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Neotectonics and geochemical dispersion processes in Australia: a proxy to assist mineral exploration

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Mineral exploration in regions under thick cover is challenging. This study looked into vertical geochemical dispersion processes through ~550m of cover in the Coompana Province, South Australia. We collected new data collected from CDP008 drill hole (~680m), which contains the most complete record of the cover sequence in the region including: (1) mafic volcanic basement; (2) ~140m of undifferentiated fluvial sediments (Phanerozoic); (3) overlain by ~230m of fluvio-lacustrine to marine Mesozoic deposits; and followed by ~200m of Cenozoic carbonates. Our study revealed that REE patterns in the basalts and the overlying sandstone package show similarities. Yet, no geochemical similarities existed with the Mesozoic units and the upper stratigraphic units. Zr/Hf and Y/Ho ratios are close to UCC values and show low overall variability throughout the stratigraphic sequence. This indicates that Zr, Hf, Y and Ho were not affected by post-depositional processes. Regolith mapping of this area revealed intricate landscape patterns. These include numerous linear scarps, which trend NW-SE to N-S to NE-SW and experienced <10m of displacement. When coupled with magnetic data, this scarps trend correlates with basement structural trends at depth and these scarps are interpreted as neotectonic features. Based on the geochemistry we concluded that: (1) the lower sandstone package contains a geochemical footprint of the basement rocks produced by vertical and lateral geochemical dispersion; (2) the Mesozoic sediments do not record vertical dispersion related to the underlying basement that could be identified; (3) the top limestone units are a chemical barrier for vertical geochemical dispersion due to lack of permeability. They are an efficient stratigraphic boundary to produce redox gradients and therefore differential geochemical horizons; and (4) basement features identified from magnetic data are mimicked by linear surface landscape features. We pose that neotectonic surface features may record vertical geochemical dispersion from lower stratigraphic units. The relation between neotectonic structures and landscape geochemistry could have critical implications in mineral exploration under cover in Australia and in other similar landscape contexts in the world.