ZEEHAN EL 28/1988

ANNUAL REPORT
FOR THE PERIOD ENDING DECEMBER 2014

Author:	Kim Denwer
Date:	25th November 2014
Submitted To:	Exploration Manager - Australia
Copies To:	Tasmanian Regional Exploration Office Library Mineral Resources Tasmania, Hobart MMG – Melbourne Group office
Submitted By:	Neil Rankine

CONTENTS

LIST OF FIGURES

1. SUMMARY

EL28/1988 Zeehan is a prospective lease held by MMG Australia for the purpose of Nickel sulphide exploration potential. A major research program has commenced documenting Avebury and comparing it with the Melba Flats deposits. The Avebury research part of this work was completed during the period.

Drilling planned for the 2013-14 period has been postponed to the 2014-15 period.

2. INTRODUCTION

EL28/1988 Zeehan is and is located west and south of the Avebury Nickel Mine (Figure 1). The EL is highly prospective for Avebury style nickel sulphide mineralisation. The Avebury deposits are hosted in serpentinised dunite and strongly metasomatised, tremolite-diopside ultramafic skarn intruded into Mid Cambrian basaltic volcaniclastics. Much of the ultramafic is not outcropping so to generate drill targets, heavy reliance is placed on geophysical techniques. High resolution aeromagnetics is a key early exploration tool as the altered ultramafics have a strong magnetic signature due to high concentrations of contained magnetite. Electromagnetic techniques are a key targeting tool in conventional nickel sulphide exploration and will be employed over the Avebury and surrounding tenements. Down hole electromagnetic surveys are also thought to have the potential to significantly enhance exploration success.

MMG take a holistic approach to exploration within the Zeehan to Trial Harbour areas due to the main targets being analogues of the Avebury system. MMG has assembled a highly prospective portfolio of tenements within the area. In line with this approach, exploration expenditure over the surrounding tenements of EL28/1988, EL22/1997 and EL37/2003 have been granted amalgamation to Avebury Mine exploration and resource expenditures.

3. LAND TENURE

EL28/1988 was initially 13 km^2 and covered the current Avebury and Avebury East Mining leases, with 3M/2003 excised in 2003 and 6M/2007 excised with the delineation of the East Avebury Resource. In 2013 three tenements EL28/1998, EL22/1997 and EL37/2003 were amalgamated into a single 25 km^2 tenement EL28/1998 (Figure 1).

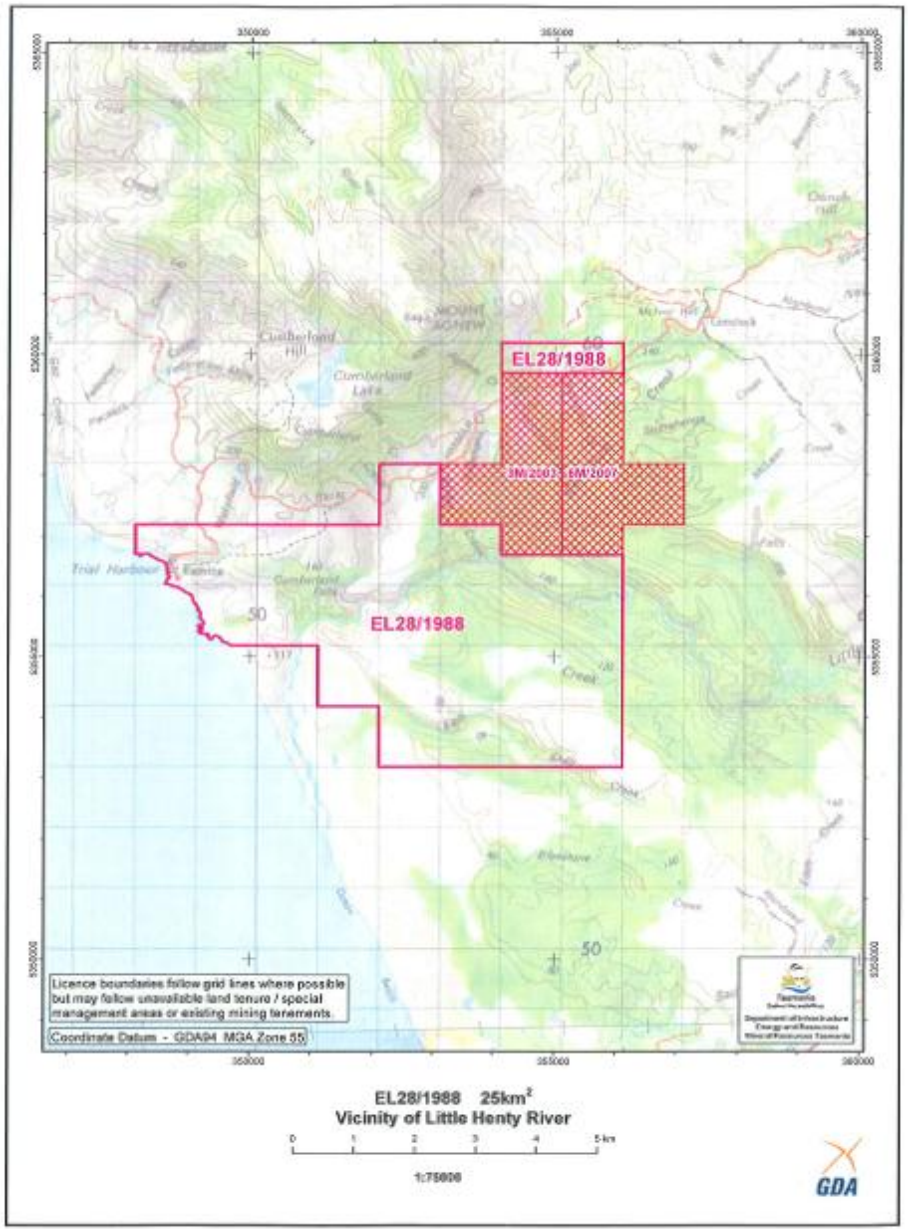

Figure 1: Location of EL 28/1998 Zeehan:

4. GEOLOGY

The Avebury deposits are hosted in serpentinised Cambrian dunite or strongly metasomatised, tremolite-diopside ultramafic skarn obducted onto Mid Cambrian basaltic volcaniclastics. The ultramafic rocks demonstrably extend onto the surrounding EL's including EL28/1988. EL28/1988 is therefore considered highly prospective for Avebury style nickel sulphide mineralisation.

Variable metasomatism of the serpentinised host ultramafics, thought to have occurred during intrusion of the Heemskirk Granite, has formed two distinctly different mineral assemblages, each of which may host ore grade nickel sulphide mineralisation:

- **Essentially unmetasomatised serpentinised ultramafic:** a fine grained black rock composed predominantly of antigorite with minor disseminated chromite, magnetite and sulphides

- **Metasomatised serpentinised ultramafics:** pale grey or green, coarsely crystalline tremolite/actinolite and diopside with minor magnetite, chromite and sulphides.

Sulphide mineralisation in both serpentinised ultramafic and ultramafic skarn generally consists of pentlandite and pyrrhotite and is associated with magnetite in the form of crystalline intergrowths and veins within massive granular magnetite-chromite. Pentlandite occurs as coarse disseminations and stringer veins associated with secondary magnetite. Sulphide contents are generally low with mineralised ultramafic comprising between 0.5 to 3% sulphides although massive pentlandite does occur in some drill intersections.

Nickel sulphide mineralization is largely concentrated within the ultramafic immediately adjacent to its margins with nickel grades diminishing toward the interior of the intrusions. Some internal zones of nickel sulphide mineralisation are present.

The serpentinised ultramafics have a strong magnetic signature due to their high concentrations of magnetite, and their presence can be interpreted from magnetic images. The nickel sulphide mineralisation too has a strong magnetic signature due to the pentlandite-pyrrhotite-magnetite relationship. High resolution aeromagnetics is a key early exploration tool.

The Oonah Formation and the Crimson Creek Formation are the most prevalent sedimentary rocks, and the Devonian Granite and McIvor Hill Complex are the most prevalent igneous rocks within EL28/1988 (Figure 2).

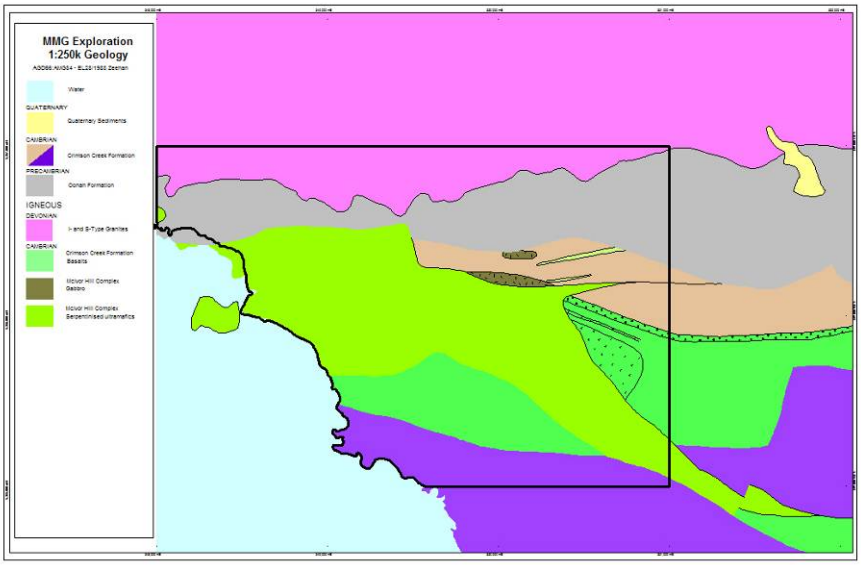

Figure 2: 1:250,000 Geology Map of EL28/1988 Zeehan

5. CURRENT EXPLORATION

Work Completed in the 2013-2014 Period

A major research program is underway with the following aims:

Western Tasmania Nickel Project – planned research

Project 1

Geological and ore genesis models for the Avebury Nickel deposit, Tasmania

Supervisors: Reid Keays and Kim Denwer (MMG)

Student: Ben Mackay-Scollay

Field of Study: Economic Geology/ Igneous Petrogenesis

Support offered: Analytical and field costs

Program: Honours

Collaborating Organization: MMG

This project focuses on the ultramafic host rocks and Ni sulphide mineralization of the Avebury Nickel deposit in Tasmania. The aims of the project are to contour the 3-dimensional distribution of the major rock types (serpentinites and skarns) and ore metals (from assay data,) in the deposit and to determine the origin of the mineralization. It has been suggested that the Ni sulphide mineralization is a product of hydrothermal processes, but it may also be

possible that Avebury is a metasomatised magmatic Ni sulphide deposit. These aims will be accomplished through logging of diamond drill core, limited mapping of underground exposures and utilization of the drill core photo library. Ore genesis models will be refined using whole rock PGE, Cu, Ni, S and Se data; sample collection for this work will be guided by the results of the mapping and core logging. Rock type identification will be confirmed by petrographic examination of thin sections and the Ni contents of silicates established.

The composition of magnetite and serpentine will be established using the Electron Microprobe and, if time permits, LA-ICP-MS -this will be done to determine if iron in the magnetite was derived from the olivine and liberated during serpentinisation or if it was derived from the granite, along with W, Mo, Sn, etc.

This project was completed during the period and is attached as **appendix 1.**

Project 2

Petrogenesis of the gabbroic sills hosting magmatic Ni-Cu-PGE sulphides at Melba Flats, Western Tasmanian

Supervisors: Reid Keays, Dave Phillips (University of Melbourne) and Kim Denwer (MMG)

Student: Marcus Phia

Field of Study: Economic Geology/ Igneous Petrogenesis

Program: Masters

Support offered: Analytical and field costs

Collaborating Organization: MMG

This project focuses on a series of gabbroic sills that host magmatic Ni-Cu-PGE sulphides at Melba Flats where mineralization was discovered in 1893 and worked intermittently until 1948. Although total production was small (~6050 tonnes) the ore was high grade, averaging 9.7 % Ni and 4.7% Cu. The gabbroic sills are narrow and occur in clastic sedimentary rocks. The aims of the project are to establish the tectonic setting, magmatic affiliations and age of the sills. These aims will be accomplished by logging of diamond drill core, petrographic

investigations, and whole rock geochemical studies; the ages of the sills will be establishing by U-Pb dating of accessory minerals such as zircon, baddelyite and rutile. These phases will be sought for in thin sections using the scanning electron microscope.

The following work will be included in this project:

• A structural study of sill orientations will be carried out

-this will enable the derivation of a 3-D model of the sills

• The whole rock geochemistry of the sills will be assessed to determine if there is a difference in the compositions of the rocks hosting mineralisation and those that do not

-limited geochemical data (Crawford and Keays, 2010) and examination of Melba Flats drill core indicate the mineralised rocks are more primitive than the non-mineralised rocks

• Whole rock geochemical analyses together with PGE, Cu, Ni, S and Se will be carried out on samples from the gabbroic sill intersected in A254 that lies below and appears to intrude the Avebury serpentinite. Sections of the sill carry magmatic Ni-Cu sulphides and a xenolith of some type. These analyses will be undertaken to answer the following questions:

- what, if any, is the relationship between these sills and those at Melba Flats?
- was the magma that formed the sills a “pregnant” magma, transporting magmatic Ni-Cu sulphides?
- is the xenolith a metasomatised serpentinite or is it something else?
- do these gabbroic rocks carry the same granite-related metasomatic overprint as the serpentinites?

• It may be possible to establish an age for this gabbroic sill. Minerals suitable for age dating will be searched for using the SEM in samples of the fractionated gabbro collected on this trip

- if an age can be established, it will provide a minimum age for the Avebury serpentinite

- a search will be made for minerals suitable for age determination in the xenolith observed in the gabbro sill

This work is ongoing.

Planned drilling was not completed during the period due to the impending sale of the Avebury asset.

6. ENVIRONMENTAL

There were no surface disturbance or rehabilitation activities undertaken during the reporting period.

7. CONCLUSIONS AND RECOMMENDATIONS

Additional magnetic anomalies remain to be tested, - further drilling is required.

8. EXPENDITURE

A total of $21,349 was spent on the tenement during the period, not all costs associated with the research have been received.

Salaries	**$17,117**
Tenement costs	**$2,008**
Travel	**$2,224**
Total	**$21,349**

9. 2014-15 WORK PROGRAM:

It is proposed that for the next twelve months that:

1. the research project (in progress) that characterises the geology, mineralisation and age of the Avebury and Melba Flats deposits continues - estimated expenditure $30,000
2. drill test the magnetic anomaly(s) at Trail Harbour – estimated 1,200 metres of drilling at a cost of $240,000

Appendix 1:

Controls on Ni mineralisation at the Avebury Deposit, Western Tasmania.

Thesis submitted by Ben Mackay-Scollay for the degree of Bachelor of Environmental Science (Honours).

School of Earth, Atmosphere and Environment

Monash University

November 2014