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Aerogeophysical evidence for strike-slip faulting at the boundary between East and West Antarctica: implications for Jurassic magma emplacement and Gondwana breakup models

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Fragmentation of the Gondwana supercontinent began in the Jurassic and was the most significant reconfiguration of the continents of the southern hemisphere in the last 500 Ma. Jurassic continental rifting began adjacent to South Africa in the Weddell Sea region of Antarctica. This region is therefore critical for understanding the process that initiated supercontinent breakup, including the role of mantle plumes, magmatism, and major plate and microplate re-configurations. However, due to the remote location and blanketing ice sheets, the magmatic and tectonic evolution of the Weddell Sea sector of Antarctica has remained poorly understood and controversial. Our recent aeromagnetic and airborne gravity investigations reveal the inland extent of the Weddell Sea Rift system beneath the West Antarctic Ice Sheet, and indicate the presence of a major left-lateral strike slip fault system, separating the Ellsworth Whitmore block from East Antarctica (Jordan et al., 2013 Tectonophysics).

In this study we use 3D inversion of magnetic data to investigate the geometry and emplacement mechanism of Jurassic granites both along the boundary and within the Ellsworth-Whitmore block. Our models demonstrate a high degree of structural control on Jurassic granite emplacement along the newly identified left-lateral Pagano Shear Zone that flanks the Ellsworth-Whitmore block. Other granitoids emplaced further west within the Ellsworth-Whtimore block itself do not appear to have the same structural control, suggesting that this possible microplate or block was relatively more rigid. Extensive and likely more rigid Precambrian basement of Grenvillian-age is clearly delineated from aeromagnetic signatures at the northern edge of the Ellsworth-Whitmore block, lending support to this interpretation. Most intriguing, it that the high amplitude anomalies over the northern margin of the Ellsworth-Whitmore block are remarkably similar to those previously mapped over the Shackleton Range in East Antarctica. In the Shackleton Range, the association between Grenvillian-age basement and aeromagnetic anomalies is less well-constrained but nevertheless possible. Here we test in Gplates our new geodynamic model that involves the Ellsworth Whitmore block being originally closer to the Shackleton Range region in East Antarctica and then translated to West Antarctica in Jurassic times via ca 300 km of crustal extension in the Weddell Sea rift. We compare and contrast our new model with the currently more widely accepted geodynamic model that predicts significantly more complex movements of the Ellsworth-Whitmore microplate, including 180 degree rotation, and $\sim$1500 km of strike-slip displacement from the Natal Embayment adjacent to South Africa to its current position in West Antarctica.