SYNTHESIS OF THE ASSEMBLY AND BREAK-UP HISTORY OF RODINIA: RESULTS FROM IGCP 440

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This paper gives a brief overview of the construction of the Geodynamic Map of Rodinia, a final product of UNESCO/IGCP 440: Rodinia Assembly and Breakup (1999–2004). Contributors to this work include past leaders C.McA. Powell, R. Unrug, A.B. Kampunzu, and map compilers A. Collins, A. Davidson, R.E. Ernst, D.A.D. Evans, I.C.W. Fitzsimons, R.A. Fuck, D.P. Gladkochub, J. Jacobs, K.E. Karlstrom, S. Lu, J-P Milesi, J.S. Myers, L.M. Natapov, M.K. Pandit, V.L. Pease, K. Thrane, and V. Vernikovsky.

RATIONALE OF THE MAP

Although a huge amount of data have accumulated since the idea of a late Precambrian supercontinent was proposed, there is no consensus on the configuration of Rodinia. The aim of the Rodinia map, which includes maps for all major Precambrian cratonic blocks compiled using GIS databases, is to illustrate major tectonic elements relevant to the formation, configuration, and breakup of Rodinia, in a transient configuration. This will enable researchers to see the constraints available and make their own reconstructions using the compiled maps and new information as it becomes available. Features in the 1600 to 700 Ma range are given prominence in the map.

WHEN DID THE CORE OF RODINIA COME INTO EXISTENCE?

At the beginning of the Rodinia debate, the predominant view was that Laurentia, Australia and East Antarctica, forming the core of Rodinia, were together since 1900-1600 Ma. However, this view was challenged by the truncations of crustal provinces between Australia-Antarctica and Laurentia, the existence of late Mesoproterozoic orogenic events in Queensland, the King Island and NW margin of Laurentia, and palaeomagnetic data which indicate that none of the currently suggested configurations between these continents could have existed at ~1200 Ma. Recent work suggests that assembly of the core of Rodinia may have lasted until ~900 Ma.

WHICH RODINIA?

Both geological and palaeomagnetic data suggest that central and western Rodinia broke apart at ~750 Ma. The sparsity of palaeomagnetic data between 1000 and 750 Ma precludes unique solutions, but in combination with geological constraints, the field of choices is narrowing. In the Rodinia map we adapted a revised SWEAT fit with South China between southwestern Laurentia and eastern Australia. This configuration is consistent with current palaeo-magnetic data, strong similarities between Hainan Island of South China and southwestern Laurentia, and similar Neoproterozoic magmatic and rifting histories in these blocks, although we realise that other possibilities exist. We reconstructed the relative positions of India, Tarim, North China, Siberia, Baltica, Congo-Sao Francisco and Amazonia, using palaeomagnetic data and geological constraints. The positions of West Africa and most small continental blocks remain poorly constrained.

TIMING AND MECHANISM OF BREAKUP

Rodinia breakup started as early as ca. 850 Ma, but large-scale rifting in Australia, South China, India, and Kalahari did not start until ca. 820 Ma. This global rifting event was accompanied by emplacement of LIPs, including radiating dyke swarms and rapid continent-scale doming, indicating the presence of mantle plumes (or a superplume?). Recent palaeomagnetic data suggests that Rodinia could have stretched from the equator to polar regions at 820-800 Ma, and underwent a rapid 90° rotation before 750 Ma which brought the entire supercontinent to a low-latitude position. It has been proposed that a 830-800 Ma superplume beneath the polar end of Rodinia caused an IITPW event, and thus the rapid 90° rotation. Enhanced carbon burial in and around an equatorial supercontinent, and higher albedo, may have led to the Sturtian glaciation. Global rifting and associated magmatism lasted until at least 750-740 Ma when Rodinia started to break apart (rift-drift transition). Breakup along eastern Laurentia did not occur until after 600 Ma, when Gondwanaland started to assemble.