The use of surface regolith geochemistry to map the major crustal blocks of the Australian continent

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Multi-element near-surface geochemistry from the National Geochemical Survey of Australia has been evaluated in the context of mapping the exposed to deeply buried major crustal blocks of the Australian continent. The major crustal blocks, interpreted from geophysical and geological data, reflect distinct tectonic domains comprised of early Archean to recent Cenozoic igneous, metamorphic and sedimentary rock assemblages. The geochemical data have been treated as compositional data to uniquely describe and characterize the geochemistry of the regolith overlying the major crustal blocks across Australia according to the following workflow: imputation of missing/censored data, log-ratio transformation, multivariate statistical analysis, multivariate geospatial (minimum/maximum autocorrelation factor) analysis, and classification. Using cross validation techniques, the uniqueness of each major crustal block has been quantified. The ability to predict the membership of a surface regolith sample to one or more of the major crustal blocks is demonstrated. The predicted crustal block assignments define spatially coherent regions that generally coincide with the known crustal blocks. In some areas, observed spatial inconsistencies are due to uncertainty in the initial crustal boundary definition or from surficial processes that mask the crustal block geochemical signature. In conclusion, the geochemical composition of the Australian surface regolith generally can be used to map the underlying crustal architecture, despite secondary modifications due to physical transport and chemical weathering effects (Yilgarn Craton, Figure 1). This methodology is however less effective where extensive and thick sedimentary basins such as the Eromanga and Eucla basins that are characterized by transported sediments, which have been transported hundreds of kilometres and overlie the crustal blocks (Eromanga Basin, Figure 2).