Geophysical Research Abstracts
Vol. 14, EGU2012-10862, 2012
EGU General Assembly 2012

Aeromagnetic legacy for a diffuse intraplate boundary between northern Victoria Land and the Wilkes Subglacial Basin (East Antarctica)

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Major terrane bounding faults and intra-terrane faults that were active during early Paleozoic subduction and accretion stages of the Ross Orogen have been subject to intense research over the northern Victoria Land sector of East Antarctica. However, the paucity of outcrop, coupled with incomplete geophysical data coverage, has limited the ability to trace the inland extent and architecture of these basement fault systems and has hampered efforts to assess their controls on later Cenozoic intraplate faulting within the Transantarctic Mountains and the eastern margin of the Wilkes Subglacial Basin. Here we compile and analyse new enhanced aeromagnetic anomaly images that help constrain regional-scale crustal architecture and tectonic evolution over northern Victoria Land and the eastern margin of the Wilkes Subglacial Basin. Long-wavelength magnetic lows are modelled as reflecting several-km thick sedimentary basins of inferred early Cambrian age that were inverted along major thrust faults during the late stages of the Ross Orogen to form a major pop-up structure within the Wilson Terrane. A residual Bouguer gravity high in the central Wilson Terrane corresponds to a broad magnetic low and images the ∼500 Ma old high-grade granulite-facies core of the pop-up. Arrays of NNW trending magnetic lineaments reveal thin sheared sheets of mylonitic granitoids emplaced along the late Ross (∼480 Ma old) Exiles Thrust fault system within the western Wilson Terrane, which is also marked by a prominent deep electrical conductivity anomaly. In contrast, much thicker magmatic arc intrusions are modelled along the Prince Albert Fault System that fringes the eastern margin of the Wilkes Subglacial Basin. Recent zircon U–Pb dating over exposures of gabbro-diorites within the Prince Albert Mountains further south suggest that these intrusions may have been emplaced during an earlier stage of subduction (∼520 Ma or older?), likely in a transtensional setting. Our magnetic models suggests that these batholiths may have provided a back-stop for the late Ross-age thrust fault belt of the central and western Wilson Terrane. Comparisons with California and other regions reveals striking similarities between the complex patterns of fault strands imaged from our aeromagnetic compilation and those typically associated with major strike-slip fault systems. When coupled with independent regional interpretations of Cenozoic brittle fault arrays, our findings support the hypothesis of a diffuse Cenozoic intraplate strike-slip boundary between northern Victoria Land and the Wilkes Subglacial Basin that reactivated the inherited Ross-age fault systems and provided key kinematic connections with the West Antarctic Rift System.