Geophysical Research Abstracts
Vol. 16, EGU2014-14810, 2014
EGU General Assembly 2014

Possible future directions for understanding transpressional deformation and oblique tectonics

Basil Tikoff (1), Joshua Davis (2), and Sarah Titus (3)

(1) University of Wisconsin - Madison, Geoscience, Madison, United States (basil@geology.wisc.edu), (2) Carleton College, Northfield, United State (jdavis@carleton.edu), (3) Carleton College, Northfield, United State (stitus@carleton.edu)

In some sense, it was unlikely that transpression (+- transtension) should become the avenue for discussion about three-dimensional deformations generally, including – in roughly chronological order – strain partitioning, non-steady state deformation, triclinic deformation, and emphasis on flow apophyses (vs stress or strain). We speculate that there were two reasons for this path. First, as highlighted by the work of Sanderson and Marchini (1984), a mathematically very simple deformation can give rise to a variety of complicated effects. The implications of the partitioning of the stretching and vorticity of a deforming system are still not fully appreciated in structural geology or, particularly, in allied fields (experimental deformation, geophysics). There is still significant understanding yet to be gained in the response of real rocks to simple, three-dimensional boundary conditions. Second, transpression is a widely applicable deformation style, especially at the plate boundary scale. Any area of oblique convergence or divergence that has straight and parallel flow lines, which are not strictly normal or tangential to a straight plate boundary, will undergo transpressional or transtensional deformation. Shear zones can also exhibit transpressional deformation, but may exhibit slight variations from end-member models.

There are a variety of ways in which mathematical advances may further our understanding of transpressional systems. We present a framework for our ongoing work, which involves statistical analysis of various geologic quantities, such as lineation-foliation pairs, ellipsoids, and homogeneous deformations. At its core, our approach consists of transferring standard multivariate statistical techniques to geologic sample spaces, using exponential mappings. Analyses include normality tests, estimates of mean and variance, and hypothesis testing. These tools can inform a variety of geologic modeling questions in more mathematically rigorous ways. For example, one could address these types of questions: 1) Is a set of lineation-foliation pairs consistent with transpression along a specified plane? 2) How does one quantify the clustering or girdling of rigid ellipsoids rotating in a transpressive velocity field? or 3) How different are two homogeneous transpressional models? Thus, ultimately, transpression may also provide the avenue for starting to apply statistical treatment to structural geology data and models, which may provide significantly stronger basis for interpretting kinematics and dynamics from empirical data.