Why grade is king in the Tennant Creek mineral field!

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Summary

The discoveries in the Tennant Creek mineral field (TCMF) of the Northern Territory by the Emmerson Resources' team and joint venture partners marks a successful journey of systematic science-based exploration. The most recent drill intersection at Emmerson's Hermitage project returned 117 m of continuous mineralisation grading 3.4% Cu, finishing (due to drilling difficulties) in some of the best grades of 3 m at 15 g/t Au and 4.2% Cu. This intersection was ranked as the 16th best global copper intersection for 2021. Adding to this are numerous ultra high-grade gold intersections from Emmerson's Mauretania discovery, eg 22 m at 36 g/t Au (including 6 m at 122 g/t Au).

These discoveries are attributed to adoption of new prediction and detection tools based on new data and geoscience, coupled with new technology. Conversely, 'doing the same things with the same technology in the same search space' is a recipe for diminishing returns given the exploration maturity of the TCMF (**Figure 1**).

For '**Prediction**', Emmerson has supported numerous internal and external studies to better understand the 4D structural framework of the TCMF. This includes age-dating, new structural analysis and, most notably, a 60 km 2D seismic reflection survey co-funded by the Northern Territory Geological Survey. With the aim to image the upper crust and pinpoint major fluid conduits (thrust faults), plus map the spatial distribution of the Tennant Creek Suite of intrusions – which from age-dating are spatially and genetically linked to this family of iron-oxide copper-gold (IOCG) deposits that occur within this strongly deformed fold and thrust belt.

Initial interpretation from the seismic survey suggests that all major copper-gold deposits are associated with northward-verging, D1 listric thrust faults that have a depth extent down to about 10 km. This survey also identified new thrusts, one of which correlates with the northern gravity ridge that hosts a cluster of prospects and deposits including the Hermitage, Jasper Hills and Edna Beryl projects.

Independent predictive targeting verification was undertaken by specialist company Kenex Pty Ltd utilising Emmerson's Mineral Systems framework to produce predictive 2D maps for both Weights of Evidence (WoE) and Logistic Regression (LR) models. The theoretical Success Rate (predictive ability to find known mineralisation) for the WoE model was ~96% and the LR efficiency of prediction of 99% – providing confirmation that the principal elements of Emmerson's Mineral System were crucial to ore formation.

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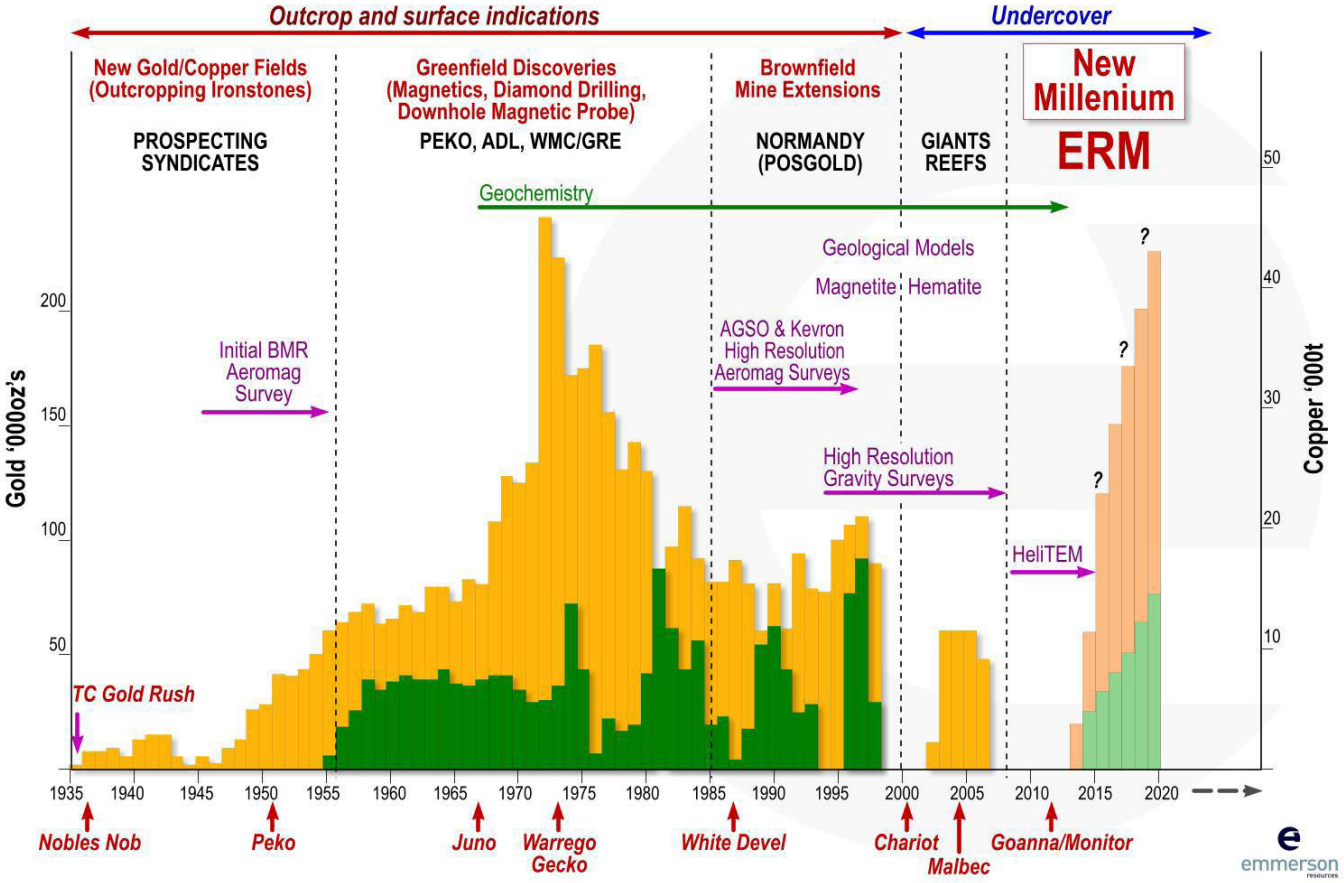

Figure 1. Discovery history of the Tennant Creek mineral field.

An attempt was made to extend the 2D into 3D predictive maps; however, this proved to be challenging given the vagaries in modelling the potential field data and projecting surface/subsurface features to depth in a fold and thrust belt.

There has been a long history in the application of various '**Detection**' technologies in the TCMF with the first ground magnetic surveys in 1935 and first airborne magnetic survey in 1956. The efficacy of magnetics together with the pioneering of forward modelling and down hole magnetics lead to many discoveries – not surprising given the primary ironstones (host to the mineralisation) in Tennant Creek are typically composed of 50-90% magnetite with susceptibilities of 1-7 SI units. Unfortunately, there are also many false positive magnetic anomalies caused by barren magnetite ironstones (some 700 known ironstones in the field), further complicated by folded and faulted magnetite-bearing (magnetic) sediments of the lower Warramunga Formation. This is coupled with the challenge of detecting relatively small footprint, mineralised and altered ironstone bodies that, by virtue of their structural setting, are typically steeply plunging and pipe-like.

Emmerson has adopted a deliberate strategy to avoid the 'diminishing returns' pathway (**Figure 1**), particularly as most of the obvious magnetic anomalies have been the subject of historical exploration and drilling. Whilst Emmerson is not the first company in the TCMF to apply gravity geophysics, it has pioneered large regional and very detailed (20 m × 10 m stations) prospect-scale surveys. These surveys have assisted in developing a better understanding of the geological setting but were certainly not the 'silver bullet' in terms of direct detection of gold and copper-bearing hematite (non-magnetic) ironstones. Emmerson has also trialled electrical, seismic, airborne, and downhole electromagnetic, magnetotellurics, sub-audio magnetics and others – all with varying degrees of success.

Fortunately, the evolution of our targeting/exploration model combined with the advent of cost effective, ultra-high resolution drone magnetics has renewed confidence in reinvigorating the rich discovery history of the TCMF – with Emmerson making the first new discoveries in over two decades. These discoveries can be attributed to a multifaceted approach of investing in new and higher resolution data (the new drone magnetic surveys); refinement of the exploration model; and a preparedness to drill test early in the exploration cycle. Going forward, these high-resolution magnetic surveys are likely to play an ever-increasing role in discovery, particularly in pinpointing subtle magnetic anomalies that may correspond with hematite-dominant ironstones formed along the predicted D1 corridors (thrust planes). This was conclusively demonstrated from our recent discovery at Mauretania where the oxidised, hematite-bearing primary fluids, likely associated with the Tennant Creek event (ca 1847–1851 Ma), carry high grades of gold (**Figure 2**).

Similarly, the discovery of the Goanna copper and gold mineralisation in predominantly hematite ironstone, some 100 m outside of the historic Gecko mine (and magnetic anomaly), underscores the potential of these fluids in forming economic concentrations of metals – although at Goanna, a later D3 event likely remobilised primary copper sulfides into vein arrays with the best grades (drillhole GODD015: 24 m at 4.12% Cu and 0.19 g/t Au) corresponding

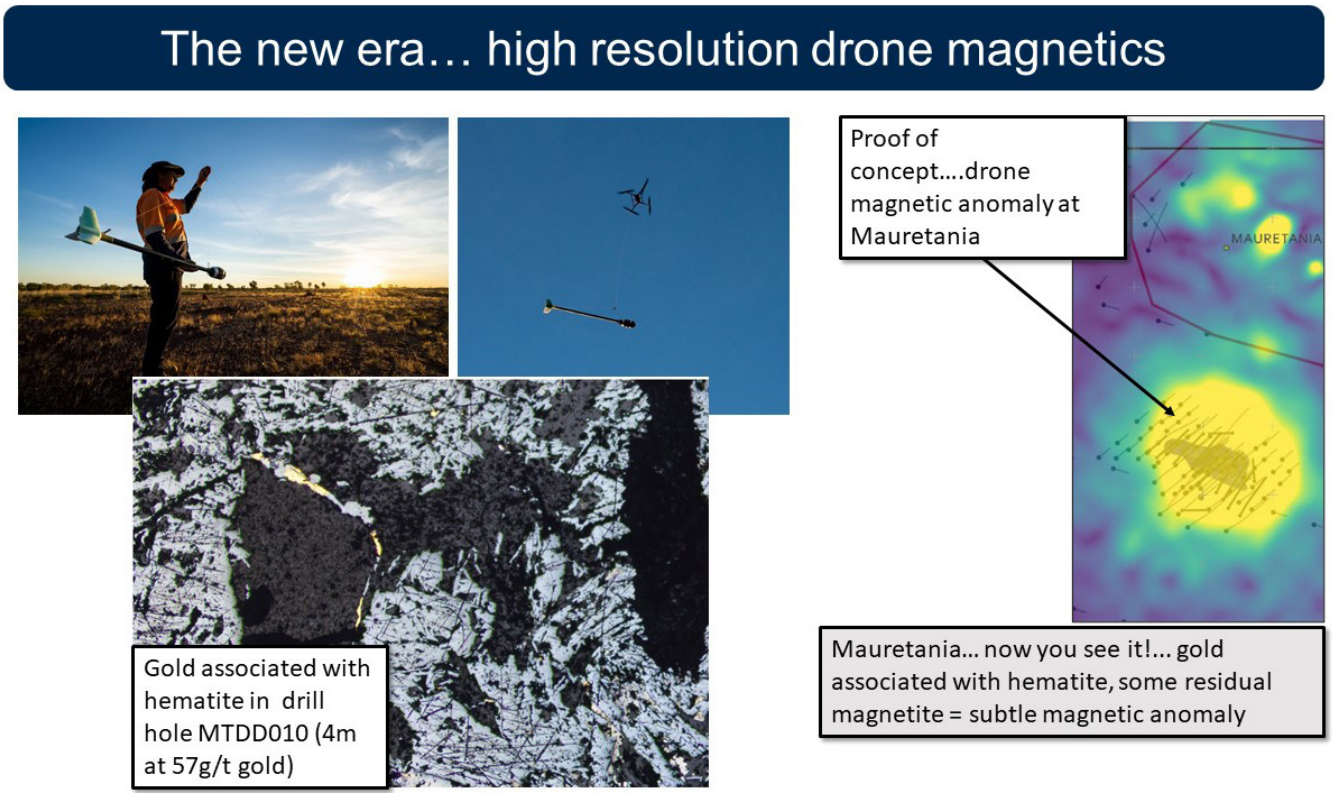

Figure 2. Mauretania Discovery – high grade gold in the oxide and primary zones.

to the highest density of chalcopyrite–quartz veins. This discovery arose from trialling airborne electromagnetics (HeliTem), followed by induced polarisation (IP) surveys to pinpoint drill targets.

Our recent intersection at the Hermitage project suggests this style of high-grade breccia-hosted mineralisation is a further variation on the TCMF-IOCG theme – intersecting a zoned iron-oxide breccia that consists of hematite-jasper close to the surface, before grading into magnetite-hematite-chlorite at depth. The metal zonation reflects the interaction of both supergene and primary processes with malachite occurring from 70 m to 120 m down the drillhole, grading to a thick zone of native copper, then transitioning to chalcopyrite-quartz-chlorite at depth. Both the copper and gold grades appear to be increasing with depth, with cobalt a likely later overprint to the primary assemblages.

Conclusion

Our exploration strategy continues to be nimble and responsive to the advent of new techniques, technology, and discoveries – apart from the large investment in flying ultra-high resolution drone magnetics across the TCMF, we are also partners in the CSIRO UltraFine+™ geochemical project and are conducting collaborative research on ironstone fertility indices with the University of Tasmania (CODES). Our journey is underpinned through applying cutting-edge geoscience by geologists who have a passion for making discoveries, by strong partnerships with research and government, plus a supportive Board and shareholder base. Where possible, we are bringing our stakeholders along on the journey and have recently formed a landmark joint venture with the local custodians of the Jasper Hills project – where we hope to apply modern exploration to an area that has been off limits to exploration since the 1980s.

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