Geophysical Research Abstracts
Vol. 17, EGU2015-10769, 2015
EGU General Assembly 2015


# Early breakup of Gondwana: constraints from global plate motion models

Maria Seton (1), Sabin Zahirovic (1), Simon Williams (1), Joanne Whittaker (2), Ana Gibbons (3), Dietmar Muller (1), Sascha Brune (1,4), and Christian Heine (5)

(1) University of Sydney, School of Geosciences, University of Sydney, Australia (maria.seton@sydney.edu.au), (2) Institute for Marine and Antarctic Studies, University of Tasmania, TAS, Australia , (3) Statoil ASA, Oslo, Norway , (4) Geodynamic Modelling Section, GFZ-Potsdam, Germany , (5) New Ventures, Shell International Exploration and Production, The Hague, The Netherlands

Supercontinent break-up and amalgamation is a fundamental Earth cycle, contributing to long-term sea-level fluctuations, species diversity and extinction events, long-term greenhouse-icehouse cycles and changes in the long-wavelength density structure of the mantle. The most recent and best-constrained example involves the fragmentation of Gondwana, starting with rifting between Africa/Madagascar and Antarctica in the Early Jurassic and ending with the separation of the Lord Howe microcontinental blocks east of Australia in the Late Cretaceous. Although the first order configuration of Gondwana within modern reconstructions appears similar to that first proposed by Wegener a century ago, recent studies utilising a wealth of new geophysical and geological data provide a much more detailed picture of relative plate motions both during rifting and subsequent seafloor spreading. We present our latest global plate motion model that includes extensive, new regional analyses. These include: South Atlantic rifting, which started at 150 Ma and propagated into cratonic Africa by 145 Ma (Heine et al., 2013); rifting and early seafloor spreading between Australia, India and Antarctica, which reconciles the fit between Broken Ridge-Kergulean Plateau and the eastern Tasman region (Whittaker et al., 2013); rifting of continental material from northeastern Gondwana and its accretion onto Eurasia and SE Asia including a new model of microcontinent formation and early seafloor spreading in the eastern Indian Ocean (Gibbons et al., 2012; 2013; in review; Williams et al., 2013; Zahirovic et al., 2014); and a new model for the isolation of Zealandia east of Australia, with rifting initiating at 100 Ma until the start of seafloor spreading in the Tasman Sea at ∼85 Ma (Williams et al., in prep). Using these reconstructions within the open-source GPlates software, accompanied by a set of evolving plates and plate boundaries, we can explore the factors that govern the behavior of plate motions during supercontinent break-up and subsequent dispersal. For example, a global analysis of absolute plate velocities over the past 200 million years shows that plates dominated by continental material and bounded by transforms and mid-ocean ridge segments, as is characteristic of plates involved in Gondwana break-up, have average speeds of ∼2.6-2.8 cm/yr RMS. In contrast, oceanic plates surrounded by subduction have average speeds of ∼8.5 cm/yr RMS. An exception, however, is the rapid motion of India (∼18 cm/yr RMS) in the Paleocene preceding its collision with Eurasia, which suggests that plates with continental and cratonic keels can exhibit short-lived (∼10 Myr) accelerations resulting from a combination of plume head arrival effects and other complementary plate boundary forces (i.e. slab pull and ridge push). In another example, our reconstructions illustrate that a spectrum of rifting styles from orthogonal to oblique is present during rifting, rather than dominantly orthogonal as often assumed. Although our approach has so far been limited to one supercontinent cycle, these types of models can be extended to cover the entire Phanerozoic, capturing continental rifting and plate behavior over several supercontinent cycles.