# Borroloola West Project, N.T.

# Fieldwork July 2016
# Four Mile, Mariner, Johnstons and Coppermine Creek Prospects

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**August 2016**

## *Work completed*

Two weeks were spent in the field on the Borroloola West Project in July 2016. Geological mapping with pXRF reconnaissance was carried out to firm up sites for the planned RC drill program at Four Mile, Mariner, Coppermine Creek, and Johnstons (Fig. 1).

It was planned to identify, meet with, and obtain a cultural clearance from the Native Title claimants of parts of the Limmen National Park ahead of the planned RC drill program. One of the senior elders had just died and I was advised it was not a good time for a meeting at that time. I did identify the people who speak for the areas covered by Pacifico's licences, and obtained information from the offices of the NLC in Borroloola and Darwin, and the AAPA in Darwin.

## *Summary of Results and Conclusions*

New extensions to the copper mineralisation have been found, and mapped at Coppermine Creek. Two kilometers of strike of newly discovered outcropping gossanous dolomite breccia along the Gordons Fault will be RC drill tested.

A copper rich extension was identified by rock chip sampling with the pXRF, to the south of Johnstons workings, to be RC drill tested.

At Four Mile some of the geology was infilled and the position of the Barney Creek Formation better delineated, and reinterpreted. Nine drill sites will be prepared to allow for flexibility.

At Mariner constructed drill sections and field mapping established that the lead mineralisation is stratabound and that potential for primary zinc-lead mineralisation lies down-dip to the north. Four or five RC holes are planned.

The area covered by EL28508 at Berjaya is covered by a granted Native Title claim. It also lies within a Restricted area. Information from the AAPA on the conditions for working within the Restricted area has been applied for. Four to six drill sites are planned, the timing of the program will depend on cultural site clearances.

The Limmen National Park covers all our current prospects apart from Berjaya. I talked with the NLC in Borroloola and Darwin, and the AAPA in Darwin. I tried to locate Desmond Lansen of the Alawa People, but was told one of their senior elders had just died, and was advised that it would not be an appropriate time for a meeting.

The timing of the planned RC drilling at Four Mile, Mariner, Johnstons and Coppermine Creek now depends on cultural site clearances and is expected to commence in September. A meeting with Desmond Lansen (Alawa), Wallie Cook (Bauhinia Downs) and elders of the Alawa People is arranged for 23rd August at Devils Springs near Borroloola.

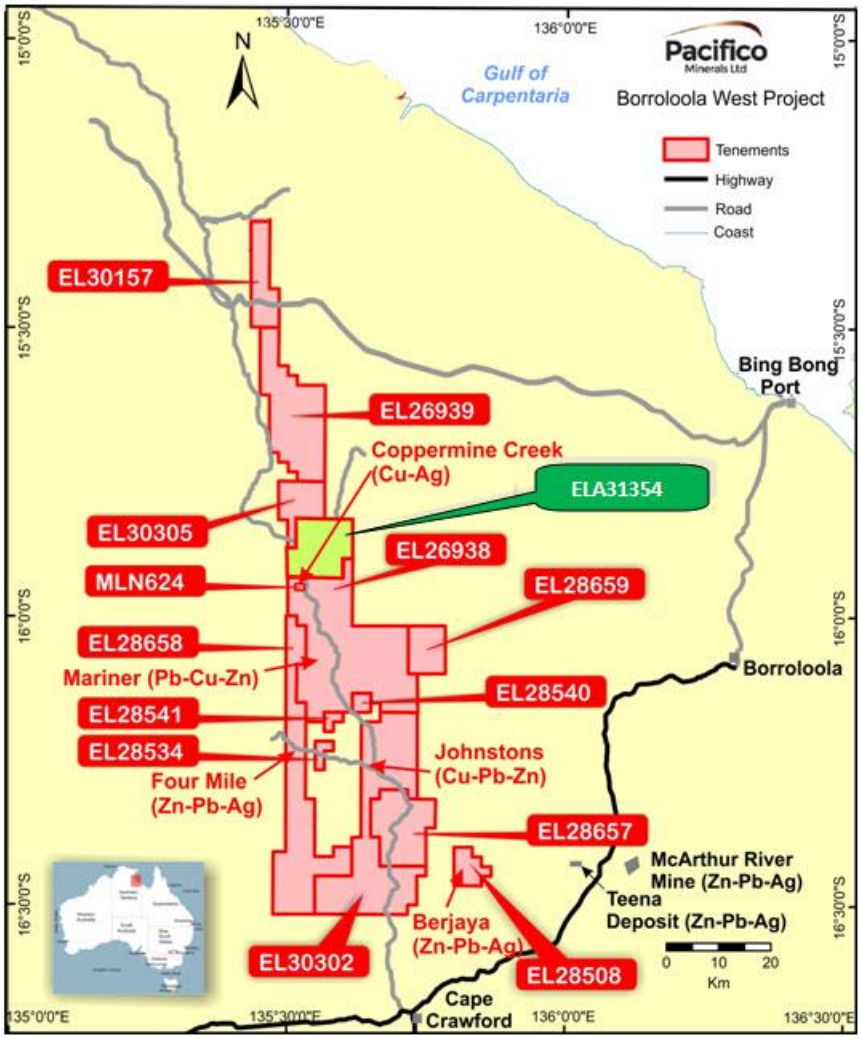



***Figure 1: Borroloola West Project Tenements and Location of prospects***

## *Native Title and Ground Access*

<u>Limmen National Park, formerly Billengarrah Station</u>

An updated map and extracts from the records has been requested from the AAPA.
DC2000/029 is an active native title application, accepted.
There is also DC2014/008, a claim not accepted for registration
The southern part of Limmen National Park (our current area of interest) is covered by claim DC2000/029 in the name of the Alawa People (Billengarrah). The applicant Harry Lansen died. The replacement applicants (20/5/16) are Asman Rory, Christopher Pluto and Tom Hume.

It is accepted that Tomothy Lansen (lives at Devils Creek) son of Harry Lansen, speaks for the Alawa People for this ground, or is at least the most important person. A meeting is arranged for Tuesday 23rd August with Timothy Lansen. It is requested that the senior elders are also there.

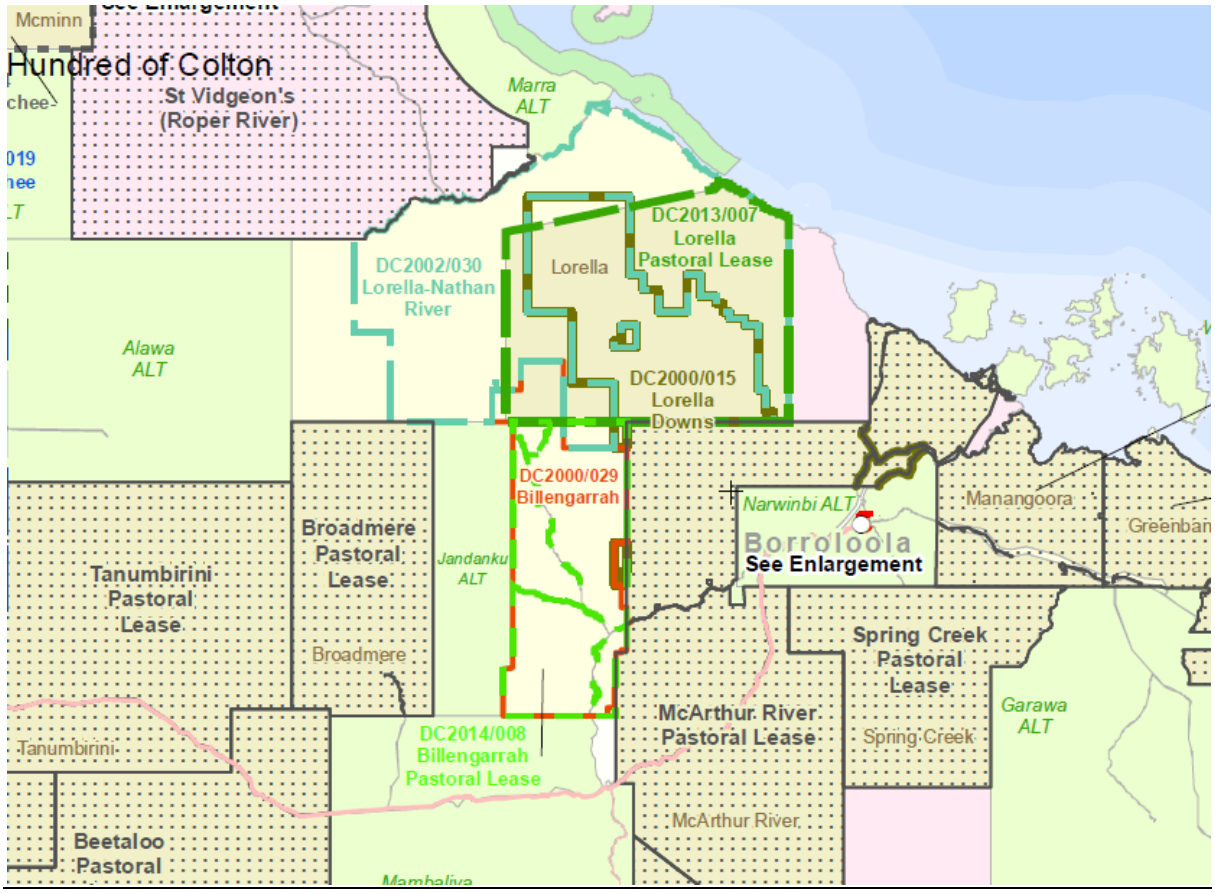



Fig. 2. Cadastral map of project area.

Berjaya

Berjaya lies in McArthur River Station and is covered by granted Native Title: DCD2015/008 registered Native Title 26/11/2015. It is divided into 11 estates.

The NLC said that our area of interest is called Hot Springs and that the person speaking for this area is Billy Coolabar a.k.a. Billy Rapsen, of Campbell Springs.

An application has been made to the AAPA for information and conditions for work within the Restricted Ground.

## *Four Mile (zinc-lead-silver)*

Geology and mineralisation

From youngest to oldest the main mappable units are:

- Hot Springs Member – sandstone and dolomitic siltstone.
- Barney Creek Formation – Upper – Dolomitic siltstone and ferruginous finely bedded dolomite, some stromatolites.
- Barney Creek Formation – Lower – carbonaceous shale and siltstone, with disseminations, nodules (Figure 3) and thin stratabound bands (Figure 4) of disseminated iron oxides after sulphides, that contain anomalous values of Pb, Zn and As.
- Mara Dolomite Member – massive and finely bedded dolomite, only minor interbedded siltstone.

The units are displaced by NE trending faults, that are also apparent on the Landsat images. They appear to terminate in the Hot Springs Member indicating a possible Barney Creek timing. The northernmost fault is reflected in the regional seismic survey (Figure 7), and in Barry Murphy's gravity worms (Figure 8). It is possible that these early NE trending faults are a mineralisation control.

***Figure 3: Four Mile outcrop - Ferruginous nodules after pyrite in silty dolomite. Nodules high in Pb, Zn and As.***

***Figure 4: Four Mile outcrop - thin gossanous stratabound lens of ex-sulphides in dolomitic siltstone.***

The prospective mineralised unit in the Barney Creek Formation may continue to the NNW to pass into Energia's adjoining ELA 25272. Historical work by CRA in the 80's obtained some anomalous Pb values in wide spaced shallow auger drilling near Barney Creek Formation outcrop to the NNW.

The Barney Creek Formation dips beneath younger Roper Group sediments to the west, again into Energia's ELA.

Current mapping indicates a thickness of the carbonaceous shale and siltstone unit of the Barney Creek Formation of up to 200m. Outcrop is poor (Figure 5) and the overall dip is shallow but difficult to estimate accurately. About 6 deg west is indicated by the VTEM, but field measurements indicate 5 to 20deg west.

Six reverse circulation ("RC") drill holes sites are planned (Figure 6).

***Figure 5: Four Mile - Standing on material with sulphide pods – best mineralisation may sub-outcrop in the creek***

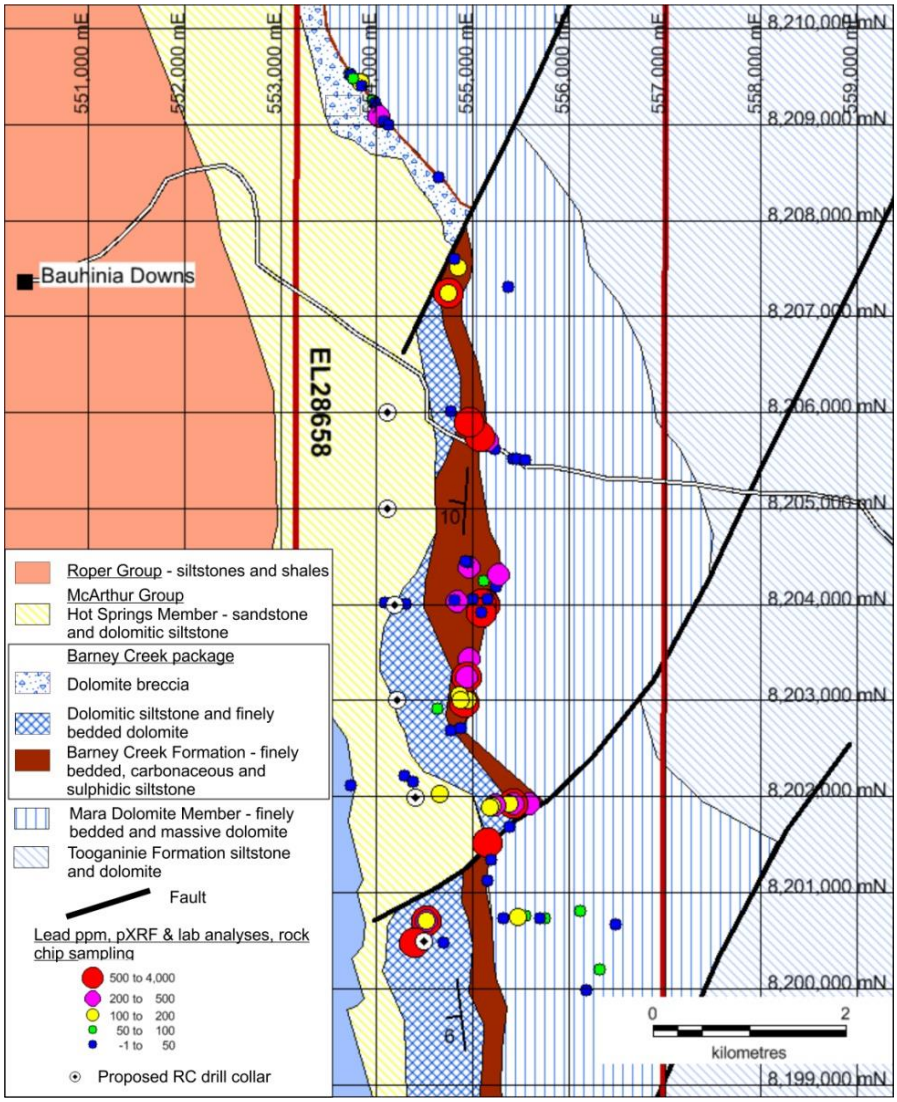
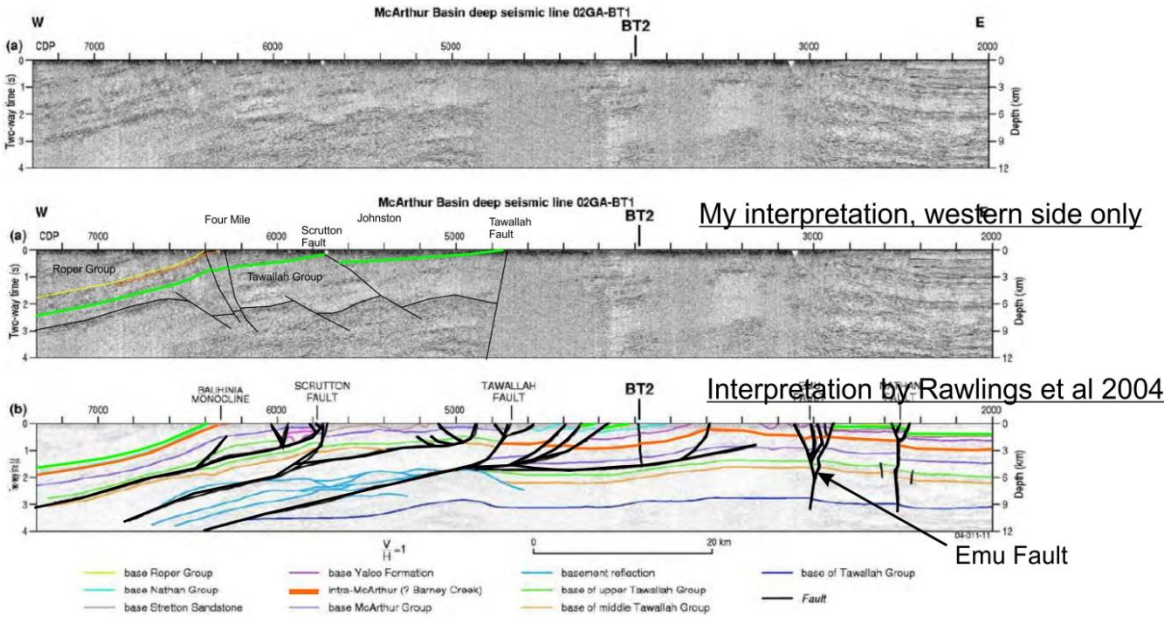



***Figure 6: Four Mile Prospect – Geology, Pb geochemistry and planned drilling***




Shows Barney Creek Formation at Four Mile dipping west beneath the Roper Formation

Seismic not that clear and open for other structural interpretations

Only small displacement around Emu Fault

***Figure 7: McArthur Basin deep seismic line OGA-BT1 and published interpretation from Rawlings et al 2004. I have produced an alternative non-thrust interpretation***

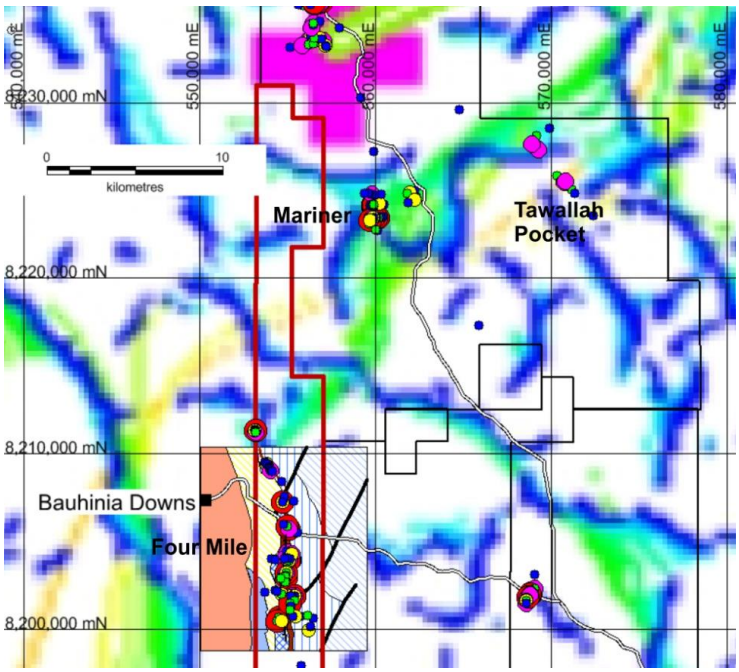



***Figure 8: Gravity worms, from memo by Barry Murphy 2014. Strong NE trending gravity gradient passes close to Four Mile, Mariner and Tawallah Pocket. Pb + Cu geochem plotted.***

Geochemistry at Four Mile

Selected rock chips of outcrop with pyrite nodules are consistently high in lead and arsenic (and sometimes Zn) within the carbonaceous shale unit, as well as in ferruginous zones in an overlying stromatolitic dolomitic siltstone. Small pods and lenses of gossan after sulphides in the carbonaceous sediments contain up to 0.26%Pb (in lab sample), As (to 0.17%As in lab sample), and Zn (up to 907ppm in lab sample).

The geochemistry could be indicating something significant that is not outcropping, or distal along strike, or down dip.

A comparison is made for Four Mile samples, sent to ALS and analysed by method ME-ICP61 with pXRF readings (table 1). The table only includes those elements that were measured by both the lab samples and by the pXRF. The samples are grouped where taken from the same place. They are not splits of the same sample. The results indicate that for reconnaissance type work at Four Mile the pXRF is effective and reproducible for Al, As, Cu, Fe, K, Mn, Mo, Pb, Zn and Sr. Other elements are clearly below or close to the pXRF detection limit. However V is grossly overestimated by the pXRF.

The samples list also shows correlation between high Pb with As and Cu (but only to 101ppm Cu). Zn is not directly correlatable with individual high lead samples, but high zinc does correspond spatially. It is in lower concentration but more dispersed, and has moved differently in the weathering environment.

The lab samples also show that high Pb is associated with high Ba (up to >1%Ba) and detectable Ag (up to 1.3ppmAg).

Table 1 - Comparison of Lab Analyses and pXRF readings

| Analysis Method | Descrip | Lat | Long | Sample No | Al | As | Ca | Cu | Fe | K | Mn | Mo | Ni | P | Pb | S | Sr | Ti | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ME-ICP61 | SLFE | -16.1773 | 135.4964 | 91801 | 2.91 | 121 | 0.05 | 32 | 23.5 | 2.59 | 39400 | 3 | 170 | 190 | 493 | 0.02 | 55 | 0.12 | 72 | 907 |
| pXRF | | | | | 2.84 | 119 | -0.15 | 82 | 20.64 | 2.31 | 54851 | 19 | 172 | 1343 | 486 | 0.03 | 100 | 0.13 | 202 | 1487 |
| pXRF | | | | | 2.67 | 108 | -0.15 | 47 | 10.50 | 2.04 | 954 | 14 | 79 | 1587 | 100 | 0.04 | 13 | 0.11 | -150 | 824 |
| ME-ICP61 | SLFE @ | -16.1989 | 135.5064 | 91804 | 4.74 | 9 | 0.05 | 12 | 15.65 | 5.58 | 69800 | -1 | 115 | 430 | 15 | 0.03 | 43 | 0.12 | 86 | 608 |
| pXRF | | | | | 5.18 | 34 | -0.15 | 59 | 33.27 | 5.10 | 36803 | 6 | -15 | -400 | -5 | -0.01 | 18 | 0.18 | 462 | 292 |
| ME-ICP61 | Fe bands in SL | -16.2738 | 135.5103 | 91805 | 0.52 | 70 | 19.9 | 101 | 3.48 | 0.63 | 93200 | 13 | 104 | 590 | 764 | -0.01 | 305 | 0.02 | 53 | 259 |
| pXRF | | | | | 0.71 | 132 | 9.39 | 179 | 6.33 | 0.41 | 160516 | 26 | 71 | 946 | 1248 | 0.04 | 203 | 1.80 | 10167 | 317 |
| pXRF | | | | | 0.71 | 35 | 30.61 | 84 | 3.00 | 0.67 | 90829 | 15 | 81 | 498 | 254 | -0.01 | 150 | 0.24 | 1363 | 120 |
| ME-ICP61 | SLBR | -16.2758 | 135.5091 | 91806 | 3.53 | 134 | 0.18 | 92 | 27.9 | 2.91 | 3780 | 8 | 121 | 700 | 376 | 0.01 | 17 | 0.11 | 49 | 243 |
| pXRF | | | | | 4.70 | -10 | -0.15 | 21 | 1.13 | 0.59 | 253 | 7 | 19 | -400 | 7 | -0.01 | 23 | 0.23 | 401 | 19 |
| pXRF | | | | | 5.70 | 89 | -0.15 | 116 | 20.22 | 1.65 | 8063 | 6 | 127 | -400 | 599 | -0.01 | 24 | 0.22 | 416 | 197 |
| ME-ICP61 | Fe Bands in SL | -16.2440 | 135.5159 | 91813 | 6.25 | 1715 | 0.16 | 52 | 14.9 | 5.83 | 3890 | 19 | 204 | 370 | 2630 | 0.06 | 19 | 0.11 | 55 | 634 |
| pXRF | | | | | 4.42 | 1175 | -0.15 | 75 | 21.44 | 5.86 | 1498 | 25 | 69 | -400 | 3108 | 0.28 | 18 | 0.07 | 221 | 416 |
| pXRF | | | | | 4.88 | 1873 | 0.24 | 104 | 29.15 | 5.72 | 270 | 22 | 145 | -400 | 2898 | 0.27 | 17 | 0.07 | -150 | 743 |
| pXRF | | | | | 9.39 | 47 | -0.15 | 19 | 2.41 | 11.27 | 327 | -5 | 39 | -400 | 405 | -0.01 | 19 | 0.22 | 468 | 81 |
| ME-ICP61 | SLDM with ferrug nodules | -16.2533 | 135.5138 | 91814 | 8.42 | 469 | 0.09 | 87 | 9.12 | 6.63 | 600 | 96 | 127 | 320 | 258 | 0.03 | 24 | 0.18 | 50 | 19 |
| pXRF | | | | | 3.78 | 1910 | 2.09 | 151 | 37.74 | 3.96 | 80 | 182 | -15 | -400 | 727 | 0.02 | 12 | 0.02 | -150 | -15 |
| ME-ICP61 | SL ferrug bands | -16.2147 | 135.5122 | 91512 | 3.16 | 198 | 2.59 | 71 | 15.15 | 3.18 | 4070 | 5 | 183 | 870 | 494 | 0.03 | 25 | 0.14 | 88 | 362 |
| pXRF | | | | | 3.15 | 233 | -0.15 | 85 | 36.00 | 2.03 | 1157 | 13 | -15 | 3451 | 547 | -0.01 | 15 | 0.12 | 179 | 273 |
| pXRF | | | | | 4.25 | 192 | -0.15 | 57 | 32.93 | 3.26 | 2054 | 10 | 48 | -400 | 676 | -0.01 | 8 | 0.12 | -150 | 275 |
| pXRF | | | | | 3.80 | -10 | -0.15 | 22 | 5.03 | 6.45 | 431 | 13 | -15 | 700 | 134 | -0.01 | 20 | 0.24 | 272 | 77 |

## *Mariner (zinc-lead-silver)*

Geology

The prospect area (Figure 9) includes the upper part of the Tooganinie Formation (usually interbedded sandstone, siltstone and dolomite, sometimes stromatolitic), basement Tawallah Group sandstone and overlying Roper Group sediments. The host Tooganinie Formation strata dip at 20 to 30deg to the west.

A more detailed stratigraphy is indicated from MIM's drill logs of the percussion chips, and plotted on the drill sections F 10, 11, 12, 13, 14). From youngest to oldest:

| | |
|---|---|
| SH | Shale, no Pb |
| SS + CH | Sandstone, cherty and with cherty beds. No Pb |
| CHCY | Chert + clay, some remnant silty dolomite, probably breccia. Pb values, some Zn in RDH09 |
| SLDM | Dolomitic siltstone, chert and clay, probably breccia. Best RDH01 Pb intersection. |
| F/W DM | Footwall dolomite. No Pb. Not present on every section |
| SHDM | Dolomitic shale. No Pb |

The geology log in BHP's diamond hole MARD1 (Figure 10) appears likely to be describing Amelia Dolomite with finely bedded dolomite, graphitic bands and stromatolites. Also there is brecciation of the dolomite with dolomite-ankerite fill and minor associated copper mineralisation. A red shale near the bottom of the hole (150m) could then be Mallapunyah Formation.

Mineralisation

Previous exploration by Mount Isa Mines Ltd ("MIM") obtained a best percussion drill (prone to downhole contamination) intersection in RDH-1 of 16m at 7.9% Pb, in oxidised cerussite rich material, within the Tooganinie Formation. Mineralisation appears to be leached above 14m.

The mineralisation is stratabound within a collapsed stromatolitic dolomite which lies within a dolomitic shale unit. The mineralisation at the Mariner prospect itself, and south of the prospect is cut off down-dip by a post-mineralisation major north-south fault. The petrography of mineralisation (MIM reports) describes cerussite, anglesite and some unweathered galena, covellite and chalcocite, a lot of barite and minor disseminated chalcopyrite.

The mineralisation may represent:

- Low grade Pb disseminated mineralisation in dolomite beds that is upgraded by dissolution of carbonates in the weathering zone.
- Stratiform zinc-lead mineralisation that has been subject to intense weathering, pre-Roper, Cretaceous and present.

At Mariner RC drilling is planned to test for associated zinc primary sulphide mineralisation along strike and down dip to the north (Figure 9). Four RC holes are planned to test for stratabound zinc-lead mineralisation. Further mapping will be carried out south of the drilling area to assess whether a target for a further RC hole can be developed in this part of the prospect.

Geochemistry

pXRF reconnaissance obtained widespread anomalous values from outcropping gossanous breccia. Values up to 1.29%Pb, 0.46%Cu and 0.13%Zn were obtained. Arsenic was generally below detection limit but 2 readings were above 100ppm (200ppm max). The pXRF readings are supported by a rock chip of the gossanous breccia sent for lab analysis (Table 2):

Table 2. Laboratory analysis of rock chip sample from Mariner prospect

| Prospect | SAMPLE | Ag | Al | As | Ba | Bi | Ca | Cd | Co | Cu | Fe | K | Mg | Mn | Mo | Ni | P | Pb | S | Sb | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mariner | 91130 | 2.6 | 0.27 | -5 | 50 | 1.3 | 0.07 | -0.5 | 45 | 2310 | 12.1 | 0.07 | 0.12 | 3200 | -1 | 20 | 200 | 3450 | 0.01 | 6 | 12 | 685 |

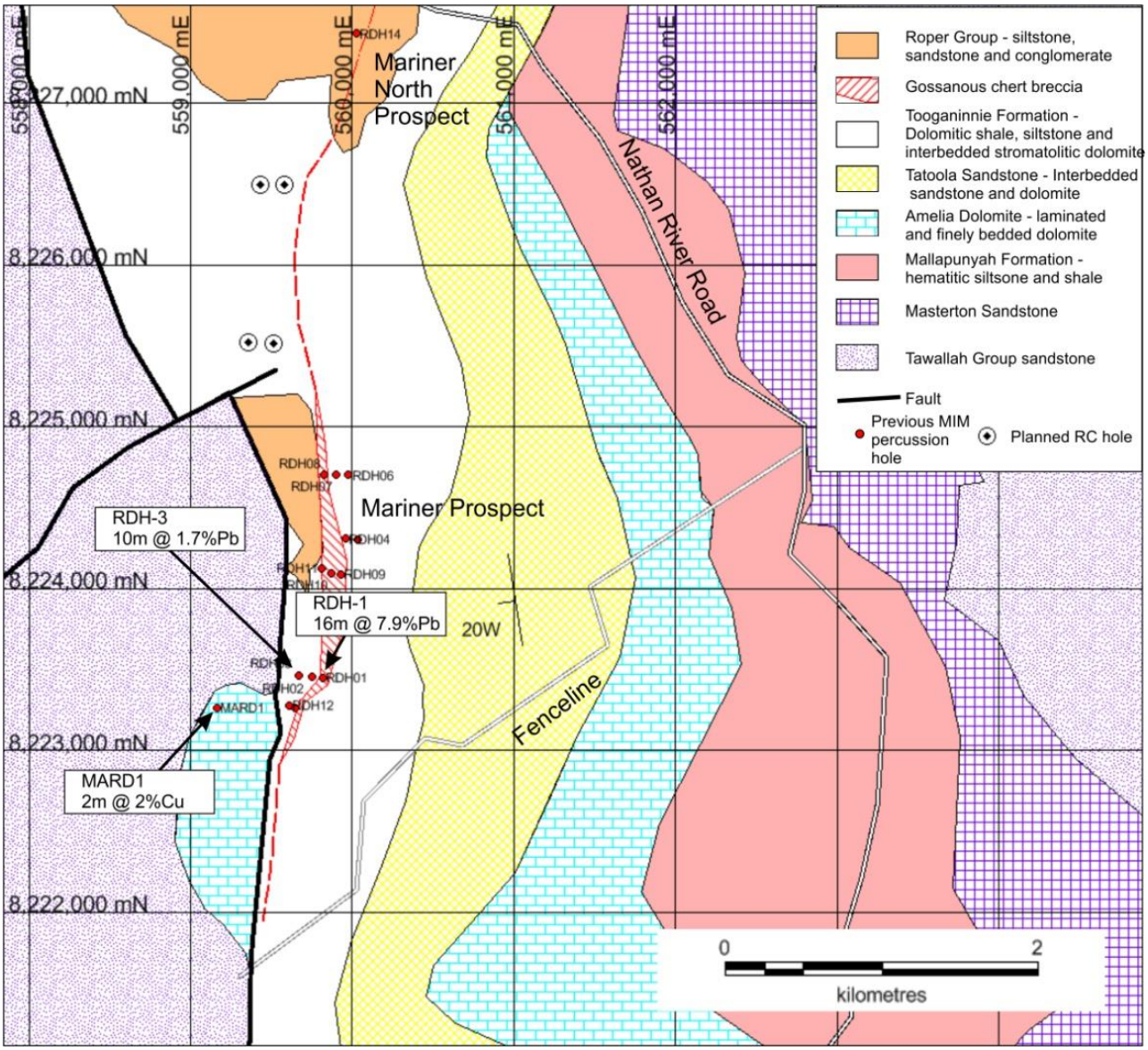



***Figure 9: Mariner – showing prospect as mapped by Pacifico, previous percussion drilling, intersections, and planned RC collars***

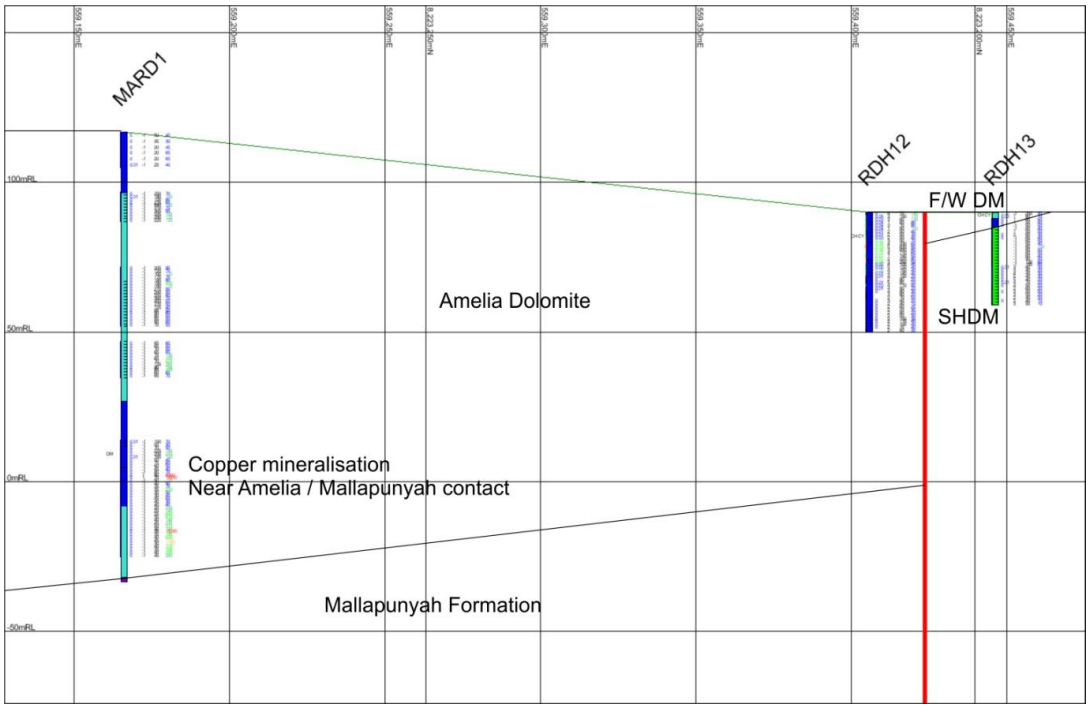



***Figure 10: Section through MARD1, RDH12, RDH13***

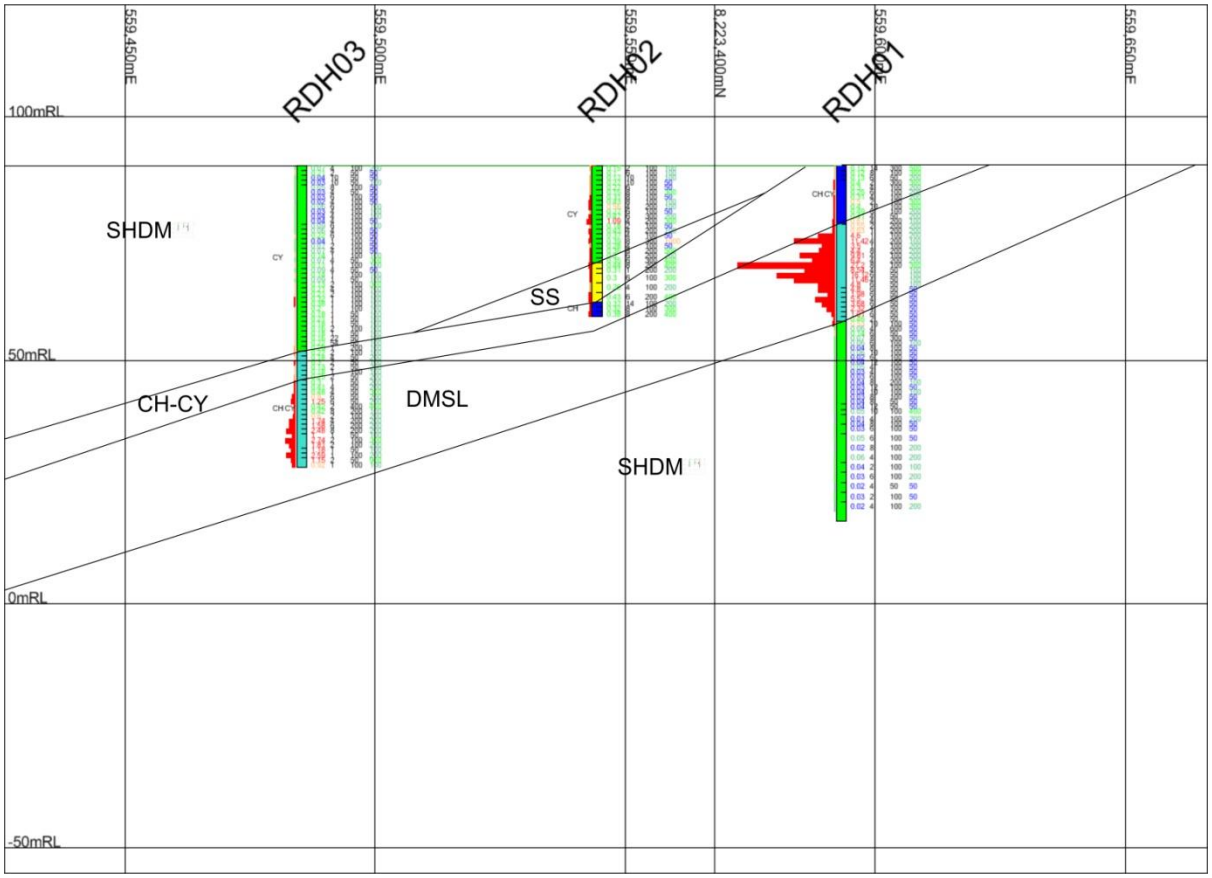



***Figure 11: Section through RDH01, 02, 03. Interp 30 deg dip, 20m thick higher grade lead zone and 50m thick overall mineralised zone (>0.1% Pb). No F/W DM***

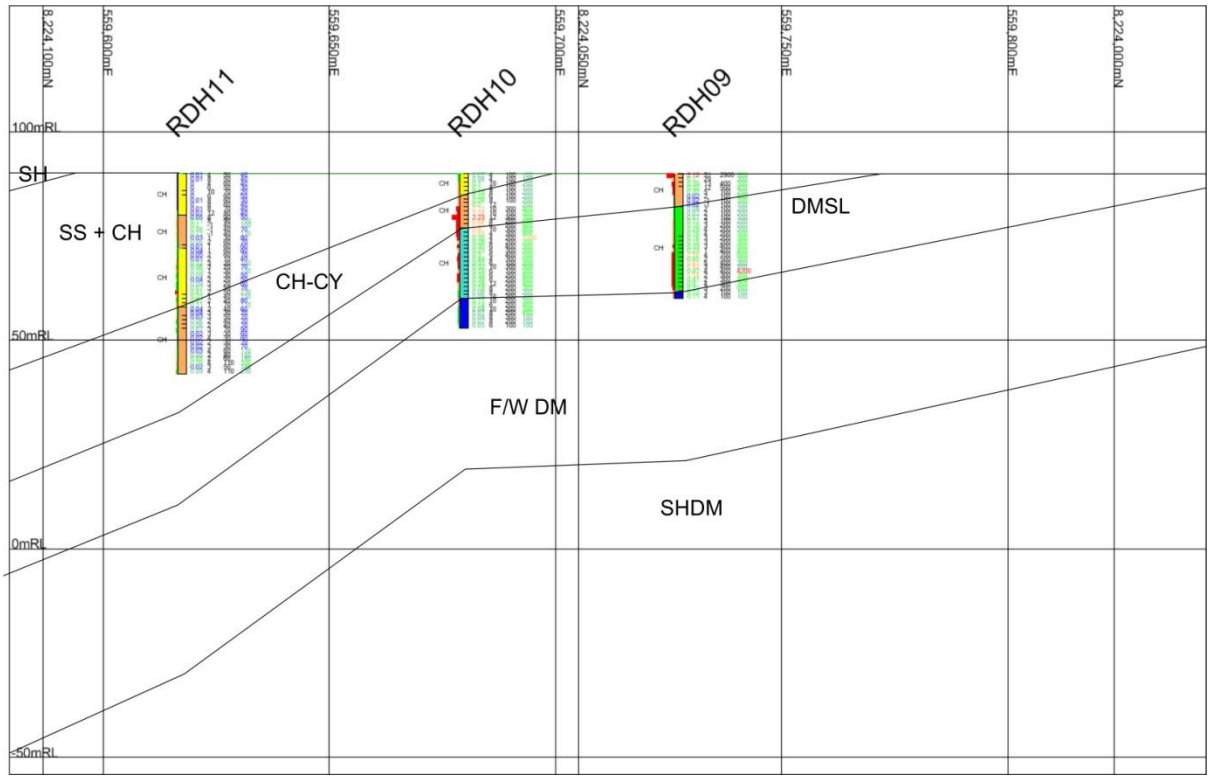



***Figure 10: RDH09, 10,11 Section***

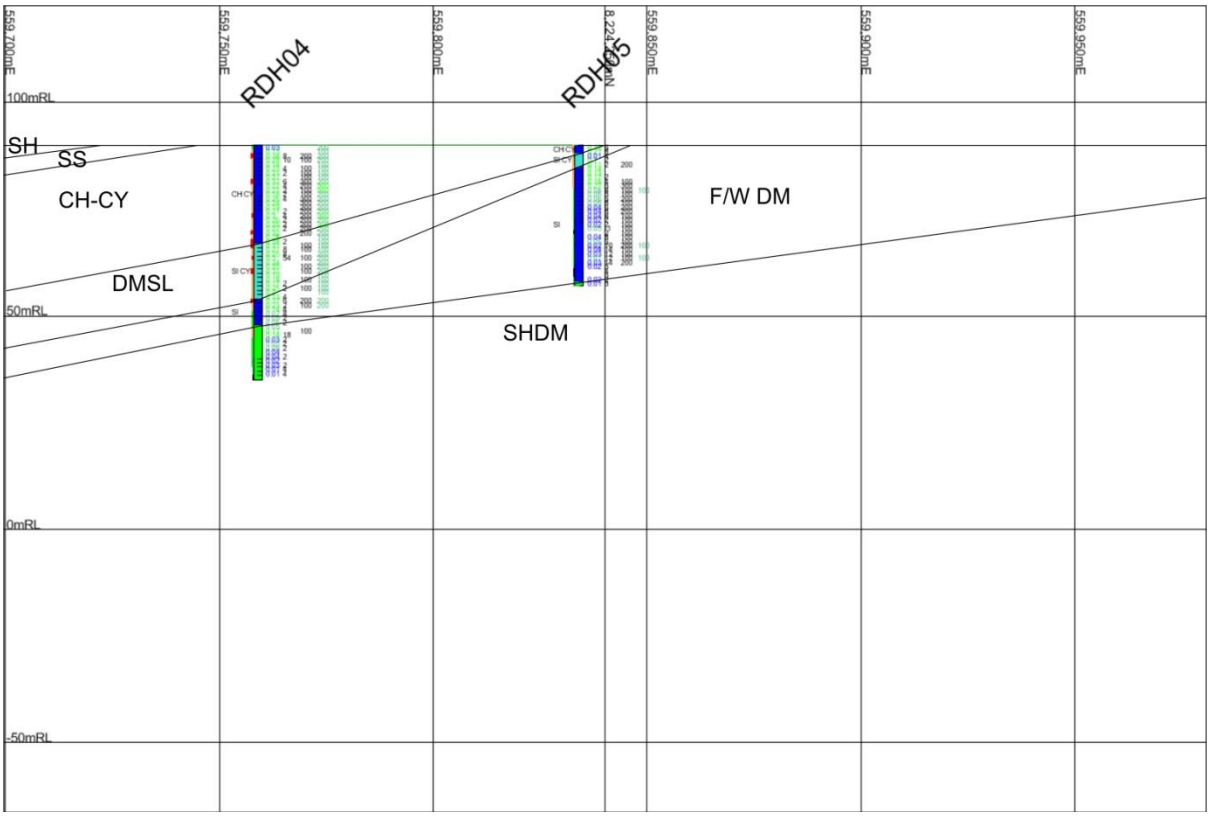



***Figure 12: RDH04, 05 Section***

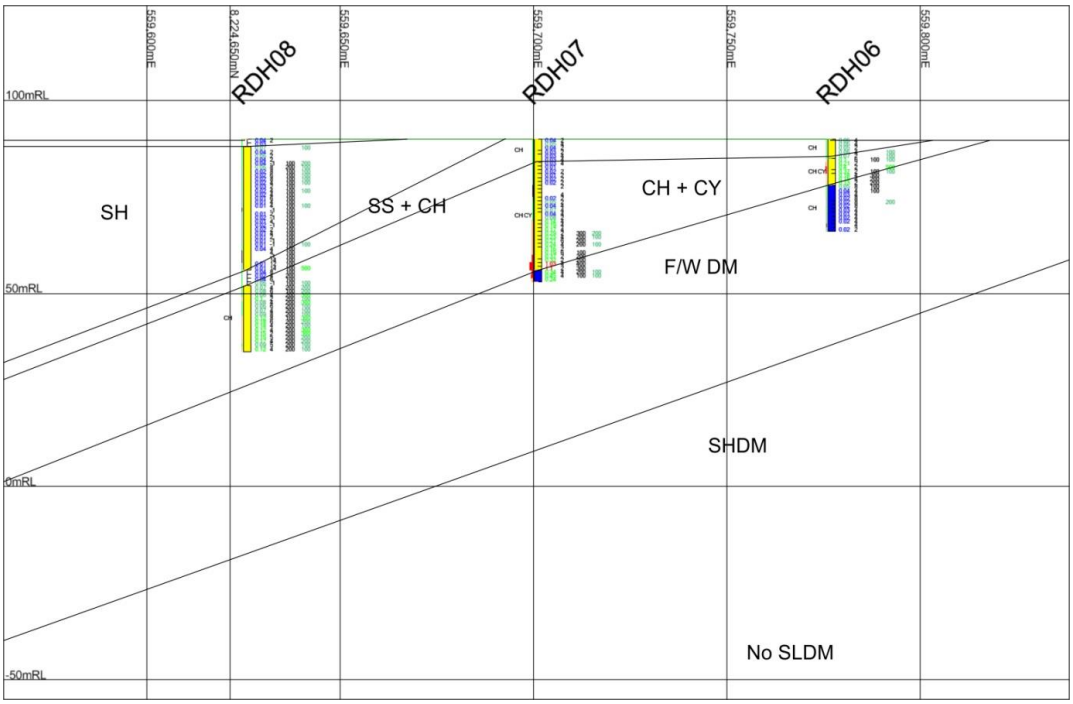



***Figure 13: RDH06, 07, 08 Section***

## *Coppermine Creek (copper)*

The eastern extension to the copper mineralised Gordons Fault has been recognised and mapped for five kilometers east of previous drilling by Pacifico (Figure 14). The fault is recognised as a brecciated or sheared contact between Mallapunyah Formation north of Gordons Fault and and Amelia Dolomite or Tatoola Sandstone to the south. The recognition of Mallapunyah Formation north of the fault is supported by drill core and logs available for the holes drilled by Sandfire (Figure 15). Parts of the fault are intersected by the later, post mineralisation, post-Roper Group, Coppermine Creek Fault. Where mineralised the Gordons Fault consists of a dolomite fragment breccia with gossanous matrix containing anomalous copper and lead values using a pXRF.

It is best mineralised where the fault runs in an east-west direction, and where the Mallapunyah Formation (hematitic siltstone, sandstone and dolomite) is faulted against the Amelia Dolomite. In the 2km zone targeted for RC drilling by Pacifico the structure is mapped with up to 15m width, with pXRF values from gossan breccia matrix of up to 0.47%Cu and 3.3%Pb (selected rock chips). These values are considered significant due to the consistency of anomalism within the Gordons Fault in the highly weathered and silcretised rocks and poor outcrop.

Two rock chips were taken over the newly discovered gossan breccia to check the pXRF values (Table 3).

Table 3. Laboratory analyses of rock chip samples taken at Coppermine Creek prospect

| Prospect | SAMPLE | Ag | Al | As | Ba | Bi | Ca | Cd | Co | Cu | Fe | K | Mg | Mn | Mo | Ni | P | Pb | S | Sb | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cu Mine Ck | 91133 | 2.5 | 0.26 | 48 | 540 | 1.2 | 0.05 | -0.5 | 14 | 146 | 1.98 | 0.05 | 0.03 | 664 | -1 | 14 | 1050 | 2560 | 0.04 | 6 | 40 | 53 |
| Cu Mine Ck | 91134 | -0.5 | 1.26 | -5 | 60 | 2.4 | 0.03 | 0.8 | 123 | 12 | 18.7 | 0.3 | 0.08 | 929 | -1 | 24 | 260 | 3360 | -0.01 | -5 | 36 | 1120 |

The pXRF values at these two sites varied from 67 to 510 ppmCu, 300pmm to 0.38% Pb and 60ppm to 0.12% Zn, indicating that the pXRF is functioning acceptably.

Three RC drill targets (nominal 150m depth) are selected to test the Gordons Fault for structurally controlled high grade copper mineralisation (eg Gunpowder/ Mammoth, Mt Isa region), as well as adjacent sediments for related stratabound Mount Isa/ Nifty style copper mineralisation, and stratabound zinc-lead mineralisation.

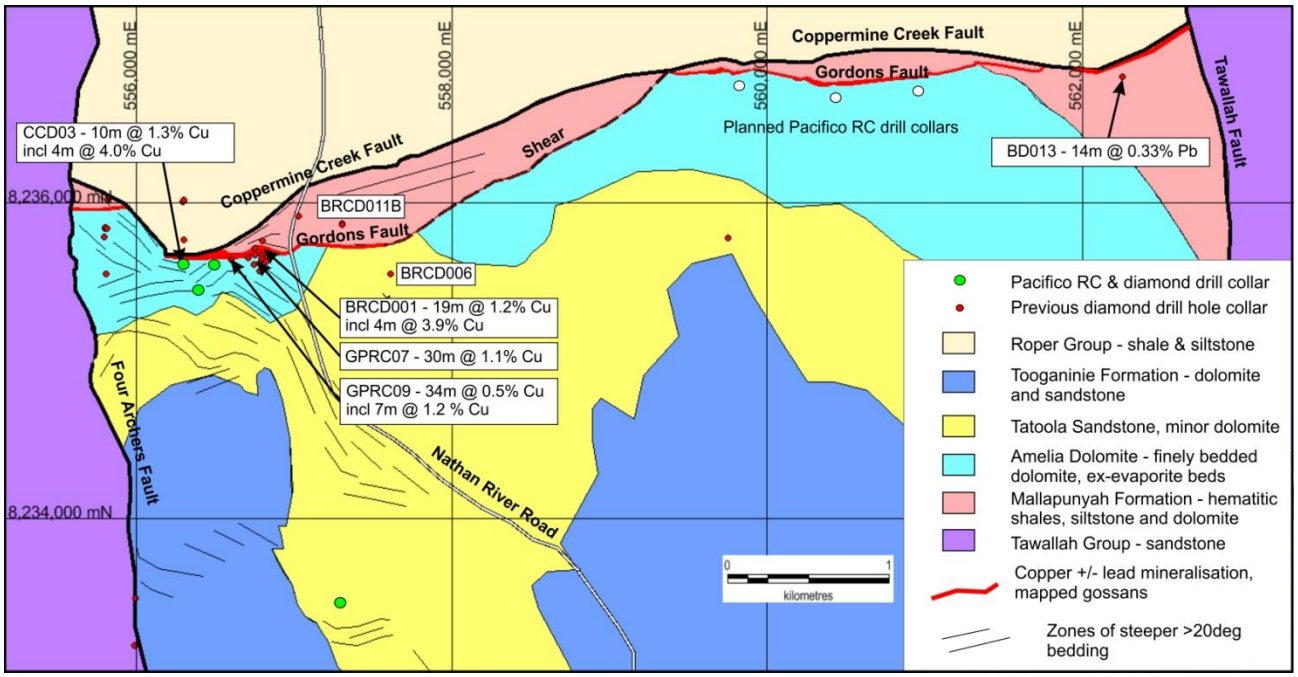



***Figure 14: Coppermine Creek – showing new extensions of Gordons Fault and planned RC collars***

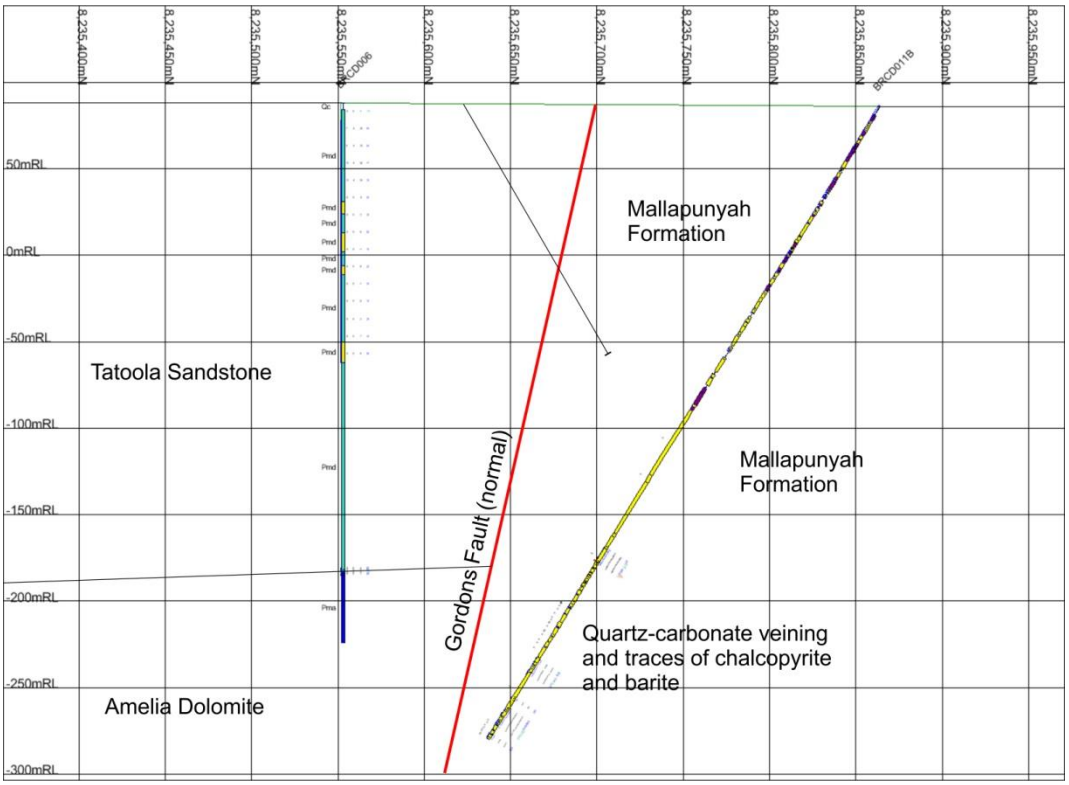



***Figure 15: Section through Sandfire holes BRCD006 and BRCD011B***

## *Johnstons (copper-zinc)*

Johnstons prospect consists of shallow diggings on copper-lead mineralisation (Figure 16). Host rocks are flat lying dolomite and siltstone. There are a large number of thin discontinuous steeply dipping breccia zones over an (exposed at the workings) area of 100m x 40m. Malachite is common, and cerussite is reported.

One hole has been drilled previously, by MIM under the workings, which obtained 7.4m @ 1.3%Pb and traces of chalcopyrite, from 55.3m. Mapping and pXRF work indicate that the mineralisation may extend northwards for 600m under shallow colluvium and sheetwash.

Mineralised breccia has now been identified over 300m strike (Figure 16), to the south of the main old workings, with pXRF readings of selected ferruginous rock of up to 0.65%Cu (supported by a lab analysis of 0.16% Cu, 13g/t Ag, again of a selected rock ferruginous rock, see below, also high in As and significant Sb) (Table 4).

Table 4. Laboratory analysis of rock chip sample from Johnstons prospect

| Prospect | SAMPLE | Ag | Al | As | Ba | Bi | Ca | Cd | Co | Cu | Fe | K | Mg | Mn | Mo | Ni | P | Pb | S | Sb | V | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Johnstons | 91131 | 12.8 | 1.63 | 902 | 210 | 0.5 | 0.04 | -0.5 | 43 | 1590 | 5.86 | 1.54 | 0.05 | 215 | 11 | 76 | 300 | 183 | 0.01 | 24 | 30 | 246 |

These values are obtained in weathered rocks in an area of very poor outcrop, and may be indicative of significant mineralisation, either in the structure itself, or derived from related stratabound mineralisation. The overall width of the structure that contains thin breccia zones is up to 40m. Two RC holes are planned to test the apparently more copper rich southern extension.

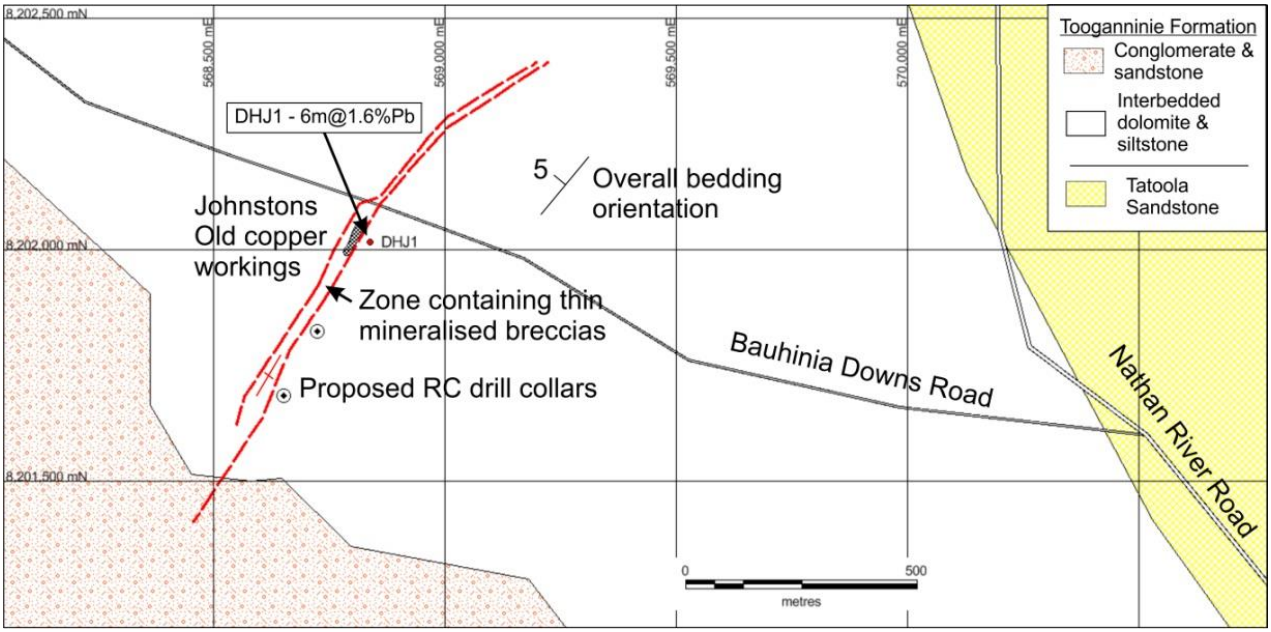



***Figure 16: Johnstons – extension of structure defined to south, and planned RC collar sites***