

Geodynamic Models of Extension in West Antarctica

The Geodynamics group at Colorado State University (CSU) is investigating rifting in West Antarctica. The fundamental questions concern 1) why the mode of rifting in West Antarctic transitioned from a prolonged period of Late Mesozoic and Early Cenozoic diffuse extension that encompasses most of the Ross Sea to a more recent period of more focused extension in the Victoria Land Basin; and 2) what constraints do these rifting models place on the nature of the mantle beneath the rift system – is a hot mantle or impingement of a mantle plume required to explain the transition in the style of rifting (as previously argued) or is a cooler mantle consistent with the change in rift style? Our approach to investigating these issues is to develop finite element geodynamic models of the rifting process. We are using the CIG code GALE for this purpose, and hope to improve the code (with the help of other CIG investigators) to better model the magmatic consequences of rifting. Our models suggest that even modestly high mantle potential temperatures (> ca. 1300 °C) are inconsistent with a transition from diffuse to focused extension. Assessment of magma production due to decompression melting shows these results to be marginally consistent with independent estimates of syn-rift magma volumes. However, the models that best fit the rift structural history invoke a cooler mantle and thus predict lower volumes of syn-rift melt. Models that best fit the total volume of syn-rift melt predict too much melt in the Victoria Land Basin

We are currently working on two issues to expand this research. First, our models to date are 2-D. We feel that 3-D models will better capture the structural evolution of the rift, and that this may impact the melt predictions. Second, we have not yet considered melting of a fluid metasomatised mantle. Given that the low mantle temperature models work best in a structural sense and that the region underwent a long history of subduction prior to rifting, the need to investigate this possibility seems obvious.

Funding:

“Andrill SMS Constraints on Geodynamic Models of Extension in the Ross Sea”

Subcontract to University of Nebraska, Antarctic Drilling Program (NSF), June 1 2008 – March 1 2009, \$24,188. Principal Investigator: D. Harry.

“Uplift and exhumation of the Transantarctic Mountains and relation to rifting in West Antarctica”

NSF/OPP - \$187,864, 1 June 2002 – 31 May 2005. Principal Investigator: D. Harry.

Selected Publications:

- Huerta, A., and D. L. Harry, The transition from diffuse to focused extension: Modeled evolution of the West Antarctic Rift system, *Earth and Planetary Science Letters*, 255, 133-147, 2007.
- Anoka, J.L., and D. L. Harry, Geodynamic Models of the Tectonomagmatic Evolution of the West Antarctic Rift System, *Eos Trans. AGU*, 88(52), H44A-06, 2007.
- Huerta, A., and D. L. Harry, Evolution of the West Antarctic Rift System and the Importance of Lateral Heat Conduction, *EOS, Transactions of the American Geophysical Union*, 85 (47), Fall Meeting Supplement, Abstract T14A-04, 2004.
- Harry, D.L., and A. Huerta, A Dynamic Model of the Late Mesozoic and Cenozoic Evolution of the West Antarctic Rift System, *presented at The InterMARGINS Extensional Deformation of the Lithosphere Workshop*, Pontresina, Switzerland, 11-16 July 2004.
- Huerta, A.D. and D.L. Harry, Influence of the thermal structure of the lithosphere on extensional evolution of West Antarctica, presented at SEAP 2003: Structure and Evolution of the Antarctic Plate, Boulder, CO, March 3-5, 2003.