3-D Mechanical Modeling of Basins with Underworld

Moresi, Louis[1], Dietmar Muller[2], David Abramson[1] (1) Monash University, Clayton, Australia (2) Sydney University, Sydney, Australia

Underworld is a 3-D parallel Lagrangian particle finite element code incorporating Mohr-Coulomb and Drucker-Prager failure models. It models Earth dynamics across the range of scales from regional mantle dynamics to basin evolution. Underworld has a flexible system for analysing and reducing model outputs to match typical observables geologists have available. Underworld is not the Real World. In order to "match" particular modeling scenarios to individual basins it is necessary to obtain some combination of quantitative fits to measurements with "geological reasonableness" (some models for a particular basin just "feel better" to experienced geologists than others).

The latter measure is hard to handle because it is subjective and non-unique. Within the context of an orderly database of models and observations it is hard to construct appropriate fields for these nebulous concepts. In fact the subjective information is best captured by the relative ranking of different numerical models for a given geological setting. That is, a collection of relationships between database fields, not actual fields.

Here we propose a compromise: allow the subjective ranking to occur based on the selection of different models from a representative sweep of parameter space which fit (quantitative) observations within a certain tolerance. A modeling exercise can then be undertaken based on the initial group of simulations which are known to reproduce the sparse geophysical data.

These models help to elucidate the creation of accommodation space and thermal history in sedimentary basins as a function of starting rheology and crustal inhomogeneities (e.g. fault zones, intrusions or salt domes).