ASARCO AUSTRALIA LTD.

TENNANT CREEK PROJECT

Mammoth Prospect
Mineral Claims C482 - 484, 514 - 518

Annual Report to the
N.T. Department of Mines and Energy

by
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1. Introduction

This report details the work to date on the Mammoth tenements since a joint venture was entered into between Asarco Australia Ltd. and TopEnd Resources N.L. on May 23, 1988. The block comprises eight mineral claims (C482 – 484, 514 – 518) five of which were granted on March 15, 1988, the remainder granted on October 12, 1988.
2. Regional Geology

The Tennant Creek Goldfield covers an area of approximately 3,000 square kilometres centred at $19^\circ30' S$ latitude and $134^\circ10' E$ longitude, in the middle of the Northern Territory of Australia. Mineralization is hosted by Lower Proterozoic Warramunga Group sediments, which have been unconformably overlain by folded Middle Proterozoic rocks to the north (Tomkinson Creek Beds) and south (Hatches Creek Group). Acid intrusive rocks intrude both Lower and Middle Proterozoic sequences.

Thin, flat lying Cambrian shelf sediments rest unconformably on the folded Proterozoic rocks and are not intruded by quartz or igneous rocks (See table 1).

Gold production from the field exceeds four million ounces of gold, with considerable byproduct Cu, Bi, Ag and Se.

2.1 Stratigraphy

The Warramunga group comprises a series of greywacke, siltstone, shale and acid tuffs which have been subjected to low greenschist facies metamorphism. Despite excellent preservation of textural and depositional features, a generally accepted regional stratigraphy has yet to be compiled, due largely to the paucity of outcrop, the monotonous lithology and the lack of marker beds. The Group can be broken up into several broad units (Table 1), based largely on the work of Dunnet and Harding (1967) and exploration companies (e.g. Large, 1975).

Monument Formation – The Monument Formation (Le Messurier et. al., 1975) represents the lowest exposed part of the Warramunga Group, cropping out around a granitic stock in the core of a major anticline in the north east of the field. It consists of interbedded fine and coarse grained greywacke, siltstone and minor shale.

Bernborough Formation – The base of the Bernborough Formation is marked by the Whippet Sandstone Member, a quite distinctive lithology. The unit consists of massive, well sorted quartz and feldspathic quartz sandstone, with minor interbedded siltstone and shale at its base. Current bedding and ripple marks are common. In contrast with the rest of the Bernborough Formation, volcanic material is largely absent.

The bulk of the Bernborough Formation consists of thinly bedded siltstone, interspersed with poorly bedded tuffaceous greywacke, acid lava and tuff.

Carraman Formation – The Carraman Formation crops out over the major part of the Tennant Creek field and consists principally of felsic greywacke and shale, having features indicative of deposition by turbidity currents. It has been informally divided into three members (upper, middle, and lower) based on the content and type of syngenetic iron oxides.
The lower member (magnetite facies) is composed of coarse sandstone and greywacke in basal sections, with siltstone and shale dominant in the upper half. Volcanic units are largely absent. Magnetite occurs as minute octahedra in fine laminations or cross laminations within the shale and siltstone, or at the base of the graded greywacke units.

The sediments of the middle member (hematite facies) consist of graded greywacke, siltstone, and shale within a turbidite sequence. Individual turbidite beds are from 20 cm to 10 m thick, and typically show grading from coarse lithic wacke at the base to fine silt at the top. Disseminated magnetite is present at the base of graded beds and as scattered grains, but the unit is characterised by a greater proportion of hematite than magnetite.

Hematite is commonly present in the finer sediments in proportions of up to 20%. These units have been termed 'hematite shale' and are mineralogically and chemically similar to argillaceous banded iron formation.

In the upper part of the middle member quartz-feldspar porphyry predominates. It is generally conformable with the sediments but in some areas splits into a number of lenses, some of which show discordant trends. It crops out with fair continuity over a horizontal distance of 150 km and acts as a good marker horizon.

The upper member (iron free facies) consists of interbedded greywacke, siltstone, chert and cherty sediments. The base is generally defined by the first major chert bed. The sediments are characteristically siliceous and contain no magnetite. Hematite may be present in the fine grained siltstone, but its occurrence is restricted. No felsic volcanics or intrusive porphyries occur in this unit.

2.2 Intrusive rocks

The Warramunga Group has been intruded by a series of acid igneous rocks, ranging from massive and foliated granite and adamellite through granite porphyry to quartz-feldspar porphyry and quartz porphyry. Results from drill holes suggest that all four major outcropping granite areas may be regarded as consanguineous and connected at depth. The compositional and textural differences can be attributed to processes of differentiation and the relationship between emplacement and regional tectonic activity.

A suite of basic rocks including gabbro, dolerite, diorite, and mica/amphophyre intrude the Warramunga Group and the overlying Tomkinson Creek Group. They have an undeformed fabric and therefore intruded after the deformation of the sediments. Basic dykes also cut the magnetite lodes and definitely post date the mineralization.
2.3 Structure

The Warramunga Group has been folded on east west axes and exhibits well developed axial plane slaty cleavage which is readily observed in outcrop. The major folds have a wavelength of approximately 1-5 km, are of open upright style, and their axes plunge both to the east and west from 20 to 40 degrees.

Superimposed on the limbs of the major structures are at least two sets of smaller scale folds. The second order folds are fairly open with wavelengths of 100 to 1,000 m. The third order folds are usually extremely isoclinal, with amplitude of up to 50 m and wavelength of as little as 5 m. A further set of folds may exist but for much of the field the third order fold patterns vary greatly and it is difficult to generalise.

A later period of regional tectonism folds the Tomkinson Creek Group about a north west - south east trending axis. It is probable that some of the pitch reversals noted in Warramunga folds may be due to the superimposition of the extra folding.

The prominent north-west trending faults and shears which cut both the Warramunga Group sediments and the overlying Tomkinson Creek Group also appear related to the later period of Upper Proterozoic folding. A complementary set of north-east trending faults are of less well developed, but are of importance in some parts of the field. There is very strong evidence that all major faulting is post mineralization. Minor faulting and shearing, often associated with mineralization, forms two main sets, trending 090° - 110° and 060° - 075°. Local development of shears trending 020° - 050° and 320° - 340° may also be important in some areas.

2.4 Mineralization

Economic gold, copper and bismuth mineralization within the Tennant Creek goldfield is spatially (?)and genetically) related to a number of distinct lithological and structural features of the Warramunga Group.

i. The mineralization invariably occurs within or adjacent to lenticular, ellipsoidal or pipelike bodies rich in magnetite and/or hematite, commonly referred to as ironstones. Most ironstones are replacement bodies which cut across sedimentary structures, but some outcropping ironstones are conformable and supergene enrichment of iron may have been an important factor in their formation.

ii. Ironstones carry economic mineralization only when located within the hematite facies of the Carraman Formation (Large, 1975).
iii. Mineralized ironstones can be found

- close to thin beds of hematite shale (argillaceous BIF) e.g. Nobles Nob, Juno.
- within sediments adjacent to rhyolitic porphyries (e.g. Peko).
- within soft sediment slump structures such as breccia-conglomerates (e.g. Gecko, Orlando).

iv. Ironstones are favourably located in second and third order folds on limbs of major anticlines, especially in domal positions. Axial plane cleavage is an important control in the localization of replacement bodies.

v. Some ironstones are located within fault or shear zones (e.g. Ivanhoe).

Ironstones are extremely variable in composition. At surface they are composed dominantly of hematite, quartz, maghemite, magnetite, goethite and clay minerals. Below the base of oxidation, the main minerals are magnetite and chlorite, with lesser quartz, hematite, pyrite, talc, dolomite, calcite and muscovite. The proportion of iron also varies considerably; from as little as 20% by volume to over 90%.

Economically mineralized ironstones are commonly zoned, with sharp contacts between zones and the enclosing country rocks. Some of the more common zones are comprised of magnetite-chlorite, talc-magnetite, magnetite-hematite, quartz magnetite and dolomite-talc-chlorite. In addition, mineralization is also zoned with Au, Cu, and Bi concentrations usually related to and contained within certain mineralogical zones.
3. **Location and Access**

The Mammoth tenements lie approximately 15 km north-east of the Tennant Creek township. A well graded track runs from the Peko bypass out past the relay station and through the claim block (Plan 4922). A side track leading to the Mammoth mine and battery site (excised from the joint venture ground) provides access within the area.
4. **Previous Work**

The area has seen only a limited amount of work, nearly all associated with old prospecting activities with minor diggings and scratchings in a few localities. The centre of interest was the Mammoth hill where several shafts and adits were used to extract a recorded 104 ounces of gold.

There is no record of any recent exploration over the joint venture ground.
5. **Present Work**

5.1 **Geology**

The area has been mapped at 1:1 000 scale (Plan 4926) including a brief look over the excised Mammoth Mine which follows a major north-west/south-east shear zone. A series of pits within BIF and exposing siliceous dolomite alteration with malachite staining, and minor magnetite, south of and parallel to the Mammoth shear, are the only workings within the joint venture area. Sampling returned low gold values but moderate bismuth and high copper.

In the north-west of the area are a couple of outcropping ironstone (hematite) lodes. They don't appear to be shear controlled but lie along strike from the main Mammoth lode and are in a favourable position, being associated with BIF's, hematitic sediment and a possible minor anticlinal flexure.

Also outcropping within the area are some porphyries but their significance, if any, is not known.

Also trending approximately north-west/south-east is a major quartz vein which is a prominent feature marking the fault which passes through the area. The vein of Buck quartz has minor iron staining and has no mineralization associated with it. The general dip throughout the area is towards the south-west, but there are several minor flexures and folds with the general fold plunges towards the south-east as seen in areas to the south.

5.2 **Geochemistry**

The Mammoth block, including the excised mine (permission obtained from the holder), was gridded by compass and chain at 200 m line spacings, prior to the completion of a lag sampling survey (Carver et. al., 1987) at 200 m x 25 m spacings.

A total of 139 samples were taken and analysed for gold (to ppb levels), copper and bismuth. Values in the proximity of the Mammoth Mine were expectedly high, largely accounted for by material dropped around the hill and tailings from the old battery site. The rest of the area was not noticeably anomalous, but due to the wide spread of wind blown tailings which has masked the primary geochemical signature over much of the ground, other techniques are required (see Plans 4913, 4913/1, 4913/2).

5.3 **Geophysics**

The Mammoth prospect is included in an area flown by Aerodata for magnetics and radiometrics. Line spacing was 200 m and flight height 60 m. Results from this survey have been processed and interpreted by Aerodata (see appended report). There is no indication of any obvious magnetic targets within the Mammoth block, but several prominent lineaments, that are spatially associated with historic workings nearby, pass through the area.
6. **Conclusions and Recommendations**

Preliminary geochemical prospecting has failed to delineate any targets for follow up in the area, but due to contamination from the old mine spoil and battery tailings, much of the area has not been effectively tested. Soil sampling is required to get below the contaminated surface.
7. References


Large, R.R., 1975: Zonation of hydrothermal minerals at the Juno Mine, Tennant Creek Goldfield, Central Australia. Econ. Geol., 70, pp. 1,138 - 1,413.


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<th>LITHOLOGY</th>
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