Paper Number: 4624

Not so subtle constraints from the Phanerozoic on Precambrian plate reconstructions

Eglington, B.M.[1]

[1]University of Saskatchewan, Saskatoon, Canada; bruce.eglington@usask.ca.

Precambrian plate reconstructions are often ambiguous and constrained by sparse data. To date, most reconstructions are based primarily on palaeomagnetic data and are thus limited to only a few major continental blocks or plates, effectively ignoring many smaller blocks and subdivisions which are known to have existed at the reconstruction time. Modern technology, especially plate reconstruction software such as Paleogis and GPlates, now provide effective tools to add additional constraints which could not previously be implemented at global scale.

It is no longer sufficient to develop static 'snap-shot' or schematic reconstructions without directly and quantitatively considering constraints from both older and younger time intervals. Since the only fixed boundary condition we have is the present-day distribution of crustal blocks, it makes sense to work back in time to ensure that older model reconstructions are based on viable younger ones, taking into account all possible constraints. Continuous motion reconstructions based on 1 Ma to 5 Ma increments are necessary to achieve this, as is detailed delineation of the present-day extent of blocks relevant to older reconstructions and the likely extent of older blocks which have been subducted during younger collisions e.g. 'Greater India'. Geometric relationships are often also fundamental to achieving likely plate paths. Time-related visualisation of constraining information, especially palaeomagnetic, is essential for identifying consistent deviations in plate motion, as is the spatial context of quasi-linear magmatic and orogenic belts; spatially associated palaeogeographic features and other digital information which can provide geodynamic and spatial constraints (gravity and aeromagnetic patterns, ore deposits, large igneous provinces, palaeontology, geochemistry, etc).

Younger, Cenozoic to Mesozoic plate motions may, in some cases, provide additional constraints for the older reconstructions. Examples include the pre-Atlantic position of Baltic crustal blocks relative to Greenland and Laurentia and the Jan Mayan microcontinent fragment for Caledonide reconstructions; Rockall Bank fragments for Pangaea and Rodinia and various crustal blocks linked to South America, Antarctica and India for Gondwana, Rodinia and Nuna.

Plate motions north and south of the Agulhas – Falklands/Malvinas fracture zone are very different, requiring that southern Patagonia moved independently relative to the rest of South America during Gondwana breakup. This has major implications for Gondwana reconstructions and constraints on the position of the Falkland Islands, Ellesworth Mountains, etc are relevant to Rodinia reconstruction. Other Cenozoic oceanic features further constrain the reconstruction in ways that have not previously been implemented quantitatively, other than at local scale or in relatively schematic diagrams.

Unfolding of oroclines is essential for improved reconstruction of the spatial context of older plate motions and the identification of upper and lower plate margins. Ideally, anything whose position can be determined on maps at the present day ought to be representable in its palaeogeographic context, even if one might not be able to exactly allow for non-brittle deformation. Resulting models are testable in a quantitative map context, especially if the data superimposed on the models are available in structured online databases (examples include: DateView, StratDB, GPMDB, PaleoDB, MacroStrat, NAVDAT), which facilitate re-use, so permitting future researchers to more effectively build on the efforts of current investigators.