Summary of mineralogy matches from HyLogger™ data, Malawiri prospect (MARD series holes), Ngalia Basin

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Malawiri drillholes – Introduction and background

Energy Metals Ltd successfully applied for funding for drilling the MARD-series holes in Round 9, NTGS Geophysics and Drilling Collaborations Programme in 2016-2017. These holes are located close to the Malawiri prospect in the Ngalia Basin (Figure 1). Results are reported in CR2016-0723 (Fordyce et al. 2016).

Fordyce et al. (2016) state that typical uranium mineralisation within the Ngalia Basin is within stacked tabular 1–10 m wide bodies, hosted in reduced (sometimes partially oxidised) medium- to coarse-grained arkosic sandstones (less commonly silty shales) towards the base of the Mt Eclipse Sandstone. At its base, the Mt Eclipse Sandstone is generally reduced and pyrite-bearing, but mineralisation is associated with an oxidative hematitic overprint. Early exploration models focussed on highs or flexures in the basement topography, rather than stratigraphic position.

The MARD-series drillholes were designed to test a new stratigraphic/structural model of complex, tightly folded structures with thrusts along the anticlinal axes. In this new geological model, the Malawiri uranium prospect is interpreted to be within the limb of a tightly folded syncline. The drilling is to test stratigraphic repeats of the structural location of the Malawiri prospect (Figure 2).

Fordyce et al. (2016) logged the cored interval of MARD001 as the Vaughn Springs Quartzite (Treuer Member). The overlying Mt Eclipse Sandstone has several intervals of uranium mineralisation between 128 and 145 m depth, but this is above the depth of the start of coring (182.9 m). Fordyce et al. (2016) logged the cored interval of both MARD002 and MARD003 as being within the Mt Eclipse Sandstone.

The purpose of this publication is to document the mineralogy and textures of the MARD-series holes, as each of the 3 MARD holes are texturally and mineralogically different. One hole (MARD001) is examined in more detail in Smith (2017). MARD001 differs from MARD002 and MARD003 as the cored interval is within the Vaughn Springs Quartzite, and the overlying Mt Eclipse Sandstone was not cored.

The transport costs of the drillcore from Alice Springs to Darwin (return) to enable HyLogging was funded under the National Collaborative Research Infrastructure Strategy (NCRIS) for the National Virtual Core Library (NVCL) project, which is managed through AuScope.
Figure 1: MARD Drillhole Location Map

Plan map showing the location of the NTGS Geophysics and Drilling Collaborations drillholes (MARD series) at Malawiri prospect, Ngalia Basin.
Figure 2: Interpreted Malawiri section, showing tightly folded and thrusted stratigraphy, with the locations of the Malawiri prospect, and proposed holes MARD001 and MARD002 (from Fordyce et al 2016). MARD001 was planned to intersect Mt Eclipse Sandstone on the northern limb of a syncline and extend into the underlying Vaughn Springs Quartzite. MARD001 ended in Vaughn Springs Quartzite (the top part of MARD001 in Mt Eclipse Sandstone was not cored); this publication examines only the cored interval of MARD001, ie the Vaughn Springs Quartzite. MARD002 targetted the northern limb of a very tight syncline (in comparison to MARD001); MARD002 cored interval is entirely within the Mt Eclipse Sandstone. MARD003 (not on this section) tests a possible stratigraphic repeat approximately 6.5km to the southwest. The cored interval of MARD003 is logged as intersecting Mt Eclipse Sandstone.
HyLogger overview of MARD holes, mineralogy and textures. LHS is SWIR mineral summary; RHS is TIR mineral summary. All holes have different mineralogy in both SWIR and TIR. MARD002 and MARD003 both core Mt Eclipse Sandstone but are mineralogically distinct.
The logged stratigraphy of row 1 is the Treuer Member of the Vaughn Springs Quartzite, with a zone from 191.1–194 m informally named ‘brecciated’ Vaughn Springs Quartzite (Fordyce et al 2016). Rows 2 to 4 plot scalars (spectra queries). Row 2 plots SWIR white micas (almost pure) by the wavelength of the white mica (composition) coloured by the dominant TIR mineral. Row 3 plots the quartz abundance (by plotting TIR spectra that match dominantly to quartz by the depth of the quartz 8625 nm feature). Row 4 plots the SWIR carbonates by the wavelength (composition) of the diagnostic SWIR feature. The dotted lines show that there is a difference in the mineralogy of this brecciated zone, with less white mica and more carbonate (dolomite).

The 3 inset images show textures from the 3 zones. The upper and lower Treuer Member zones are a greenish fine-grained sediment, which has white mica (muscovite), some chlorite, some carbonate, and quartz. The brecciated zone has a lot more carbonate and less white mica (and possibly less quartz).
Fordyce et al. (2016) reported that MARD002 intersected ‘mainly barren, oxidised sandstone’; no mineralisation was reported. The core is texturally and mineralogically consistent along its 51.6 m interval. The SWIR mineralogy dominantly matches to white mica (row 2); the TIR mineralogy dominantly matches to quartz (row 3). There is almost no hematite and very sporadic minor goethite (row 4) matches to the VNIR, with most of the matches being ‘not in library’. This is discussed on the next page. The core colour (row 5) is also consistent.

Texturally, MARD002 consists of a uniform reddish fine-grained sandstone, with minor local reddish mudstone clasts (see image, left, and image on next page). The carbonate matches appear to be from minor cross-cutting carbonate veins.
Row 2 shows quartz abundance is consistently high, except at 199m (see inset bottom far right) in a mudstone unit between quartzose sandstone. Schmid et al (2012) noted that a 2245 nm feature may map V-rich roscoelite; however, this feature is more likely to be a short wvl chlorite (see inset centre left). Row 4 plots the VNIR Fe oxides by the wavelength; it shows a consistent wavelength at around 875 nm which TSG returns as ‘not in library’ (inset right). Ausspec (2008) noted that ferric absorption features for hematite are around 860nm and for goethite, ~930 nm; so the 875 nm feature here is probably an impure Fe oxide.
Fordyce et al (2016) reported that MARD003 had a small mineralised zone near the Cenozoic – Mt Eclipse Sandstone unconformity (110 m; not cored). All of the cored interval is logged as Mt Eclipse Sandstone (row 1). There are mineralogical changes downhole: the dominant SWIR mineral changes from montmorillonite to white mica (~168 m), then kaolinite (170 m) with smaller mixed intervals to the end of hole. The dominant TIR mineral is quartz, with zones dominated by montmorillonite with white mica (row 3). There is more goethite and hematite matches in the VNIR (row 4) compared with MARD002. Row 5 (enhanced core colour) also shows changes in the intensity of the reddish brown colour, with the strongest reddish brown colours correlating with TIR montmorillonite/ white mica zones. Compare this mineralogy with that in MARD002 (pages 6 and 8): MARD003 is generally coarser sandstone with mudstone zones. The coarser sandstone zones have kaolinite (inset image; left) and the finer mudstone intervals have less quartz. The reddish mudstone units are dominantly montmorillonite and white mica.
Row 1 is the logged stratigraphy. Row 2 is the quartz abundance; the dotted lines show zones where the quartz abundance drops significantly or the dominant TIR mineral is not quartz (ie montmorillonite or white mica; see previous page). Rows 3 and 4 plot the occurrence of reflectance features at 2245 nm and 2290 nm respectively. Schmid et al (2012) noted that V-rich intervals at Bigrlyi had a 2245 nm feature, which is characteristic of roscoelite. MARD003 is the only hole (of the MARD holes) to have 2245 nm spectra (see inset, above). However, MARD003 also has a coincident 2290 nm feature as well as the 2245 nm feature. This may indicate a more Fe-rich smectite (nontronite?); there is also an Al-rich smectite (indicated by a 2207 nm feature). There is no geochemistry for MARD003 to assist in interpreting these spectral features. Row 5 plots the wavelength of the VNIR Fe oxide feature, coloured by the VNIR mineral. Many of the 'not in library' mineral matches have a similar wavelength to hematite (coloured red in row 5).

Note that there is a cyclicity/repetition with the spectral features in MARD003; this may indicate repeated lithology, possibly from tightly folded and/or thrusted strata?
Malawiri prospect 2016 drilling: Conclusions and further work

Vaughn Quartzite
Edgoose (2013) reports that the Treuer Member of the Vaughn Springs Quartzite consists of micaceous mudstone, laminated shale, and thinly bedded quartz sandstone; with cross-beds, intraformational breccia, and slump structures. MARD001 has low angle bedding near base (page 7; right inset image), which is less visible at the top part of the cored interval (page 7; left inset image). The intraformational breccia (page 7; inset image centre) has more carbonate than the surrounding mudstones / laminated shales of the Treuer Member. The Treuer Member may also contain glauconitic sandstone, although this was not noted in MARD001. The micaceous mudstone is dominantly muscovite (greenish hue) with some Mg chlorite features (SWIR reflectance features at 2251 nm and 2349 nm) that TSG is matching to carbonate. It is recommended that some XRD validation is carried out to determine if chlorite is present.

Mt Eclipse Sandstone
Both MARD002 and MARD003 intersected the Mt Eclipse Sandstone, but differ from each other in both mineralogy and textures. MARD002 is dominantly a fine-grained sandstone, with very minor (<5%) mudstone, mainly at 199 m. The quartzose sandstone has interstitial white mica. In comparison, MARD003 is dominantly a coarser-grained sandstone, with variable zones of smectitic white mica mudstone intervals. The coarser-grained sandstone units are quartz-rich, with minor montmorillonite +/- kaolinite +/- muscovite.

Schmid (pers comm) commented that the mineralogy and textures of the core in MARD002 indicates that it is stratigraphically located in the upper part of the Mt Eclipse Sandstone. In contrast, the mineralologically diverse, coarser-grained arkosic sandstones in MARD003 are characteristic of the lower Mt Eclipse Sandstone, which hosts the Bigryli deposit to the west.

MARD003 shows repetition with alternating zones quartzose sandstone and smectitic mudstones. This may indicate that MARD003 intersected tightly folded units (?) The logs in Fordyce et al (2016) noted ‘upward fining’ in two intervals (161 m and 181 m) and a ‘wavy base’ at 171.2 m, plus highly broken core at 180 m. It is recommended to check for younging criteria that may support the interpretation of tightly folded repeated (or thrusted) strata.

The 2245 nm feature (row 3; page 11) may indicate roscoelite (vanadium) as this was identified at Bigryli (Schmid et al 2012). It is recommended that the interval 178-179 m in MARD003 be assayed for vanadium.
References


