Geophysical Research Abstracts
Vol. 19, EGU2017-7289, 2017
EGU General Assembly 2017

From three-dimensional long-term tectonic numerical models to synthetic structural data: semi-automatic extraction of instantaneous & finite strain quantities

Guillaume Duclaux (1) and Dave May (2)

(1) Department of Earth Science, University of Bergen, Allégaten 41, 5007 Bergen, Norway (guillaume.duclaux@uib.no), (2) Department of Earth Sciences, University of Oxford, South Parks Road, Oxford OX1 3AN, United Kingdom (david.may@earth.ox.ac.uk)

Over the past three decades thermo-mechanical numerical modelling has transformed the way we look at deformation in the lithosphere. More than just generating aesthetically pleasing pictures, the output from a numerical models contains a rich source of quantitative information that can be used to measure deformation quantities in plan view or three-dimensions. Adding value to any numerical experiment requires a thorough post-processing of the modelling results. Such work aims to produce visual information that will resonate to seasoned structural geologists and assist with comparing experimental and observational data.

Here we introduce two methods to generate synthetic structural data from numerical model outputs. We first present an image processing and shape recognition workflow developed to extract the active faults orientation from surface velocity gradients. In order to measure the active faults lengths and directions along with their distribution at the surface of the model we implemented an automated sequential mapping technique based on the second invariant of the strain rate tensor and using a suite a python functions. Active fault direction measurements are achieved using a probabilistic method for extracting linear features orientation from any surface. This method has the undeniable advantage to avoid interpretation bias. Strike measurements for individual segments are weighted according to their length and orientation distribution data are presented in an equal-area moving average rose diagrams produced using a weighted method. Finally, we discuss a method for mapping finite strain in three-dimensions. A high-resolution Lagrangian regular grid which advects during the numerical experiment is used to track the progressive deformation within the model. Thanks to this data we can measure the finite strain ellipsoids for any region of interest in the model. This method assumes that the finite strain is homogenous within one unit cell of the grid. We can compute individual ellipsoid's parameters (orientation, shape, etc.) and represent the finite deformation for any region of interest in a Flinn diagram. In addition, we can use the finite strain ellipsoids to estimate the prevailing foliation and/or lineation directions anywhere in the model.

These two methods are applied to measure the instantaneous and finite deformation patterns within an oblique rift zone ongoing constant extension in the absence of surface processes.