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<td>Annual Report for Period ending 6th February 2009</td>
</tr>
<tr>
<td><strong>Personal Author</strong></td>
<td>A Mukherji</td>
</tr>
<tr>
<td><strong>Corporate Author</strong></td>
<td>St Barbara Limited</td>
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<tr>
<td><strong>Company Reference Number</strong></td>
<td>0545-2009-01</td>
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<td><strong>Contact Details</strong></td>
<td>Alex Mukherji (Ms)</td>
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<td><strong>Fax</strong></td>
<td>08-9476-5500</td>
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<td><a href="mailto:alex.mukherji@stbarbara.com.au">alex.mukherji@stbarbara.com.au</a></td>
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<tr>
<td><strong>Email for Expenditure</strong></td>
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| **Distribution** | 1. St Barbara Limited  
2. Dept of Regional Development, Primary Industry, Fisheries and Resources – Northern Territory |
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Appendix 1  Report of Depth to Basement Modelling over EL26038
EXECUTIVE SUMMARY
This report summarises gold exploration activities undertaken by St Barbara Limited (SBM) on the Tenant Creek Project EL26038 during its first year of tenure between 7th February 2008 and 6th February 2009. EL26038 has an approximate area of 360km² and is centred 85km east-southeast of Tennant Creek in the Northern Territory. The tenement contains an iron oxide copper-gold (IOCG) target defined by external consultants to SBM. The target occurs within concealed eastward extensions of the prospective Tennant Creek Inlier. The inlier hosts several high grade Au-rich deposits (including Juno, Geko, Warrego, Nobles Nob, Peko and White Devil), which have produced over five million ounces of gold and over 440,000 tonnes of copper in the last 60 years, ranking it within the top ten Australian goldfields.

Exploration comprised open file data review and compilation, depth to basement geophysical modelling, a 669 station gravity survey, data processing and incorporation into GIS, 3D inversion and geophysical modelling, interpretation and targeting.

Depth to basement modelling revealed 3 target areas (TC102, TC103 and TC119) shallow enough to be considered worthwhile for exploration drilling/mining. The gravity survey covered the western portion of EL26038 in addition to infill surveys over the 3 target areas. The survey identified discrete anomalous gravity highs which require drill testing. Given the extreme lack of information regarding the depth to and nature of Proterozoic lithologies in these areas, SBM applied for and was given a co-contribution grant of $50,000 by the Northern Territory Geological Survey to drill one to two diamond drillholes over the north western corner of TC102 to a total depth of 500m. The drilling is expected to be completed during the 2009-2010 reporting year.
Legend

- Drill Target Area
- Depth to Basement Modelled Target Areas
- Gravity Stations
- EL26038
- Towns

Other Work:
- Data review & compilation
- Depth to basement geophysical modelling
- Processing of data & incorporation into GIS
- 3D inversion & geophysical modelling
- Interpretation
- Targeting

Datum: Geocentric Datum of Australia 1994 (GDA94)
Projection: Map Grid of Australia Zone 53

Tennant Creek EL26038 Exploration Index Plan

Date: February 2009
Drawn by: AXM
Ref: 0545-2009-01

1:500,000
St Barbara Limited
1 INTRODUCTION

This report summarises gold exploration activities undertaken by St Barbara Limited (SBM) on the Tenant Creek Project EL26038 during its first year of tenure between 7th February 2008 and 6th February 2009. EL26038 has an approximate area of 360km$^2$ and is centred 85km east-southeast of Tennant Creek in the Northern Territory.

The Project area is accessed by sealed road via the Stuart Highway to Tennant Creek then by pastoral tracks onto the tenement itself.

2 TENURE

EL26038 is held and managed by SBM and tenement details are shown below:

<table>
<thead>
<tr>
<th>Lease</th>
<th>Current Area</th>
<th>Lease Status</th>
<th>Grant Date</th>
<th>Expiry Date</th>
<th>Project</th>
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<tr>
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<td>128 Blocks</td>
<td>Granted</td>
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3 WORK COMPLETED AND RESULTS

3.1 DEPTH TO BASEMENT GEOPHYSICAL MODELLING

Following extensive open file data evaluation as part of SBM’s Australia-wide “Big Gold” project by external consultants to SBM, several Iron Oxide Copper Gold (IOCG) targets were defined near Tennant Creek including ground underlying EL26038. The targets occur within concealed eastward extensions of the prospective Tennant Creek Inlier. The inlier hosts several high grade Au-rich deposits (including Juno, Geko, Warrego, Nobles Nob, Peko and White Devil), which have produced over five million ounces of gold and over 440,000 tonnes of copper in the last 60 years, ranking it within the top ten Australian goldfields.

Studies indicate that all targets within SBM’s current tenure lie under Cainozoic cover at significant and variable depths. The range of depths is uncertain as there is a paucity of drillhole data over the areas of interest. As
such, depth to basement modelling of currently available potential field data was deemed prudent in order to determine which targets occur at explorable depths (ie: <200m). Appendix 1 contains the results of the depth to basement geophysical modelling over EL26038.

This modelling identified three targets TC102, 103 and 119 over the western portion of EL26038 that have explorable depths with TC102 containing the most attractive modelled median depth to basement of 160m.

3.2 GRAVITY SURVEY

Following the completion of depth to basement modelling to identify whether these targets are at explorable depths, the logical first phase in geophysical exploration of the area was to acquire higher resolution data over the three targets. Gravity data coverage is particularly poor in some areas at present and was viewed as the first priority.

Gravity is an integral tool when exploring for mineralisation in the Tennant Creek district, in particular when searching for low-temperature “high-level” haematite-predominant IOCG systems that do not manifest so clearly in magnetic datasets as magnetite systems. As current gravity station coverage over EL26038 is approximately 4km, a program of 800m with infill 400m station spacings (for a total of 669 stations) was completed by Daishat Geodetic Surveys during August 2008. Survey data is appended under the folder “EL26038 gravity data”.

The results of the gravity survey have been successful in identifying two diamond drill sites (marked red as the drill target area in Figure 1) over the northwestern corner of target area TC102. During the latter part of 2008, SBM successfully applied for a co-contribution grant of $50,000 as part of the Bringing Forward Discovery exploration initiative with the Northern Territory Geological Survey in order to assist with SBM’s drilling costs and share new data from “Greenfields” exploration. It is anticipated that diamond drilling will be completed during the latter half of 2009.
APPENDIX 1
REPORT OF DEPTH TO BASEMENT MODELLING OVER EL26038
BigGold Tennant Creek Project – Naudy Depth to Basement Modelling

Executive Summary

For the purpose of inclusion into the 2008-2009 Annual Report for EL 26038, this Naudy depth to basement modelling report has been amended to show work conducted only that tenement. EL26038 overlies interpreted concealed extensions of IOCG prospective Proterozoic rocks east of Tennant Creek. Modelling indicates that several of the targets contained within SBM tenure (namely TC119) appear to overlie magnetic basement of considerable depth, greater than the 250m limit typically used as a cut-off in other St Barbara Limited (SBM) BigGold projects. Targets TC102 and TC103 appear to lie over shallower basement (140-230m).

Table 1 shows the depth range within each of the target areas (within the 80\(^{\text{th}}\) percentile), as well as a degree of confidence with which those depths should be accepted. The level of confidence is affected by both the amount of solutions that occur within a given target area and the distribution of depths within that area.

Economic analysis suggests that it would be feasible to explore for high grade Tennant Creek style deposits under cover depths of up to 400m, however while grades required are often present in deposits within the Tennant Creek field, the tonnages required rarely are. It is noted however that SBM targets are prospective for larger ore systems than the larger Tennant Creek deposits such as Warrego and White Devil, and are also prospective for larger breccia style systems analogous to Chilean Mesozoic deposits such as Manto Verde and Mantos Blancos. As such, depths indicated by this modelling should not preclude further exploration work being performed by SBM on these targets.
<table>
<thead>
<tr>
<th>Target</th>
<th>Number of Solutions</th>
<th>Dominant Depth Range (m)</th>
<th>Median Depth (m)</th>
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<td>TC119</td>
<td>14</td>
<td>200-360</td>
<td>290</td>
<td>Low – medium range of depths but low number of solutions</td>
</tr>
<tr>
<td>TC102</td>
<td>137</td>
<td>125-235</td>
<td>160</td>
<td>High – many solutions and small range of depths</td>
</tr>
<tr>
<td>TC103</td>
<td>58</td>
<td>145-290</td>
<td>220</td>
<td>High – moderate amount of solutions and small range of depths</td>
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*Table 1: Summary of Naudy depths and confidence levels*

**Background - Naudy Automated Depth to Basement Modelling**

The Naudy Automatic Model routine has been developed by Intrepid Geophysics to provide rapid, automated determination of depths to magnetic bodies. The routine is based upon Naudy’s (1971) automatic depth-determination routine for application to magnetic profile data, with subsequent enhancements by Shi and Boyd (1991, 1994).

The routine scans a magnetic profile dataset for dyke-like geological bodies. The routine examines the Total Magnetic Intensity (TMI) profiles along traverse lines
of a dataset. It proposes geological bodies at a range of depths and calculates the TMI profile that would result from them. It then selects the set of proposed bodies that would produce a TMI profile that most closely matches the observed TMI profile in the input dataset. This set of inferred geological bodies is the Naudy model. The routine also calculates the strike of each inferred body using an inbuilt automatic depth-dependent trend estimation process, and the depth, width, dip, susceptibility and similarity coefficient (closeness of match between observed and calculated data) are also outputs of the routine.

The routine is widely applicable as most aeromagnetic datasets will contain features that are more likely to be caused by dyke-like bodies than other body geometries. However, certain caveats must be considered when dealing with the results. The application of the method depends on the nature of the bedrock and will give useful results only where the bedrock is magnetic. The most accurate estimate of bedrock depth will be from anomalies with significant strike length and with a strike at a high angle to the flight direction. Also if the strike of the inferred geological body is markedly different to the strike of the local geology, the error in the indicated depth is generally 20% or greater. Interpretation of Naudy solutions must also take into account anomalies caused by the presence of magnetic material in cover/overburden (e.g. maghaemite in palaeochannel sediments), as the Naudy routine will provide depth solutions for these features.

Results

Modelling was performed on aeromagnetic data over concealed extensions of the Flynn Group about the Tennant Creek Inlier. Three areas were modelled, each encompassing IOCG target areas defined by Doug Haynes that fall within granted SBL tenements (EL26036 and EL26038) or tenement applications (EL26037 and EL26039), as well as IOCG target areas that occur close to but not within current tenure. As the Naudy routine provides a huge volume of results for a given area, the results were interpolated using an inverse distance squared
algorithm, employing minimum curvature. Figures 6 and 7 show modelled depths to basement over EL26038. For each area two images have been prepared: the first has the colour map stretched to show all depths to basement greater than 250m as blue, while the second has been stretched to show all depths to basement greater than 400m as blue.

Black areas that occur within the bounds of the data coverage represent areas where the Naudy routine could not find a solution; on a regional scale this usually occurs within magnetically “quiet” areas with no anomalous behaviour, generally representing areas of thick, non-magnetic sediments, but also occurs anywhere in the absence of a relatively high-frequency magnetic anomaly. There is a notable high frequency variation in the images. This is a product of the significant number solutions that are produced by the Naudy routine, over areas where (a) the observed magnetic feature does not possess the ideal characteristics for Naudy modelling (i.e. not striking at a high angle to the orientation of the observed magnetic data profile and/or does not have a significant strike length), (b) the Naudy solutions may have calculated strikes which do not match the strike of the observed magnetic feature and (c) the observed magnetic feature cannot be approximated by a dyke-like body. As a result, such solutions are somewhat unreliable and contribute to the variability seen in the image. Removal of these solutions (~25% of the dataset) would need to be done on an individual basis; an extremely time consuming task which has not been attempted here. A reasonable estimation of the depth distribution within the data can be ascertained by careful analysis of the Naudy results and their relationship to the underlying magnetic feature, as well as looking at the regional distribution of depth to basement solutions.
Figure 6: Interpolated Naudy depths to basement over EL26038. Blue colours indicate depths greater than 250m.
Figure 7: Interpolated Naudy depths to basement over EL26038. Blue colours indicate depths greater than 400m.

EL26038 sits on the north-eastern edge of a large area of relatively shallow basement (Figures 6 and 7), with outcropping Warramunga Formation sediments and intrusives occurring to the south-west of the tenement. There appears to be a deepening of basement on the south-western edge of the tenement (~300-400m), while the three targets appear to lie over basement of depths ranging from 130-260m. A drillhole ~1-2km to the west TC119 (CRAE hole GR1: X:\Projects\BigGoldNT\TennantCreek\Tennant_Creek_Open_File_Data\CR1986_0190) intersected Proterozoic quartz-potassic feldspar biotite granite at a depth of 72m, overlain by ~20m of Cambrian Antrim Plateau basalt. Statistical analysis of the targets indicates that:
• **TC119** (Figure 8) – Interpretation is problematic due to the very small number of solutions (14) contained within. Median depth is ~290m, although 9 out of the 14 solutions have depths ranging between 150 and 300m. The drillhole 1-2km to the west of TC119 (CRAE hole GR1) intersected quartz-potassic feldspar biotite granite at 72m, which according to the stratigraphy of the areas is synchronous to Warramunga Formation. While it is not the prospective sedimentary sequence in this formation, it is encouraging that a rock type of the same age is present at such a depth.

**Figure 8**: Distribution and statistics of Naudy depths within target TC119.

• **TC102** (Figure 9) – A well-defined distribution of solutions with median and modal depths of 158 and 143m respectively indicates that the target should be eminently explorable on the basis of depth. The lack of data in the central area of the target is indicative of a lack of anomalous magnetic signal, and could therefore represent a zone of magnetite destructive alteration.
Figure 9: Distribution and statistics of Naudy depths within target TC102.

- **TC103** (Figure 10) – A lack of data in a large part of the central-western area of the target is problematic. A well defined distribution of solutions with median and mean depths of ~220m indicates that the target is at an explorable depth.

Figure 10: Distribution and statistics of Naudy depths within target TC103.
The majority of depth solutions over TC102 and TC103 are likely caused by the presence of thin bodies of Cambrian Antrim Plateau basalt. Mapped and interpreted occurrences of this unit in the Tennant Creek area are minor in comparison to the major flows that occur in the north-west of the Northern Territory, where flow thicknesses reach up to 200m. Flows in the vicinity of Tennant Creek are likely to be much thinner. In the target area this is evidenced by the presence of basalt within the drillhole described above, as well as the sinuous, high frequency magnetic signal (Figure 11), which is an indicator of thin basalt flows. This signal differs markedly from the magnetic signal seen in the major basalt province to the north-west.

Figure 11: Sinuous, high frequency magnetic signal within EL26038, likely to represent Cambrian basalt flows.
Discussion/Conclusions

A target contained within SBM tenure (TC119) appears to overlie magnetic basement of considerable depth, greater than the 250m limit applied to other SBM BigGold project areas. Targets TC102 and TC103 appear to lie over basement shallower than 250m and should be considered well within the range of drilling, allowing for the possible presence of thin 20-30m thick Cambrian basalt flows.

In the case of Tennant Creek, interpretation of Naudy depth data has several caveats. The magnetic signature of the region is extremely complex. The effects of remanent magnetisation and alteration are well known in the area (e.g. Clark et al. 2004) and unlike other parts of Australia it is difficult to define lithological units by their magnetic signature. There are several lithologies other than Proterozoic Warramunga Group that have a significant magnetic signature (e.g. Cambrian Antrim Plateau Basalt); therefore Naudy solutions may be picking up depths to these lithologies rather than prospective ones. Another factor is that the ironstone bodies that host Tennant Creek deposits vary in magnetic intensity. Haematite end member or “high level” targets are predominant (Haynes 2007) and have a lower magnetic intensity; therefore they may not be delineated by the Naudy routine.

These caveats point to the fact that the Naudy routine may not be resolving the depth to prospective Warramunga Formation and that several other causative lithologies are present. This is especially applicable to EL26038 where TC102, 103 and 119 sit on the margins of interpreted Antrim Plateau basalt, a rock type which is probably responsible for the high-frequency magnetic signature seen in the area and the resultant relatively shallow depth solutions. Antrim Plateau basalt can range up to 200m in thickness; therefore depths to prospective Warramunga Formation in these areas could be up to 200m greater than indicated by the Naudy results.
In order to determine a viable depth of exploration for Tennant Creek, an investigation was made into the economic viability of exploring for and mining various styles of discreet, high grade Tennant Creek deposits. The study concluded that such deposits are viable to explore at depths of up to 400m. For example a tonnage and grade required to make exploration viable at a depth of 400m would be approximately 5Mt @ 12-15g/t Au, including Cu credits. While several deposits in the Tennant Creek field contain the required grade (e.g. Nobles Nob, Juno, White Devil), only one contains the required tonnage (Warrego).

References


