Thermomechanical models with surface processes: Low-Temperature Thermochronology predictions for model calibration

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State of the art thermo-mechanical models have become very efficient at testing scenarios of tectonic evolution but uncertainties on the rheologies and the complexity of the have so far limited the potential to quantitatively predict uplift and subsidence. Coupling thermo-mechanical models to landscape evolution models remains challenging and require careful validation and better integration of field data to prevent error in interpretation.

Low temperature thermochronology has been extensively used to quantitatively constrain the thermal histories of rocks. It can provide important information on tectonic uplift (or subsidence) by measuring the erosional (or burial) response and can also map the spatial and temporal pattern of geomorphic response of a landscape.

We use the temperature evolution of our coupled thermo-mechanical models with surface processes to predict Apatite fission track data (Ages and Track lengths distributions). The aim is to provide a direct means of comparison with actual empirical thermochronometric data which will allow different model scenarios and/or model parameter choices to be robustly tested.

We present a series of 3D coupled models (Underworld / Badlands) of Rifts and the associated Apatite Fission Track predicted by the thermal evolution of the rocks exhumed to the surface. We compare models predictions to existing thermochronological transects across passive margins.

We discuss the technical challenges in obtaining sufficiently high resolution temperature field and other associated challenges that need to be addressed to satisfactory apply our model to natural examples.