3D Numerical Models for Continental and Oceanic Core Complexes

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Core Complexes: 3D structures

Metamorphic core complexes (MCCs) are perhaps the most three dimensional and controversial of major extensional structures. The discovery of oceanic core complexes (OCCs) and the associated modes of spreading has revealed a surprisingly complicated side of the mechanics of sea floor spreading. One of the remaining questions regarding these structures is how they form. Numerical models have been successful in reproducing various types of faulting both in continental lithosphere and at mid-ocean ridges (e.g., Lavier et al., 2000; Buck et al., 2005). However, the three-dimensional aspects of core complexes have not been addressed. We present a preliminary results from a model being developed for core complexes under oblique rifting.

Examples of MCC

adapted from (McCarthy et al., 1991)

Examples of OCC

(Smith et al., 2006)

2D Models for Core Complexes

Detachment faults, by which MCCs are exposed to surface, are now routinely reproduced in 2D numerical models with a sophisticated layered structure. (e.g., Lavier and Manatschal, 2006)

OCC-like structures were also reproduced in 2D numerical models that parametrized the relative effectiveness of diking to tectonic stretching in accommodating plate motion. Left: Buck et al. (2005); Right: Tucholke et al. (2008)

3D Code to be used: SNAC

<Some applications of SNAC>

Left: Thermomechanics of mid-ocean ridge segmentation (Choi et al., 2008); Center: Fracture zone spacing in the light of thermal cracking (Choi and Gurnis, 2008); Right: Faults in an oblique rift (Cover page of the user manual)

<Features>

- Elasto-viso-plastic rheology
- Long-term simulation through remeshing.
- Multi-physics: e.g., thermomechanics.
- Open source with decent documentation (http://www.geodynamics.org/cig/software/packages/long/snac)

Preliminary Results

Elasto-plastic crustal layer extended with an initial heterogeneity of a non-trivial geometry.

- Lamé’s constants: 10 GPa.
- Initial and minimum cohesion: 44 MPa/4.4 Pa.
- Strain-weakening modulus: 147 MPa.
- Density: 2800 km/m³

References


References
