Multiscale Detection of Buried Mineralization Through Transported Cover

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Australia is an old continent with much of its remaining mineral endowment obscured by a thick cover of weathered rock, sediment, and soil materials. This presents a critical challenge for mineral exploration now and into the future, as the industry currently lacks the fundamental data, scientific knowledge, and technological tools needed to discover new, world-class ore deposits buried beneath this cover. UNCOVER is a national vision in Australia for the future for mineral exploration geoscience research to tackle the geological barriers to more tier 1 discoveries. While our initial research focus in this effort will need to be to map the cover, its thickness and character, and determine the magnitude of the challenge we face, importantly, the cover itself will also present a valuable opportunity for detection and we present some examples here.

For geochemical detection of buried mineralization through cover, our research has shown that detailed analysis down to the single mineralogical or textural level within cover materials can provide important signals of metal dispersion not necessarily realized at the bulk scales. At the Lancefield gold deposit in Western Australia, there is evidence of multiple oxidizing (weathering) events. Three stages of dispersion of As, Cu, Pb, Zn, and Au in sediments can be related to these events. Hydromorphic dispersion of Cu, As, Pb, and Au in Fe oxides by groundwater processes was important in Permian and Tertiary sediments during the Late Cretaceous and Miocene, when water tables were high. The climate was wet, moderately warm, and the vegetation was dominated by conifer forests and woodlands. During this period, metals from the underlying mineralization were incorporated into crystalline secondary minerals, and anomalies over mineralization can be recognized by a variety of methods.

Likewise, at the Mount Gibson gold deposit, cover has been subjected to ferruginization, calcification, and silicification. Geochemical analyses of an alunite-rich matrix in the cover revealed substantial signals of Cu (290 ppm), Pb (500 ppm), and As (360 ppm), and even several analyses of 1 to 2 ppm Au. In this case, groundwater sulfate precipitation is effectively trapping metal dispersion signals into the cover.

Physical dispersion is also important with metal-enriched iron oxide, gossan, and fresh sulfide fragments as detritus or individual minerals such as rutile and magnetite that might survive prolonged weathering and be useful indicators.

Ultimately, more of such studies are needed to identify minerals that act as deep geochemical sensors to understand their widest possible signature of a buried mineral system and to provide new exploration sampling media in areas of deep cover. Remembering the cover is also prospective for actual ore systems (e.g., alluvial-supergene gold, sediment-hosted copper or iron [CID/DID]).