

# Preliminary Notes on Geology of North Tawallah2 Prospect Borroloola Project, NT

12<sup>th</sup> October 2011

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## SUMMARY

Sparse outcrops of a dolostone and siltstone package near the sites of two proposed 'proof of concept' RC drill holes at North Tawallah Range 2 suggest that the two holes will penetrate the Mallapunyah Formation, but at an unknown level in that Formation.

A known copper occurrence located about a kilometre to the southwest is potentially a 'classic' red bed type deposit, in a 20 m thick sulfide bearing (reduced?) fine grained grey sandstone sandwiched between purple hematitic oxidized sandstones in a south plunging syncline, probably entirely within the Wununmantyala Sandstone member of the mid-Tawallah Group. The local structure seems straightforward, and the style of hypogene ( $\pm$  supergene?) copper mineralization could be tested with an additional 150 m deep RC drill hole

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## Geological Setting

I spent a day and a half mapping the North Tawallah Range #2 area at 1:20,000 scale and found that the excellent outcrop and lithologic variations on the ridge 0.5 km west of the creek would justify 1:10,000 scale mapping. However there's only limited exposure in the vicinity of the proposed holes.

The attached files include:

- A spreadsheet containing waypoint locations and structural observations. [NthTawallahWaypoints WH 111010.xls]
- A georeferenced image of my geological field sketch (Figure 2) [NTR2sketch.jpg & NTR2sketch.jgw]<sup>1</sup>

### Planned drill holes

The two drill holes proposed to test the North Tawallah Range #2 red bed Cu conceptual target straddle Kulampirri Creek, on the overlap between ortho-photos 11-3105 and 12-3066 (Figure 1).

On the east bank of the creek, about 200 m south of the eastern proposed hole, there is a small outcrop of thinly interbedded fissile pale greenish-grey tan weathered dolomitic? siltstone and minor fine grained sandstone, dipping at 25 to the south. Chunks of similar weathered lithology exist in the bottom of the drill sump. Three to four hundred metres NW of the eastern site there are outcrops of thin-bedded grey crystalline dolostone and fissile purple dolomitic? siltstone (Figure 2 and Figure 3). Dips are gentle 15-20° possibly to SE and SSW (but uncertain of dip azimuth). This group of lithofacies seems consistent with Mallapunyah Formation, as interpreted by NTGS.

Immediately north of the eastern site, and in a discontinuous chain extending 2 km to the SE, there are low-profile outcrops of thin-bedded, cross bedded and rippled, variably fine-medium-coarse grained, white

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<sup>1</sup> Colour reference for Figure 2:

Purple = dominantly thin to medium bedded, cross bedded and rippled, poorly sorted medium-coarse grained (locally fine-grained) purple quartz sandstone.

Pink = coarse cobbly sandstone-polymictic conglomerate.

Yellow = fine grained sandstone; the arcuate unit west of the creek is grey (tan weathered) flinty sandstone with trace disseminated Py  $\pm$  Cpy and surficial malachite staining.

Blue = dolostone.

Olive green = siltstone.

quartz sandstone dipping at low angles  $\sim 10^\circ$  to the E, ENE, and W; i.e. nearly flat, possibly in (non-observed) broad open folds with roughly NNW axial trends (Figure 4). The spatial distribution suggests these lie stratigraphically just above the suspected Mallapunyah Fmn near the eastern drill site. The northerly strike trends suggest my dubious bedding measurements in the dolostone-siltstone group are spurious. The sandstone group is lithologically similar to the triplet of 'quartzite' sandstones intersected in several of the southwestern Tawallah2 drill holes, and which crop out in central Lorella Pocket, and which are there interpreted to lie near the base of the Amelia Dolomite.

It's drawing a long bow to make that correlation to NTR2 on such slender evidence, but if so, then the eastern drill site might be near the top of the Mallapunyah Formation, and the 200 m (planned) hole may not reach the base to effectively test the conceptual target. I am, however, reasonably confident that it will collar into Mallapunyah Formation. I'm less certain of the western drill site, just west of the creek, but given the gentle dips in the sandstone group, and assuming there's no major structural-lithostratigraphic break along the creek, then it should also drill into Mallapunyah Fmn. Even so, its planned depth of 100 m doesn't give it a much better chance of reaching the base.

### Copper Prospect #1

Haines et al. (1993) tabulated the location of a stratiform copper occurrence at about 561200E 8283600N, which is about 800 m southwest of the western planned drill hole. My observations indicate it consists of minor malachite staining (Figure 5) on fracture surfaces in an arcuate ridge of thinly-planar bedded flinty fine-grained grey sandstone weathering to a pale tan colour. An abundance – literally hundreds – of anthropogenic rock flakes along the ridge top attests to the unusual flintiness of this rock type, evidently the site of an ancient tool factory (Figure 6). Some beds have recessive weathered laminae suggesting a carbonate cement, and there are minor sub-centimetre thick layers of medium to coarse grained sandstone which contain disseminated up to a percent or two of blebby pyrite  $\pm$  chalcopyrite<sup>2</sup>.

This unit dips at about  $20^\circ$  to the SW, S and SE in a small syncline plunging at about  $15\text{-}20^\circ$  SSW. It is underlain and overlain (Figure 7 and Figure 8) by thin-medium, cross-bedded, rippled poorly sorted medium-coarse-grained purple (hematitic) quartz sandstone commonly with cm-scale lensoidal solution cavities representing flattened muddy intraclasts.

These purple sandstones are identical, in composition and bedforms to the sandstones forming the bulk of the 1.5 km long ridge extending to the north.

The aforesaid ridge also exposes some spectacular massive cobble conglomerate and white coarse grained sandstones in units upto a few metres thick *clearly interbedded* with the purple sandstone (Figure 9). The

western half of this  $\sim 600$  m wide group of clastic rocks dips at around  $20^\circ$  to the east but white coarse grained units on the eastern side are folded into a narrow syncline-anticline pair; the synform possibly co-axial with the boomerang shaped fold in the copper bearing fine grained sandstone to the south.

The NTGS (Madigan and Rawlings, 1992) assigned the purple sandstones to the Wununmatyala Sandstone (Ptn) and the copper bearing unit to the Masterton Sandstone, presumably separated by the usual low-angle unconformity (Figure 1). The former lithofacies seems consistent with Haines et al.'s description of the Wununmatyala Sandstone, although the conglomerate facies seems atypical. However, I have problems with their interpretation of the Masterton Sandstone because the copper bearing fine grained sandstone is conformably sandwiched between purple sandstones of similar composition and bedforms. The grey fine grained unit is probably only about 20 m thick, its composition and grain size is unlike other exposures of usually pink medium to coarse grained Masterton that I've observed around Lorella Pocket and at North Costello, and it seems illogical that the Masterton should revert to a facies identical to the several hundred metres thick purple footwall sandstone association after a significant depositional and erosional interlude (mid Tawallah Group to lower McArthur Group)

Accordingly, I see it all as a continuous conformable sequence, bounded by a major N-trending silicified fault zone on the west. There are traces of NNE trending faults near the eastern edge of the ridge, which I've incompletely mapped to date. The relationship between this ridge of coarse clastic rocks and the carbonate-siltstone association along the creek to the east, is obscure. If the purported stratigraphic assignments are correct, then:

- There must be a fault between them, maybe analogous to the western rim of Lorella Pocket where Tawallah Group abuts gently dipping Mallapunyah-Amelia,
- or:
- The Masterton sandstone is here absent and the 'Mallapunyah' carbonate-siltstone facies directly unconformably overlies the Wununmatyala member of the Tawallah Group.

Irrespective of the stratigraphic level, the copper occurrence could be a 'classic' redox-controlled sandstone-hosted red bed copper deposit, situated in a reduced sandstone bed sandwiched between hematitic oxidized sandstones, possibly near the top of a thick oxidized sandstone package. It may not 'make the grade' but it could be an opportunity to learn more about this style of deposit – to 'refine' rather than 'prove' the concept.

A vertical drill hole collared about 200 m south of the boomerang outcrop, say at about 561150E 8283350N could be expected to intersect the copper-bearing fine sandstone at  $\sim 80$  metre below surface, hopefully below the zone of oxidation<sup>3</sup>

<sup>2</sup> A bag of samples outside the Lorella Camp geo's office contains some numbered rock specimens.

<sup>3</sup> I've made this estimate and proposed collar location without the benefit of a protractor; it warrants a more careful geometric interpretation and review before preparing the site.

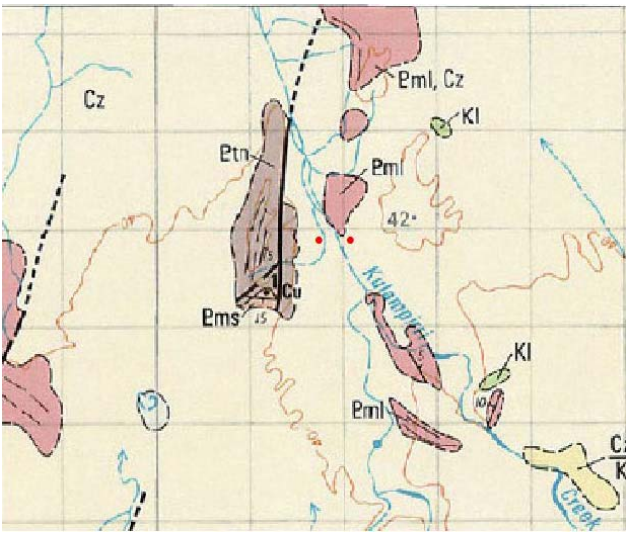


Figure 1. North Tawallah Range 2 surface geology (adapted from Madigan and Rawlings, 1992). The locations of Sandfire's proposed 2011 RC drill holes are shown as red dots.



Figure 3. Dolomite with partly silicified bands (upper), purple fossiliferous siltstone (lower).

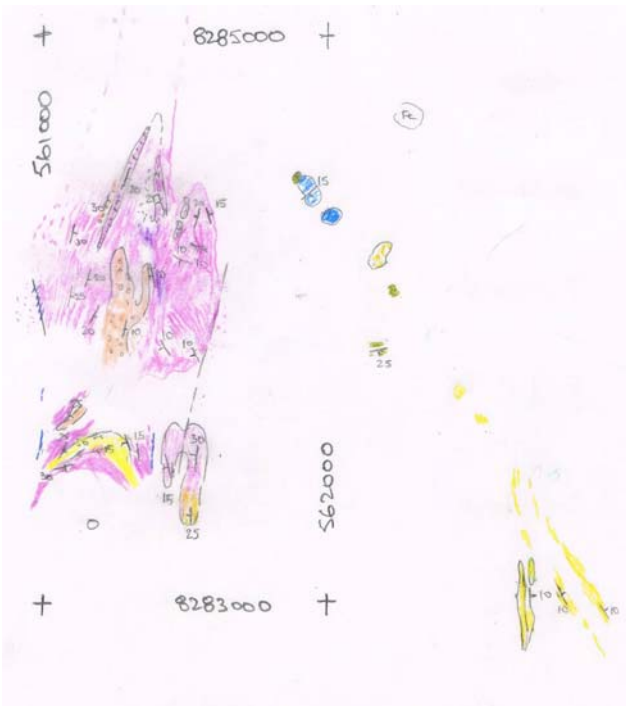


Figure 2. Geological sketch map of NTR2 area (GDA datum).



Figure 4. Gently east dipping thin-cross-bedded variably fine-medium-coarse-grained white quartz sandstone.





Figure 5. Malachite on joint surfaces in fine grained sandstone.



Figure 8. Upper contact of the copper bearing sandstone unit (tan coloured weathered outcrops and blocks in left foreground) overlain by purple sandstone (rubble at upper right).



Figure 6. Anthropogenic stone flakes of flinty fine grained grey sandstone.



Figure 9. Coarse cobbly conglomerate overlain by pinkish-purple ripple-marked medium grained sandstone.



Figure 7. Lower contact of the fine grained copper bearing sandstone unit (existing mainly as rubbly sub-outcrop in the upper right of frame) underlain by gently south dipping purple sandstone (in foreground outcrop).

## REFERENCES

- Haines, P. W., Pietsch, B. A., Rawlings, D. J., and Madigan, T. L. A., 1993, 1:25,000 Geological Map Series, Explanatory Notes, Mt Young SD53-15, p. 81.
- Madigan, T. L. A., and Rawlings, D. J., 1992, Tawallah Range Sheet 6066, 1:100,00 scale Geological Map, NT Department of Mines & Energy.