New Insights from an Emerging Australian Proterozoic Polymetallic Province: Sediment-Hosted, Volcanic-Associated Cu-Ag-Pb-Zn-Au Massive Sulfide and Metasomatic Cu ± W ± Mo Mineralization in the Eastern Arunta Region, Northern Territory

Matt McGloin,[1*] Anett Weisheit,[1] Barry Reno,[1] Eloise Beyer,[1], Roland Maas,[2] Jay Thompson,[3] and Sebastien Meffre[3]

[1]Northern Territory Geological Survey, Darwin, PO Box 4550, Australia, 0801
[2]School of Earth Sciences, University of Melbourne, Australia
[3]CODES, University of Tasmania, Australia

*matthew.mcgloin@nt.gov.au

Numerous polymetallic, Cu, and W occurrences in the eastern Arunta Region (central Australia) are hosted within the ca. 1.8 Ga Bonya Metamorphics. This metasedimentary sequence comprises both clastic and chemical sedimentary protoliths and hosts significant known resources. These include metamorphosed Cu-Ag-Pb-Zn-Au massive sulfide deposits of KGL Resources' Jervois project, representing one of Australia's largest undeveloped inferred copper resources (25.3 Mt @ 1.1% Cu, 22.1 g/t Ag); and Cu, W, and Mo occurrences, including Rox Resources' recently delineated Bonya prospect (drill intercepts of 38 m @ 4.4% Cu).

Lack of detailed regional mapping hindered past exploration efforts, while little consensus existed on regional ore-forming processes. Recent 1:100000-scale regional mapping and mineral systems research by the Northern Territory Geological Survey has begun constraining the geological evolution of the prospective stratigraphy. New results reported here address the nature, timing, and setting of sedimentation, magmatism, metamorphism, and deformation with respect to three regional mineralization events.

The first event, typified at Jervois, produced Cu-Ag-Pb-Zn-Au sulfide mineralization at ca. 1785 Ma. Mineralization was near-contemporaneous with sedimentation, emplacement of bimodal intrusives at shallow crustal depths, contact metamorphism, and deformation, supported by coincident U-Pb zircon-monazite ages, and galena Pb model ages. (Near) syndepositional strata-bound massive sulfide mineralization is hosted predominantly within chemical sediments. High Cu, Fe, and Mn concentrations, discrete locally homogeneous sulfide isotope values, a lack of ore-associated sulfate, and inferred deposition of host sediments in a relatively oxidized but S-poor paleobasin support a magmatic sulfur source. Published base metal complexation modelling suggests that bisulfide rather than chloride complexes dominate Cu and Pb transport in >300°C, reduced S-rich hydrothermal fluids, regardless of fluid salinity. Together, these characteristics suggest that the sediment-hosted base metal mineralization formed in part from high-temperature, HS^--bearing hydrothermal fluids related to local bimodal magmatism.

A second event deformed and remobilized preexisting mineralization, producing sulfide-hosting garnet and Zn-rich metamorphic minerals, during peak-pressure regional metamorphism at ca 1755 Ma. Subsequently, the sulfide mineralization was compressed and sheared, producing a km-scale, J-shaped synclinal fold structure in the Jervois area. The third event produced regional metasomatic, vein-related Cu, W and Mo mineralization, dated at ca 1705 Ma using Re-Os molybdenite, and Pb model ages. Such mineralization in Bonya Hills overprints the main regional foliation. At Jervois, it also overprints preexisting sulfide mineralization. This mineralization is contemporaneous with syn- to posttectonic magmatism.

The stratigraphic-tectonic setting and timing of these mineralization styles resemble those observed elsewhere regionally. Syngenetic sulfide mineralization at Jervois shares affinities with VHMS deposits such as Utnalanama, whereas regional Cu-W-Mo mineralization is comparable with W-Mo skarn at Molyhil.

Current results identify an emerging polymetallic province, challenging the perceived lack of prospectivity compared with other mineral-endowed Australian Proterozoic terranes. There remains regional potential.