Geophysical Research Abstracts
Vol. 14, EGU2012-3285-1, 2012
EGU General Assembly 2012

Significance of fault-slip analyses in active and fossil orogens

U. Riller (1), I. Lenauer (1), H. Daxberger (1), and T. Santimano (2)

(1) McMaster University, School of Geography and Earth Sciences, Hamilton, Canada (rilleru@mcmaster.ca), (2) Deutsches Geoforschungszentrum Potsdam, Telegrafenberg C122, 14773 Potsdam, Germany

Small-scale shear faults are ubiquitous in brittlely deformed geological terrains. Inversion of the brittle shear faults is routinely applied to unravel the deformation kinematics of such terrains. Rudimentary tensors resulting from such analyses are interpreted either in terms of (paleo)-stress or strain, and in some cases, displacement and plate convergence directions. Challenges and limitations in the interpretation of fault-kinematic data concern mostly the variation and superposition of deformation (or stress) regimes as well as the spatial extent (scale) and density of data. A large spatial coverage of data is required to obtain geologically meaningful results and to distinguish between near-field and far-field strain (or stress) fields. Based on the acquisition of comprehensive sets of brittle fault data from the Paleoproterozoic Eastern Penokean Orogen, Canada, and the southern Central Andes, Argentina, conducted over a period of several years, we delineate the significance of fault-slip analyses for regional tectonic analyses. For each shear fault, we recorded its orientation, striation (slicken-line), slip sense and the quality of kinematic information. Populations of this fault data at a given station was processed using mostly the Numeric Dynamic Analysis.

Our fault-slip analysis from the Eastern Penokean Orogen is based on the acquisition of some 4200 faults at 288 stations within a 60 km x 30 km area. In this area, the Sudbury Igneous Complex, the relic of an approximately 3 km thick impact melt sheet, is deformed into a large, non-cylindrical syncline. Here, we investigated the geometric relationship between eigenvectors inferred from fault-data inversion and the orientation of planar-linear (S-L) mineral shape fabrics, which formed during folding of the Complex. We present evidence that the shape fabrics formed from brittle to brittle-ductile shear faults under low-grade metamorphic conditions. Moreover, eigenvectors are remarkably co-linear with principal strain axes indicated by L-S fabric geometry and kilometre-scale folds.

For the southern Central Andes our data base consists of 1750 faults from 148 stations complemented by kinematic axes at 318 stations (4756 fault data) compiled from published sources. The variation of these axes in the Central Andes has previously been interpreted in terms of changes in absolute plate motion, plate convergence direction and vertical-axis rotation associated with the formation of the Central Andean orocline. We tested the plausibility of these hypotheses by examining to what extent the kinematics of small-scale shear faults adheres to the kinematics of first-order structures, i.e. kilometre-scale folds and faults. We analysed shear fault populations of up to 30 stations at a given first-order structure at a total of 10 structures. Results indicate that the orientations of kinematic axes vary significantly on the regional scale. Locally, however, they may be uniform at, but vary with orientation and type of, a given first-order structure. We, therefore, caution the usage of brittle fault-kinematics as paleostress indicators and for tracking plate-kinematic changes. The close correlation in the kinematics of small-scale shear faults and that of associated first-order structures observed at Sudbury, Canada, and the Central Andes indicates that eigenvectors inferred from brittle fault analyses portray local strain.