Deriving Plate Boundary Information from Deep-Time Palaeo-Reconstruction Models and Implications for Regional Mineral Exploration Targeting

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Recent advances in palaeo-reconstruction models, such as the ability to perform deep-time Precambrian reconstructions, provide more opportunities for applications in regional mineral exploration. All palaeo-reconstruction models have similar foundations: a set of rotation records and a collection of polygon features (geodynamic units or GDUs) that describe their motion. Most Precambrian models tend to be snapshots (rather than kinematically continuous) and comprise a limited number of simplified GDUs without full present-day geographic coverage of the Earth. This precludes direct visualisation of all mappable features and limits data reconstruction and further geoprocessing workflows. More recent models provide interpreted plate boundaries, but other than for the last ~180 m.y. when preserved oceanic crust is available, these boundaries are manually inferred from the kinematics of the continental fragments, a time-consuming and potentially interpreter-biased approach. Models extending further back in time and incorporating thousands rather than tens of polygons need a more automated process to delineate plate boundaries. Geometrically constrained oceanic crust synthesised during this process provides an invaluable check on the geodynamic realism of any model. Coding is performed in Python and makes extensive use of the pyGPlates module and various GIS and scientific packages. Kinematics alone is insufficient for distinguishing upper and lower plate settings, so geochronological and mineral deposit data have been accessed from the DateView and StratDB public-domain databases to help identify geodynamic features like volcanic arcs.

We use two independent models to illustrate the quantitative identification of supercontinent cyclicity (SuperGDU's) back into the Palaeoproterozoic and its association with various styles of mineralisation; the delineation of different styles of magmatism related to SuperGDU break-up, accretion and collision; subduction of synthesised oceanic crust and the impact for mineralisation of predicted transitions from compression to extension in the upper plate in convergent margins.