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New model for Jurassic microcontinent movement and Gondwana breakup in the Weddell Sea region

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The breakup of the Gondwana supercontinent changed the face of our planet. Precursors of supercontinental breakup are widely recognised in the Weddell Sea region in the Jurassic. These include the Karoo/Ferrar Large Igneous Province that extends from South Africa to East Antarctica and significant continental rifting and associated translation of microcontinental blocks in the Weddell Sea Embayment region. However, significant controversy surrounds the pre-breakup position, extent, timing and driving mechanism of inferred microcontinental movement. In particular geological and paleomagnetic data suggest >1000 km of translation and 90 degree rotation of the Haag-Ellsworth Whitmore block (HEW) away from East Antarctica. In contrast, some geophysical interpretations suggest little or no Jurassic or subsequent HEW block movement.

Here we present a simpler tectonic model for the Weddell Sea Rift System and HEW movement, derived from our new compilation of airborne geophysical data, satellite magnetic data and potential field modelling (Jordan et al., 2016- Gondwana Res.). Based on the amount of inferred Jurassic crustal extension and pattern of magnetic anomalies we propose that the HEW was translated ∼500 km towards the Paleo-Pacific margin of Gondwana, possibly in response to a process of slab roll-back that led to distributed back-arc extension in the Weddell Sea Rift System. Widespread magmatism in the region was likely influenced by the presence of one or more mantle plumes impinging beneath the stretching lithosphere. A second phase of continental extension is inferred to have occurred between 180 and 165 Ma (prior to seafloor spreading) and is more closely associated with Gondwana breakup. This second phase over-printed the northern part of the older back arc system. We find no geophysical evidence indicating more than 30 degrees of syn-extensional HEW rotation during Jurassic rifting in the southern Weddell Sea Rift System. Instead, we propose the majority (∼60 degrees) of the inferred block rotation of the HEW sedimentary sequences occurred prior to Jurassic rifting, likely during the Permian-age Gondwanide orogeny as a phase of oroclinal bending in an overall transpressional intraplate orogenic setting.