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Mesoproterozoic plate configurations – an examination of the three lines of evidence and an example from Grenvillian belts of ancestral North and South America

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The Rodinia hypothesis has become a cornerstone of the so-called supercontinent cycle, the global-scale Wilson cycle that begins with the assembly of continental plates across suturing orogens, i.e. the Grenville-Sveconorwegian belts and their global equivalents. The waning phase of the supercontinent occurs by continental rifting and break-up with the opening of new ocean basins. Unlike Pangea, the pieces of the Rodinia jigsaw must be reassembled without the benefit of Jurassic-to-present seafloor anomalies, paleontological evidence, or easily correlated stratigraphic sequences. Instead, robust Mesoproterozoic plate reconstructions stand on a tripod of paleomagnetism, geo-thermochronology, and isotope geochemistry. Considered in isolation, each of these techniques can plausibly support many, non-unique paleogeographic configurations, leading to a proliferation of Rodinia reconstructions. By definition, all of these reconstructions will be incorrect, except for one. For example, paleomagnetic data provide the only true paleogeographic constraints for plate reconstructions, but reliable data are sparse for Meso-Neoproterozoic times. In addition, the uncertain geomagnetic polarity and the insensitivity of paleomagnetic directions to longitude signify that paleomagnetism can narrow the field of plausible configurations, but it cannot uniquely identify a single "best" configuration. Similarly, the use of geochronological provinces as "piercing points" is bedevilled by the non-uniqueness of plausible fits, especially when igneous rocks form the basis of comparison. As direct products of collisional orogeny, metamorphic rocks and their geothermochronological history provide a more direct constraint on the assembly phase of the supercontinent, but here too the record is subject to interpretation. Isotopic "fingerprints" (Hf, Nd, and Pb) hold some promise for differentiating the igneous products of different source regions. Some of the lines of evidence for paleogeographic correlation using these techniques will be examined, with particular emphasis given to the widely-adopted correlation of Laurentia and Amazonia in Mesoproterozoic reconstructions.