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Neotectonics and landscape geochemistry in Australia: a proxy to assist mineral exploration

Ignacio Gonzalez-Alvarez (1), Carmen Krapf (2), Ryan Noble (1), David Fox (1), Nathan Reid (1), Clive Foss (1), Tania Ibrahimi (1), Rian Dutch (2), Liz Jagodzinski (2), Monica LeGras (1), Dave Cole (1), Ian Lau (1), Jess Robertson (1), and Tenten Pinchand (1)

(1) CSIRO (The Commonwealth Scientific and Industrial Research Organisation), Mineral Resources, Western Australia (ignacio.gonzalez-alvarez@csiro.au), (2) Geological Survey of South Australia, Adelaide, South Australia

Detection of geochemical footprints of ore deposits at depth in areas of thick cover is one of the most important challenges facing mineral exploration today. Our study assessed the processes of vertical geochemical dispersion through cover, to determine if and where such footprints have penetrated through cover to appear at surface. To do so we investigated the data acquired from the new CDP008 drill hole in the Coompana Province of South Australia. A new drill hole CDP008 contains the most complete record of the cover sequence in the region.

The Coompana Province, situated west of the Gawler Craton (South Australia), is characterised by a thick sedimentary sequence (from >100 m to >1400 m). It also comprises a small portion of the Nullarbor Plain, which exhibits minimal topographic variation. However, detailed regolith mapping in the Coompana area has revealed intricate regolith and landscape patterns, which include numerous linear fault scarps that cut the Nullarbor Plain. These scarps mainly trend NW-SE to N-S to NE-SW, and experienced generally less than 10 m of displacement. The trend of these surface linear features are identified, as well as basement structural trends at depth via magnetic data. The fault scarps appear to represent evidence of neotectonism.
Drill hole CDP008 intersected mafic volcanic basement rocks at a depth of ∼550 m. These basalts are nonconformably overlain by ∼140 m of Neoproterozoic or Phanerozoic undifferentiated fluvial sediments; which are, in turn, disconformably overlain by ∼230 m of fluvio-lacustrine to marine Mesozoic deposits, followed by ∼200 m of carbonates of the Eucla Basin.

The results of this study reveal that: (1) the lower undifferetiated fluvial sandstone package contains a geochemical footprint of the basement rocks, hence is a good sampling medium; (2) the Mesozoic sediments did not host vertical geochemical dispersion processes related to the underlying basement, hence is not a good sampling medium; (3) the limestone units of the Eucla basin at the top of the stratigraphic sequence are a chemical barrier for geochemical vertical dispersion processes. It is an efficient stratigraphic boundary to produce redox gradients and therefore changes in the geochemical composition of fluids; and (4) basement features identified from magnetic data are mimicked by linear surface landscape features. These features may be geochemically linked to the underlying basement rocks, and may be act as efficient pathways for vertical geochemical dispersion. The relation between neotectonic structures and landscape geochemistry could have important implications in mineral exploration under cover.