formation of calcretes, particularly within drainage channels and atop the Waite Formation, was widespread during the Quaternary (Weathering Event E).
MINERALISATION AND PROSPECTS

The Strangways region hosts a broad range of mineralizing styles and base metal deposits that include, (Figure 7);

- Cu-Pb-Zn deposits at Gecko, Rankins Gumtree, Utnalanama (Johanssen’s Phlogopite Mine), Edwards Creek and Glancroil.
- Cu-Au deposits at Johnnies Reward, Pinnacles and Turners.
- Vermiculite-REEs at Bleechmore Dykes and Mud Tank.
- Au in the Arltunga-Winnecke Goldfields.

Base metal and gold mineralisation deposits in the SMC deposits discovered to date are currently uneconomic with the maximum combined Zn+Cu+Pb content at around 4%, (Hussey et al., 2006). The base metal deposits are interpreted as syngenetic massive sulphide stratabound deposits of Broken Hill type of Palaeoproterozoic age.

The Cu-Au deposits are interpreted to be of epigenetic fault-related origin, or possibly metamorphosed iron oxide-Cu-Au deposits, but still of Palaeoproterozoic age.

A vermiculite prospect at Mt Bleechmore located in SEL25056 13km NNW of Gemtree was explored extensively and drilled by FMS in 2002-2003.

The Arltunga-Winnecke Goldfields mineralisation is controlled by Palaeozoic structures as either retrograde shear zones or faults and breccias.
Other mineralisation is considered to be related to deformation and fluid flow during the Alice Springs Orogeny. According to Scrimgeour (2006) during the latter stages of the Alice Springs Orogeny, in the Carboniferous, significant amounts of fluid were mobilised along shear zones in a belt that trends southeast from the Napperby region through to Arltunga, resulting in significant mobilisation and deposition of gold.
This includes the Winnecke-Arltunga goldfield that straddles the boundary between the SMC and the Neoproterozoic Amadeus Basin, where mineralisation is hosted by retrograde green schist zones (Swarnecki, 2004).

The Bruce’s Cu-Au prospect (in the Harts Range Metamorphic Complex) and much of the uranium and rare-earth mineralisation in the eastern Arunta can also be attributed to large-scale Paleozoic fluid-flow events including Arafura Resources’ Nolan’s Bore REE-phosphate-uranium deposit. This deposit, hosted by the Boothby Gneiss is located approximately 100 kilometres WNW of the Strangways licenses.

In addition to base metals and gold prospects there are several mica occurrences. A small quantity of phlogopite was mined during the 1940s from Johanssen’s phlogopite mine, in SEL25055 north of the Arltunga Road. Vermiculite is currently being mined from the Mud Tank carbonatite by Australian Vermiculite Industries and there is a vermiculite/phlogopite prospect about 15km NNW of Gemtree.

PREVIOUS WORK
There has been considerable exploration for gold and base metals in the region.

**CR19950650, AP1721, Central Pacific Minerals NL, 1967-1971**
Explored for gold and base metals. Small remnants of lateritized sandstone of probably Tertiary age are preserved in the central part of the area about Sliding Rock. Prospect is low grade lead-zinc with minor copper. Exploration consisted of geological mapping, stream sediment sampling and testing for radioactivity using scintillometers.

Exploration was for carbonatites and base metals. Results of air photo mosaics, auger drilling, stream sediment sampling and on air ‘survey’ were unsatisfactory and the tenement was dropped.

**CR19720084, AP3427 and AP3428, ASARCO Australia Pty Ltd, 1971-1972**
Exploration was for base metals and consisted of stream sediment sampling, geological traversing and aerial reconnaissance. Results were not encouraging and the tenements were dropped.

**CR19740102, ELs 110, 154, 183, 283, 346, Russgar Minerals NL, 10972-1975**
Results of stream sediment, rock chip and air photo interpretation were disappointing.

**CR19740097, CR19740098, Stockdale Prospecting Ltd, 1973-1974**
IP was flown, but there is no relevant data.

**CR19770139, EL1341 and EL1342, Dampier Mining Co Ltd, 1976-1977**
These two tenements appear to mostly lie over basement outcrop. Exploration was for stratiform copper-lead-zinc mineralization.

Exploration was for gem stones and base metals. Work included stream sediment sampling, stream gravel sampling, rock chip and geologic investigations.

**CR19800125, CR19810178, EL1802, Alcoa of Australia Ltd, 1979-1983**
Exploration was for uranium and included 52 rotary drill holes. The report included gamma logs, cross sections and drill hole logs.
CR19800192, EL2074, Otter Exploration NL, 1979-1982
Exploration was initially for diamonds, then changed to gold and base metals. Work included stream sediment sampling, rock chip sampling, and geological reconnaissance. Initially encouraging anomalies were eliminated after follow up.

CR19830169, EL 3026, Alcoa Australia Ltd, 1982-1988
Exploration was for gold and base metals and included five diamond core drill holes with limited sampling. Results were unsatisfactory.

CR19830228, EL3501, CRA Exploration Pty Ltd, 1982-1983
The sampling results were negative for kimberlite, carbonatite, base metals and micro diamonds.

CR19890356, EL4326, Range Resources Ltd, 1983-1988
Exploration focused on gold and base metals. A ground magnetometer survey was followed by 18 reverse circulation rotary percussion holes and 13 trenches. Mineralisation was judged to be too small, too low grade and hence sub-economical.

CR19890356, EL5545, Range Resources Ltd, 1987-1988
The company was exploring for gold and base metals. Their report concerns literature research only.

CR19870287, EL4528, Kinex Pty Ltd, 1984-1990
This report is concerned with an apparently sub-economic gold prospect.

CR19980258, EL4959, EL5079, EL5081, Conapaira Metals Pty Ltd, 1988-1989
Exploration was for gold. The area was dropped due to the depth of sediments in EL4959. Uneconomic presumably for the others.

CR19980301, EL 5280, Tectonic Systems Pty Ltd, 1987-1989
Interest was in gold. This report contains a literature search and soil samples. No conclusions and no follow up report. Contains a compilation of all previous work, grades and reserves and proposes future drilling. Johnnies Reward is a volcanic-exhalative gold deposit. This report details exploration history of the prospect.

CR19980205, EL5283, McMahon Construction Pty Ltd, 1987-1988
Gold and base metals. Literature research and a few samples. No follow up work.

CR19930494, EL6013, G K Bogie, 1988-1993
Stream sediment and rock chip sampling. Exploration was for gold, base metals and rare earths.

CR19900305, EL6372, Carrington Holdings Pty Ltd, 1989-1990
Concerned with potential for zircon in the Mud Tank Carbonatite. Review of published literature and company reports, study of aerial photography, stream sediment sampling with follow up sampling.

CR19950511, EL6662, G K Bogie, 1989-1995
Gold and base metals. Stream sediment and rock chip sampling. Shallow RAB drilling.

The company carried out work over the Winnecke Goldfield with geologic mapping, drilling (one hole) and trench sampling. A regional bulk cyanide leach stream sediment survey yielded one unexplained anomaly of 1.3 ppb gold. Photo-mapping failed to locate any structural targets. Detailed chip sampling of quartz veining at Golden Goose gave disappointing gold values.
CR19920478, Saturn Resources Pty Ltd, 1990-1993
Results of stream sediment and soil sampling for diamonds gave unsatisfactory results.

CR19920438, EL6941, Clarence River Finance Group Pty Ltd.
Exploration targeted any economic mineralization but specifically mentioned gold, copper and garnet. They carried out rock chip and grab sampling and rock chip and stream sediment sampling in areas of known mineralization but failed to highlight any economic resource. Subsequently the tenement was examined for its garnet sand potential.

CR19930464, EL7571, Stockdale Prospecting Ltd, 1992-1993
Exploration was for gold and base metals. Work consisted of stream sediment, soil, BLEG and rock chip sampling.

CR19940277, EL7932, Normandy Exploration Ltd, 1993-1994
53 heavy media stream sediment samples were collected. No kimberlitic indicators were observed.

CR20020037, EL8164, Tanami Gold NL, 1993-2001
Extensive exploration programs over 8 years including geological mapping, stream sediment sampling, rock chip sampling, RAB drilling, diamond core drilling, aeromagnetic surveying, satellite imagery. Results included widespread, high grade but sporadic gold mineralisation. An RC drill program totaling 7 holes for 1,254m was completed testing a "structural corridor" that was derived from the mapping program. Extensive zones of quartz veining were intersected, but no significant gold values were returned from the assaying of 316 samples. The company considered that the tenement has been adequately tested and relinquished the ground.

CR20020101, EL8489, Flinders Diamonds Ltd, 1995-2001
Exploration was for gold and copper and included aeromagnetic surveys, ground magnetic and self-potential geophysics, percussion drilling, rock chip sampling and diamond core drilling. Evaluated as sub-economic.

CR19880318, Pasminco Exploration, 1995-1997
Literature search, stream sediment sampling geological reconnaissance and rock chip sampling.

CR19980043, EL9364, Pasminco Exploration, 1996-1997
Infill sampling was completed in the vicinity of anomalies identified from analyzing historical results. Results were discouraging. Mapping located a previously unknown copper-gold Pinnacles style associated silica-garnet alteration.

CR20020225, EL22292, Oneva Exploration Pty Ltd, 2001-2003
Exploration was for copper/gold. Literature research, geologic reconnaissance and traversing, soil and rock chip sampling, geological mapping. Results showed that Cu-Au mineralisation is overall patchy, and controlled by major structural faults. A number of new Au-Cu discoveries were made along the Cadney Fault. Shallow drilling was inconclusive due to shallow water table.

CR20040663, EL9528, Tanami Exploration NL, 1996-2004
Reworking of previous gold and base metals prospect.

CR2004238, EL 23184, Tanami Exploration NL, 2003-2004
Reworking of previous gold and base metals prospect.
WORK DURING CURRENT TENURE

MAXIMUS RESOURCES EXPLORATION WORK, YEAR 1, 2007
The only work carried out was an office evaluation of past diamond exploration and on-going diamond prospectivity.

NUPOWER EXPLORATION WORK, YEAR 2, 2008
During Year 2, NuPower carried out a bore ground water sampling program as part of its exploration for secondary uranium deposits, that was reported previously, (Rafferty, 2008a, b).

NUPOWER EXPLORATION WORK, YEAR 3, 2009
During Year 3 the company planned, carried out and received final reprocessed products of an airborne electromagnetic (AEM) survey over areas of flat sandy plains in the northern parts of both areas targeting the potential for buried palaeochannels that are reported here.

The Company also planned and contributed to a regional gravity survey (CAGS) to assist with structural interpretation of the basement that is reported here.

NuPower also undertook negotiations with the CLC to gain access for reconnaissance exploration work of the numerous uranium and thorium airborne radiometric anomalies identified by NTGS surveys, and completed a regional stream sediment sampling program throughout both areas for primary uranium mineralisation in basement rocks, that is reported here.

All results were reported previously (Rafferty 2009)

NUPOWER EXPLORATION WORK, YEAR 4, 2010
Minimal on-ground fieldwork was carried out in Year 4. NuPower prepared various maps and studied the historical data provided by Maximus Resources in preparation for Year 5 work

NUPOWER EXPLORATION WORK, YEAR 5 2011
2010 – 2011 fieldwork had the aims of follow up with field mapping, airborne radiometric anomalies and stream sediment geochemical anomalies defined from earlier NuPower work. 30 samples were taken for assay. All results were presented in Davey 2011.

NUPOWER EXPLORATION WORK, YEAR 6 2012
During 2011 3 phases of work were carried out. Phase 1 involved following up several magnetic anomalies on SEL 25056. Phase 2 consisted of pegmatite exploration on SEL 25055 and Phase 3 consisted of a consultant visit to SELs 25055 and 25056. All results were reported in Davey, 2012.

NUPOWER/MAXIMUS/FLINDERS MINES EXPLORATION WORK, YEAR 7 2013
No fieldwork was conducted during this reporting period

CONCLUSIONS AND RECOMMENDATIONS
Having reviewed all previous work, Flinders Mines Ltd decided that there was no further interest in the project and it was decided to relinquish the tenements.

EXPENDITURE STATEMENT
The covenant for SEL25055 for Year 7 2013 was $200,000 The expenditure was $5,451.

The covenant for SEL25056 for Year 7 2009 was $200,000 The expenditure was $0.
REFERENCES


