Targeting sediment-hosted stratiform copper deposits in the Northern Territory

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Copper has played a major role in the evolution and industrialisation of mankind since the Bronze Age. Global refined copper output in 2020 was 23.6 Mt, with demand for the metal expected to increase to around 30 Mt by 2030. Over 80% of this demand will need to be sourced from new production, with scrap being the other major source. This demand increase continues a trend seen since 1900 with the global demand for the metal doubling every 20–30 years. The de-carbonisation and electrification revolution will see demand for copper only increase as copper is a key component in almost every evolving energy-transformation technology, from wind power to electric vehicles.

Global copper production is currently in deficit and the effects of the COVID-19 pandemic has put significant additional stress on current producers, particularly in South America. This combination of supply stress and increased metal demand is being reflected in movement of the price of copper to over US$9000/t in recent months.

In 2020, the world mined about 20 Mt of copper, 20–25% of which was sourced from sediment-hosted stratiform copper (SSC) deposits; over 50% of SSC copper deposit production comes from the Central African Copper Belt. In an Australian context, although few major existing deposits of this type are currently known (eg Nifty), the Centralian and greater MacArthur basins represent two large-scale Proterozoic basins that are considered conceptually highly prospective for SSC deposits.

The schematic cross section below from Hitzman *et al* (2010) shows the key elements that are considered essential for the formation of a giant SSC deposit (**Figure 1**). These basins typically form in periods of major rifting during the breakup of super-continents. Thick sequences of oxidised terrestrial sediments (red-beds) and minor bimodal volcanic rocks form the basal sequence of such basins. Marine sandstones, siltstones, and shales of varying organic content transgressively overlie the red-bed sequence. This sequence grades upward into marine carbonates that contain a thick evaporite sequence. The upper portion of the basin contains shallow marine to continental siliciclastic sediments. The total thickness of the sedimentary sequence may range from several to more than 10 km.

Brines within these basins form from the dissolution of evaporites (or the downward percolation of near-surface hypersaline fluids, commonly referred to as 'bittern brines') and move downward into the basal, oxidised red-bed sequence. Convection of these highly saline, dense brines, driven by burial (+/- igneous activity), leaches metals from both the red-bed sediments and the basement. These oxidised, metal-rich brines circulate upward during periods of basin inversion where they encounter organic-rich sediments that provide the reductants necessary to precipitate copper sulfides. The ore-forming fluids will utilise major fault architecture within the basin to migrate from depth. Adjacent to these fault-controlled conduits, they can precipitate metal throughout the sedimentary sequence in favourable settings and may bypass lower reductant sequences. Overlying sediments and evaporite beds provide an effective top seal to the hydrologic system, whereas the basin edges themselves provide lateral containment of fluids.

Two of the main impediments to exploring for SSC deposits in Australia are the extensive and sometimes deep younger cover sequences, and the lack of relevant pre-competitive geoscience data. Over the past four years the work by Geoscience Australia through the federally funded *Exploring for the Future* (EFTF) program has fundamentally changed the geological understanding of one of the most prospective regions for SSC deposits in Australia, ie the region located between Tennant Creek and Mt Isa (TISA).

Understanding the architecture of the sedimentary basins within the TISA region through the interpretation of regional seismic and magnetotellurics data is rapidly advancing. The identification of major deep basin-forming fault systems and localised, thickened sub-basins has provided a framework for the targeting of SSC deposits. Building on the work of the petroleum industry in defining regional

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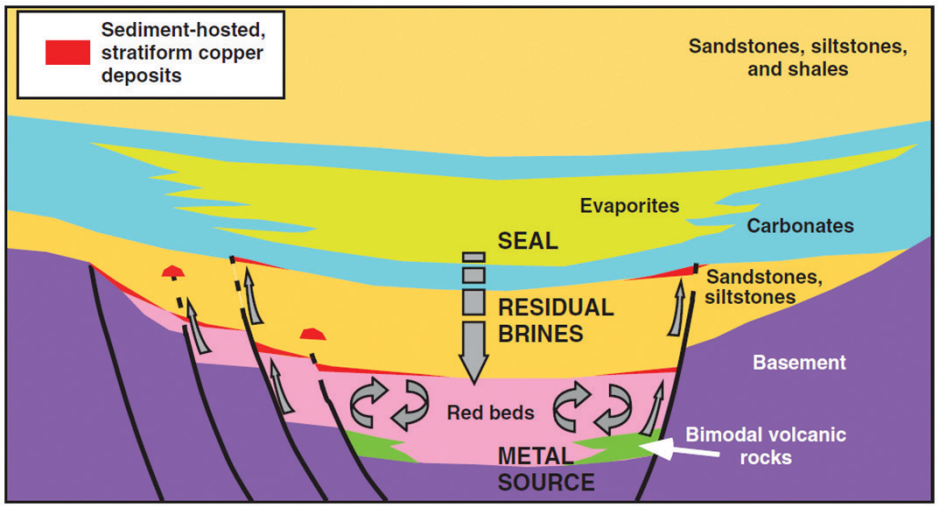

Figure 1. Schematic cross section showing key elements in the formation of SSC deposits.

sequence stratigraphy and identifying those stratigraphic units considered ideal host units for SCC deposits, provides three dimensionality to the targeting work. Empirical data, including the regional water bore and surface sampling programs, has provided an important additional element to help validate and focus target generation activities.

The climax of this intense activity has been the recent drilling in the Barkly Tablelands and Carrara Sub-basin, coordinated by the MinEx CRC and the Northern Territory Geological Survey through the *National Drilling Initiative*. This program has provided critical validation of the interpreted geology and sedimentary basin architecture in the region, as well as indications of key elements of the targeted mineral systems.

Encounter Resources has been actively applying our understanding of SSC deposits and utilising the vast pre-competitive EFTF dataset to define a series of camp-scale targets throughout the Northern Territory. We currently hold over 15 000 km^2 of exploration tenure across seven projects that we are currently actively progressing (**Figure 2**). The most advanced of these projects is the Elliott project, located 200 km north of Tennant Creek, which is currently under option with BHP.

The discovery of SSC deposits under cover remains one of the most challenging exploration propositions. However, the prize for success in the TISA area would fundamentally change the landscape for exploration in this region of the world. The new high quality datasets of the EFTF program, the greater understanding of the SSC deposit model, and the application of petroleum-style thinking to sedimentary basins, have all provided building blocks for the discovery and potentially the opening up of a globally-significant new copper district.

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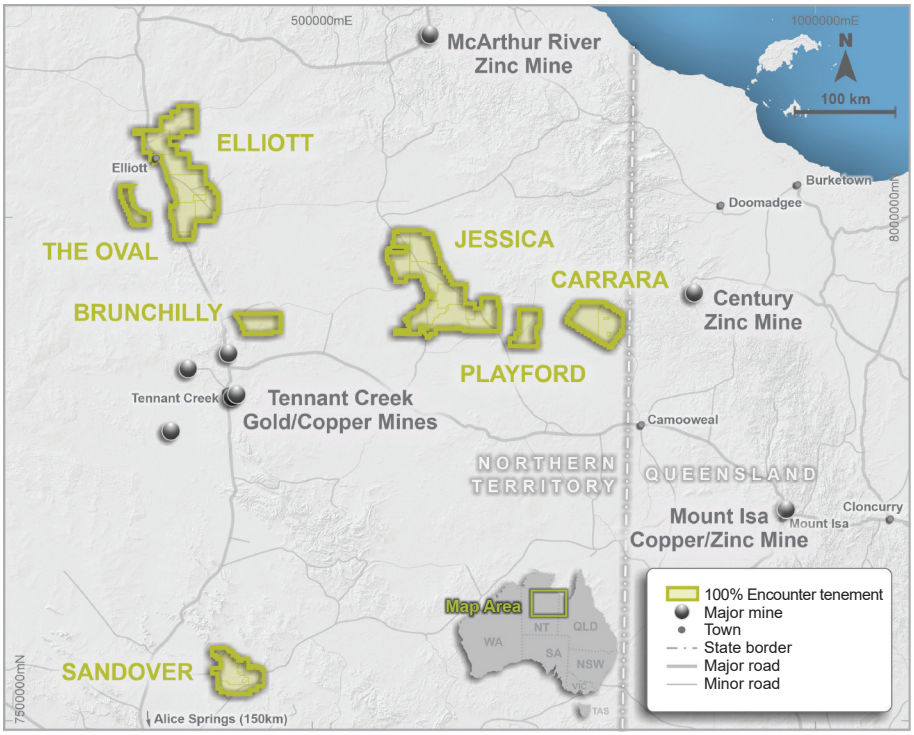

Figure 2. Encounter Resources copper projects in the Northern Territory.