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A long-lived magmatic arc of the Hercynides: the Protogonos and its disruption during the formation of Pangaea

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The Hercynian Orogenic Belt occupies a 1000 km wide swath from the North Sea to the Sahara and a ∼8000 km long swath from the Carpathians to Mexico. The final amalgamation of Pangaea took place in the late Carboniferous resulted in formation of this orogenic belt. The Hercynian orogenic belt, or the Hercynides, are the least-understood Phanerozoic mountain belt in Europe, North Africa and North America, despite the two-century-long history of investigation. The pre-collisional palaeogeography and evolution of this complex and re-deformed belt are still debated.

This study focuses on the eastern part of the Hercynides and aims to reconstruct the Hercynian orogenic belt from the Ediacaran to the end of the Permian. For this purpose, the methodology of comparative anatomy of orogens is used. This methodology is based on those distinct rocks assemblages representing specific body parts in orogenic belts such as magmatic arc, fore-arc and back-arc regions. These body parts may not be developed fully in every orogenic belt but the most common and prominent feature among all these is the magmatic arc. Properly-identified and well-dated magmatic rocks can be used as indicators of geodynamic environments, and even as reliable witnesses of geodynamic evolution and the former plate boundary. In order to create more accurate reconstructions of orogenic belts every primary and secondary tectonic unit within them should be properly identified and their original geometries estimated. Following the magmatic arcs is the best guide in this process, as it provides a hypothesis to be tested, together with apparent polar wander paths, palaeontological and geochronological data. The intermediate and felsic magmatic rocks, namely granodiorites, diorites, andesites, granites, and rhyolites are used to identify the magmatic arcs. In this study, ∼2800 high quality isotopic age data were collected from the published literature. 1197 of them are interpreted as products of a single magmatic arc which had been active at least from the Ediacaran to the late Carboniferous on the northern margin of Gondwana-Land. Magnetic anomaly maps and structural trend lines are used as supplements in identifying the extent of these disrupted magmatic arc fragments. These fragments are restored according to the approximate displacements on the major transcurrent faults at that time, which we partly identified. The long-lived magmatic arc is named “Protogonos” (=the first born). In addition to the major fault systems, the proposed displacements to tie up the arc fragments justify a Pangaea-B geometry during the early Permian and a Pangaea-A geometry by the end of the Triassic, possibly by the end of the Permian as palaeomagnetically supported. The new reconstruction, the Protogonos model is based on the comparative anatomy of the orogenic belts, and it is a hypothesis to be tested.