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A new global reference frame since the Carboniferous

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Plate motions continuously reshape the Earth's surface. Generating plate reconstructions in successive time windows enables analysis and interpretation of biologic-geologic-climatic data and provides surface boundary conditions to mantle convection models. The relative movement of tectonic plates can be determined by ocean-floor magnetic anomalies and fracture-zone geometries, location of boundaries between continental and oceanic crust, palaeomagnetic poles and other geological/geophysical data. Plates are then returned to their palaeopositions on the globe using palaeomagnetic apparent polar wander paths, 'absolute' plate rotations from hotspot trails considering fixed hotspots, or based on moving hotspot trails, accounting for plume advection in the mantle. Plate reconstructions are thus inextricably tied to modeling processes operating in the Earth's interior.

Many palaeomagnetic and hotspot reference frames have been published and compared over the past decades but mostly without appropriate consideration for the results generated by those with specialities other than that of the authors of those studies. In this contribution we combine expertise in developing palaeomagnetic and hotspot-mantle reference frames, and most importantly we compare four reference frames (Palaeomagnetic, Africa fixed hotspot, Africa moving hotspot and Global moving hotspot) that are generated with the same plate circuit closure and time-scales. We ultimately combine revised mantle and palaeomagnetic frames in order to develop the best possible global reference frame for plate motions back to the assembly of Pangea. We have constructed the first hybrid 'absolute' reference frame model since the Carboniferous: we use a moving hotspot reference frame based on Atlantic and

Indian Ocean hotspots for the last 100 Ma and then the global palaeomagnetic frame adjusted 5 degrees in longitude to smooth the frame transition. This model now enables us to quantify plate kinematics and the time-dependent plate velocity field, and is essential for providing surface boundary constraints for mantle convection models and testing the relationship between surface magmatism and Deep-Earth processes.