NT Minerals Pty Ltd
Amadeus West Project
EL29077, 29078, 29079, 29080, 29081, 29082, 29083, and EL29084
Year 1 Annual Report
For the period
06/06/12 - 30/08/13

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1.0 ABSTRACT

The Amadeus East Project lies 90km to 200km south of Alice Springs and covers an area of 5448km$^2$ of the Amadeus Basin. The project consists of 8 granted tenements, EL29077 to EL29084 and this report covers the first year of exploration. While all commodities are the target for exploration the focus will be on potash related to salt dominated stratigraphy of the Amadeus Basin as well as potash and industrial salt products / minerals associated with the playa salt lakes and shallow groundwater brines.

Only limited previous exploration has occurred across the current project area. The main target has been uranium with no prospective areas identified and no anomalous results returned. Conceptual modelling by Reward Minerals over the north east of the current project suggested potential for potash associated with stratigraphic salt layers within the Amadeus Basin although no follow-up was ever completed. The potential for Potash associated with salt layers of the Amadeus Basin should be re-evaluated.

Potential industrial salt products, potash, and industrial minerals such as gypsum associated with playa salt lake has been evaluated along the Karinga Ck, immediately to the north of the south western areas of the current project area. Playa salt lakes exist within the current project and these will be evaluated in future programmes for their industrial mineral potential via the potential processing of the brines.

Reprocessing of available airborne geophysical data (magnetics and radiometrics) is recommended as well as acquiring satellite imagery for detailed mapping for the regolith across the region.
2.0 LOCATION AND PHYSIOGRAPHY

2.1 LOCATION
Amadeus East Project is located in southern Northern Territory, approximately 90km to 200km south of Alice Springs.

2.2 TENEMENT DETAILS
Amadeus East Project is comprised of a total of 8 titles and covers an area of 5448 km². The titles were granted in 2012 for a period of six years with details shown in the table below.
2.3 ACCESS
The Amadeus East Project is located approximately 90km to 200km south of Alice Springs located east of the Stuart Hwy.

Access from the Stuart Hwy and then via various track which access a number of aboriginal communities in the region.

2.4 PHYSIOGRAPHY
The Amadeus East Project area is relatively flat with the majority of the region covered by sand dunes which obscure outcrop of formations.

3.0 GEOLOGICAL SETTING

3.1 REGIONAL GEOLOGY
Amadeus East Project is located in the intracratonic Amadeus Basin located in the south of the Northern Territory.

The Amadeus Basin is a Neoproterozoic to early Phanerozoic intracratonic sedimentary basin approximately 170,000 square kilometres in area and includes several sub-basins and troughs which are major depositional centres. Sediment thickness reaches a maximum of 14,000 metres.

The Amadeus Basin overlies the Warumpi and Aileron provinces to the north and the Musgrave Province to the south. The Amadeus Basin is overlain by the Eromanga and Pedirka Basins to the south-east.

The basin has at least nine recognisable megasequences separated by regional unconformities. These megasequences were instigated by major tectonic events including the Peterman and Alice Springs Orogenies.

Periods of subsidence and uplifts coupled with sea level changes caused a series of fluvial, glacial, marine and evaporite deposits. Though the formation of the Amadeus Basin was instigated by an extensional event, the majority of deformation that took place was compressional and...
transtensional (Shaw, R.D. 1991). More recently, halotectonics has been considered to be very important to the development of the basin’s structure with evaporite deposits allowing an alternate dispersion of tectonic forces and acting as reservoirs (Marshall and Dyson, 2007).

Figure 2  Map of the Structures of the Amadeus Basin Red box depicts location of Amadeus East Project (Shaw, R.D. The tectonic development of the Amadeus Basin, Central Australia, BMR Bulletin 236, 1991)
Figure 3 Simplified Stratigraphic Column of the Amadeus Basin. Adapted after Wells and others, 1970 and Kennard and others, 1986 (Shaw, R.D. The tectonic development of the Amadeus Basin, Central Australia, BMR Bulletin 236, 1991)
3.2 LOCAL GEOLOGY

A summary of the local Geology is shown in Figure 4.

![Figure 4 Local Geology of Amadeus East Project.](image)

3.3 HISTORIC EXPLORATION

Initial exploration over the south of the project was conducted by Le Nickel and Agipnuclear Australia in the 1970’s through to the 1980’s targeting sedimentary hosted uranium associated with ‘red beds’ of the Finke River Group. No significant results were returned from these exploration programmes.

During the 1990’s to 2000’s exploration focused (NT Evaporites Pty Ltd) on targeting the potential of the salt brines associated with playa salt lakes (and shallow groundwater) as well as various industrial products such as gypsum and various salt products. This work concentrated on the potential of Karinga Ck which is situated immediately to the north of the southern areas of the project.

CRA completed diamond exploration over the central portion of the project in the 1990’s and identified several targets which were ground followed up with no anomalous results returned.

Another phase of uranium exploration occurred across the project area in the 2000’s with no field work completed despite a large area being held under tenure by companies such as Nova Energy Ltd.
and Northern Mining limited. Reward Minerals Limited during the late 2000’s targeted hard rock potash in the Amadeus Basin rock but completed no field work other than the conceptual targeting.

In 2010 Rum Jungle Uranium re-evaluated the potential of the salt lake brines for various salt products and have defined a potash resource along the lake systems of Karinga Ck (outside the current project area).

**Le Nickel**

**EL745, 746, 747**

CR19730100: Targeting Uranium sedimentary hosted style mineralisation associated with ‘red beds’ of the Finke Group.

CR19740028: Completed a photogeological interpretation and airborne magnetic / radiometric survey. Concluded that the radiometrics were not very useful due the extensive cover.

CR19780005: No additional work completed.
EL1214

CR19770136: Targeting uranium potential. No work within current project area.

CR19780141: Completed an additional 14 drill holes targeting uranium, all drill holes are outside the current project area with no anomalous results returned.

EL1213

CR19780065: Completed a number of ground radiometric traverses as well as drilling of one hole to 111m. Not very clear exactly what the hole was targeting (which intersected 32m of Tertiary cover sediments before intersecting Amadeus basement). No anomalous uranium was intersected in the drill hole.

EL1417

CR19780074: Completed a regional ground radiometric survey along with 653m of percussion drilling and down hole logging targeting uranium. Drill holes targeted the stratigraphic and geochemical variations of the Langra Formation and Polly Conglomerate within the Lilla Creek Basin. Drill hole locations are shown on the NTGS digital database.

CR19780157: Targeting uranium. Completed ground radiometrics and collected 4 water samples with no anomalous results returned. A total of 8 drill holes for 1103m was completed most of which was completed within the current project area. Downhole logging of the holes failed to detect any anomaly. They also concluded that the nature of the sediments suggested low uranium potential.
EL1215

CR19780140: Targeting uranium potential of the Finke Group sediments in particular the Langra and the Polly Conglomerate Formations. Completed 10 drill holes which are shown on the NTGS digital database. No anomalous results were returned from the drilling.

EL3098

CR19830309: Targeting Fe and Mn gossans but very little useful information supplied to locate the prospects.

CR19860011: Targeting gossanous outcrops and returned some anomalous base metal results although all samples appear to be outside of the current project area.

CR19870087: Very strange report and almost seems that the Author was high on magic mushrooms. Difficult to work out what they were looking for or trying to achieve.

EL5862

CR19890322: Tenement mostly lies on the Musgrave Province to the south of the current project area. No work within the project area.

NT Evaporites Pty Ltd

EL6509

CR19900709: Targeting industrial minerals and brine resources within a chain of playa lakes within the tenement. Mineral groups targeted for investigation included dolomite, silica/silicate (zeolites, clays), evaporate (sulphates, chlorides and mixed salts of sodium, calcium, magnesium, and
potassium) deposits. Recent field experiments and laboratory tests indicate the possibility for producing a wide variety of valuable industrial salts and liquids, from the playa brines.

Regional groundwater system appears to be two-layered, with Cainozoic sedimentary aquifers (clay-sand units and calcretes) overlying fractured bedrock aquifers. The playa lakes represent essentially outcrops of the shallow groundwater in the region, with groundwater discharge being mostly via marginal calcrete aquifers and the basement Devonian shale units. The playa brines are highly concentrated with respect to sodium, chloride, sulphate, magnesium and potassium ions; the summer concentration of brines reach extremely high values (e.g., in excess of 400 g/l total dissolved solids), unmatched by any lake system in Australia.

Investigations so far indicate the presence of suitable brine types for production of high grade industrial salts. Selected number of the brine samples were recently subjected to a variety of laboratory and field experimentations to assess the technical feasibility of producing high-value industrial salts by using a combination of solar energy and chemical techniques. The results of these experiments have been very encouraging and work is now in progress towards a more comprehensive assessment of producing industrial-grade salts from the brines in the playa chains contained in Exploration Licences 5689, 5801 and 6509.

The investigations during the past two years in the adjoining tenement areas have indicated that, apart from presence of large volumes of highly concentrated magnesium- and potassium-enriched brines, the playa beds contain significant reserves of evaporite, carbonate and clay-mineral deposits with direct industrial application. The main industrial grade mineral types targeted for exploration in EL 6509 belong to the two groups of magnesio-aluminium silicates and bentonitic smectite clays. The available geological and hydro-chemical information also indicate favourable conditions for occurrences of zeolite deposits; for example, analcime associated with lacustrine dolomite deposits was recently reported from two BMR drill holes in the Curtin Springs area. Further field investigations, including shallow drilling, is recommended for assessing the silicate mineral resources in the area.

Water and grab sampling was completed from playa lakes and pits.

Groundwater quality in Cainozoic calcretes and associated sediments of the study area is generally in the range of 1.5-9.7 g/l total dissolved solids. The fresher groundwater (1.5-4.8 g/l TDS) in the study area are recorded mainly from the bedrock hilly areas and in the perched calcrete aquifers, which are away from direct influence of playa brines. Down the local hydrologic gradients, the groundwaters become increasingly saline, reaching salinities up to 15.7 g/l TDS. In the playa marginal areas, the brines become Cl-SO4 dominant, and Na is the major cation. Within the playas, intense evaporative concentration of near-surface solutions initially give rise to precipitation of gypsum at concentrations above 100 g/l TDS. As a result, the playa brines in the general area of Lake Amadeus are commonly Na-Cl waters and highly enriched in K, Mg and SO4.
zeolites. The main industrial clay variety in the area appears to belong to sepiolite - palygorskite group of clays, as identified by x-ray diffraction analysis. In some of the lakes, the basement shale deposits of Devonian age exhibit bentonitic smectite characteristics, as evidenced by NMR and IR analytical results. Drilling would however be required to assess the depth of alteration of the clays and their reserves.

Othe chemical deposits, including the carbonate and evaporite minerals appear to have limited reserves in this licence area.

Highlight in the paragraph above that clay deposits have the highest potential in the region. The author of this report is an expert in the field.

By considering the favourable climatic conditions and quality of brines in the Karinga Creek drainage system, a preliminary combined field and laboratory experimentation, involving precipitation of sulphate and chloride salts from playa brines has been in progress since June 1990. A sequential evaporation-cooling technique was utilised to simulate variation in the crystallisation phases and mineral quality, under natural and simulated temperature and humidity conditions. The results of these experiments clearly confirm the high potential for yielding sulphate- and chloride- salts of sodium, magnesium and potassium from playas as well as the Karinga Creek brines in the licence area. Further field investigations for assessing the brine resources, and laboratory tests to assess the feasibility of producing high grade industrial salt minerals from the brines of the area are planned for 1990-91 period.

Karinga Creek mentioned above lies immediately to the north of the south western tenements.

CR19920694

This report compiles the main findings from resource evaluation and technical pre-feasibility assessments undertaken to date by Geo-Processors Pty Ltd on behalf of NT Evaporites (NTE) and NT Department of Industries and Development. The objectives of of these investigations were to assess the resource potential and technical feasibility of utilising playa brines located in the Karinga Creek drainage system, Northern Territory (Fig. 1), for commercial salt production. Previous investigations
A very comprehensive report on the feasibility study of brines located on Karinga Creek which lies to the north and north west of the south western tenements in the project.

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>CHEMISTRY</th>
<th>KEY MARKETS / APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium sulphate*</td>
<td>(Na2SO4)</td>
<td>Powder detergent, glass and pulp &amp; paper</td>
</tr>
<tr>
<td>Potassium sulphate*</td>
<td>(K2SO4)</td>
<td>Fertiliser</td>
</tr>
<tr>
<td>Potassium chloride*</td>
<td>(KCl)</td>
<td>Oil &amp; gas, fertiliser</td>
</tr>
<tr>
<td>Sodium chloride*</td>
<td>(NaCl)</td>
<td>Swimming pool, stockfeed additives, &amp; gas, food processing</td>
</tr>
<tr>
<td>Magnesium sulphate*</td>
<td>(MgSO4)</td>
<td>Fertiliser, stockfeed supplement, cement, detergent, pharmaceutical</td>
</tr>
<tr>
<td>Magnesium carbonate</td>
<td>(MgCO3)</td>
<td>Fertiliser, paper and plastics</td>
</tr>
<tr>
<td>Magnesium oxide</td>
<td>(MgO)</td>
<td>Refractory, cement, environmental stabiliser</td>
</tr>
<tr>
<td>Ammonium sulphate</td>
<td>[(NH4)2SO4]</td>
<td>Fertiliser</td>
</tr>
<tr>
<td>Ammonium chloride</td>
<td>(NH4Cl)</td>
<td>Fertiliser, industrial additive</td>
</tr>
<tr>
<td>Potassium nitrate</td>
<td>(KNO3)</td>
<td>Fertiliser</td>
</tr>
<tr>
<td>Sodium bromide</td>
<td>(NaBr)</td>
<td>Additive to many industrial formulations</td>
</tr>
<tr>
<td>Bromine</td>
<td>(Br2)</td>
<td>Additive to many industrial formulations</td>
</tr>
</tbody>
</table>

* Main salt products expected from processing of playa brines in the NTE licence areas. The remaining salts represent secondary products for value-adding.
The key findings of this study can be summarised as:

- Brine resources identified in the licence areas originate from both regional and local sources are considered suitable for production of a range of salt commodities. Combined, these resources offer an opportunity for a sizeable commercial operation which may include a number of options for comprehensive utilisation of the brine resources. Further resource evaluation for determination of reserves and safe yields is warranted.

- Application of an integrated saline processing for producing a range of commercially valuable products is technically feasible. Brine characterisation, theoretical and experimental work indicate that the main products from saline processing would include: thenardite, halite, potassium sulphate, potassium chloride, sylvite and epsomite. The secondary products which according to these assessments could be produced for value-adding may include: magnesium carbonate, magnesium oxide, ammonium sulphate, ammonium chloride, potassium nitrate, sodium nitrates, sodium bromide and bromine.

- Assessments point to technical feasibility of a stand-alone operation in the NTE licence areas; however, a split operation partly based at the licence areas and partly at a southern port city may offer additional options for value adding through a comprehensive utilisation of the resources available in the licence areas.

- Findings from this technical study provide a significant measure of confidence in resources available for commercial development, thus justifying further assessments for commercial opportunities upon which this project could be based.

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**Figure 8.** Schematic section across a typical playa lake in the licence areas, showing the lithofacies distribution.

### 7.2.5 Precipitation of K$_2$SO$_4$ using Schoenite [K$_2$Mg(SO$_4$)$_2$.6H$_2$O]

Market value of K$_2$SO$_4$ salt is significantly higher than that of KCl, and the former is a preferred fertiliser for use in acidic soil terrains. This experiment was undertaken on Lake 17 brines to evaluate the feasibility of producing K$_2$SO$_4$ salt from bitterns generated in the Na$_2$-K$_2$.Cl-(SO$_4$)$_2$ brine stream. Having considered the solubility curves for MgSO$_4$.7H$_2$O + MgSO$_4$ salts, the "double decomposition" technique was used in this experiment for changing schoenite to K$_2$SO$_4$ by addition of KCl and water. The K$_2$SO$_4$ recovery rate was calculated to be about 4.3 kg/cu.m. brine.
CR19960679: A business plan document for the processing of salts from the area immediately to the north of the south western area of the project on Karinga Creek.

**NT Evaporites Pty Ltd**

**AS162**

CR20000296: Looking to salt rich brines and gypsum resources

CR20020062: Report looking at the feasibility and economics / markets of a playa lake brine treatment project.

The Playa brines have a high concentration of salts and of particular interest is the concentration of potassium. For example, the Dead Sea, a major source for the production of potassium compounds (e.g. potash) has the potential to produce 2 billion tonnes of potassium chloride from a total of 43 billion tonnes of total salts. This equates to a concentration of 4.65%. By comparison, the Playa brines have a concentration of 3.47% potassium chloride. Australia has no other known source of potassium which makes the Playa brines of particular interest.

However, previous studies have also reported that the brine quality is variable according to the location of the playa system; geochemistry of the particular lake and relationship to neighbouring calcrete and duneal sand aquifers. In addition, significant climatic variations do affect the chemistry of the shallow ground waters, however it has been reported that there is minimal fluctuations in ground water levels on a yearly basis.

A major product was planned to be sodium sulphate however the market for sodium sulphate has tumbled due to decline in the detergent industry which greatly affects (downgrades) the economics of the project.

CR20020231: Looks like there are objection from the Central Lands Council regarding an operation start-up and granting of long term tenure on which mining can occur.
EL6952

CR19910206: Conducted diamond exploration and completed detailed airborne magnetics. Identified an anomaly over the western portion of their EL but ground follow up did not identify any anomalous results.

EL6950, EL6951

CR19910387: Targeting diamonds and base metals. Identified several magnetic anomalies which were ground tested. No anomalous results were returned. Base metal exploration was limited to a review of the regions geology (desktop).

EL6949

CR19910506: Exploration targeting diamonds and base metals. Several diamond targets were identified with ground follow up completed with no anomalies generated.
CR19960891: Targeting sediment hosted copper mineralisation on the contact between the Arumbera Sandstone and the Chandler Formation. Identified a few areas with elevated geochemical backgrounds for As, Cu, Pb, Zn, Ag, Mo. The anomalous areas lie to the north of the current project area.
Northern Mining Limited

EL24467

CR20060426: Targeting sandstone hosted uranium and massive Mn mineralisation. Do not appear to have completed any field work.

CR20070439: No Field work completed.

CR20090719: Targeting sandstone hosted uranium and massive Mn mineralisation. No field work completed.

EL24503

CR20060436: Targeting sandstone hosted uranium and massive Mn mineralisation. Do not appear to have completed any field work.

CR20080671: Targeting sandstone hosted uranium and massive Mn mineralisation. Do not appear to have completed any field work.
EL25050, EL25051

CR20070482: Targeting sedimentary hosted redox facies related uranium mineralisation in the upper Devonian Finke Group sediments, similar to the Pamela and Angela deposits to the north. Field work completed (ground follow-up of historical radiometrics) on area outside of the current project area.

Reward Minerals Limited

EL25481

CR20080100: Targeting potash mineralisation within the Neoproterozoic Bitter Springs Formation and the Early Cambrian Chandler Formation. No field work or drilling was completed.

CR20090089: Targeting Potash mineralisation. No field work or drilling completed.

EL25961

CR20080583: Targeting potash mineralisation within the Neoproterozoic Bitter Springs Formation and the Early Cambrian Chandler Formation. No field work or drilling was completed.

EL25960

CR20080584: Targeting potash mineralisation within the Neoproterozoic Bitter Springs Formation and the Early Cambrian Chandler Formation. No field work or drilling was completed.
**EL26433**

CR20100088: Targeting all minerals with no field work completed as well as total relinquishment in the first year.
Rum Jungle Uranium

EL27047

CR20100091: Targeting Potash within the current project area although no field work was completed and the tenement was relinquished in the first year.

EXPLORATION TARGETS

**Chandler Formation**

The shallowest salt beds are known to occur in petroleum well Magee 1 at around 750m below surface. May be as shallow as 200m in some salt domes.

**Gillen Salt Member**

The deepest of the salt members and probably the most prospective. RUM researched the halotectonic history of the Amadeus Basin to find where salt diapirism has lifted the Gillen Salt Member to reasonable depths below surface for drill testing. The Gillen Salt Member is a thick evaporitic sequence within the widespread Bitter Springs Formation.

Relinquished the tenements as they could not find a JV partner soon after the potash price boom and decided to target potash associated with salt lake brines in their tenements further to the west of this project.
EL27048

CR20100092: Targeting Potash within the current project area although no field work was completed and the tenement was relinquished in the first year.

EL27049
CR20100093: Targeting Potash within the current project area although no field work was completed and the tenement was relinquished in the first year.

EL27056

CR20100094: Targeting Potash within the current project area although no field work was completed and the tenement was relinquished in the first year.

EL27060

CR20100095: Targeting Potash within the current project area although no field work was completed and the tenement was relinquished in the first year.

4.0 OPERATIONS REPORT

No field work has been completed on the Amadeus East Project. Work associated with this tenement has been focused on a review of previous exploration in order to plan the forward exploration programme.

5.0 CONCLUSION AND RECOMMENDATIONS

Only limited previous exploration has occurred across the current project area. The main target has been uranium with no prospective areas identified and no anomalous results returned. Conceptual modelling by Reward Minerals over the north east of the current project suggested potential for potash associated with stratigraphic salt layers within the Amadeus Basin although no follow-up was ever completed. The potential for Potash associated with salt layers of the Amadeus Basin should be re-evaluated.

Potential industrial salt products, potash, and industrial minerals such as gypsum associated with playa salt lake has been evaluated along the Karinga Ck, immediately to the north of the south western areas of the current project area. Playa salt lakes exist within the current project and these will be evaluated in future programmes for their industrial mineral potential via the potential processing of the brines.

Reprocessing of available airborne geophysical data (magnetics and radiometrics) is recommended as well as acquiring satellite imagery for detailed mapping for the regolith across the region.

6.0 REFERENCES


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