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Evidence for multiple reactivation of the Rennick Geodynamic Belt (northern Victoria Land, Antarctica) through inversion of fault slip data

Laura Federico (1), Paola Cianfarra (2), Laura Crispini (1), Giovanni Capponi (1), and Francesco Salvini (2)

(1) DISTAV, Università degli Studi di Genova, Genova, Italia (federico@dipteris.unige.it), (2) Dipartimento di Scienze, Universita` degli Studi Roma Tre, Roma, Italia

The Rennick Geodynamic Belt (RGB) is an outstanding geological feature of East Antarctica. It is a regionally-sized deformation zone with a dense fault network that at present separates the tectonic units of northern Victoria Land from the East Antarctic Craton.
The RGB is long known to have been active since Cambrian-Ordovician times up to the upper Cenozoic. This long period of activity brings along a great deal of structural complexity, due to superposition and reactivation of faults, and consequently many, sometimes contrasting, tectonic reconstructions.
In this contribution we explore the long-lived tectonic activity of the RGB faults combining fault-slip data inversion with other field observations (e.g. cross-cutting relationships among faults, fault rock type, coating minerals, syntectonic veins, etc.)
We compute the paleostress tensors from about 300 fault-slip data in 70 measurement stations visited by the Authors during various Italian Antarctic Expeditions in northern Victoria Land (PNRA - Italian National Antarctic Research Program).
Our approach involves the use of different inversion methodologies. The multiple Monte Carlo convergent method provides the best orientation of the principal paleostresses with an estimate of the error quantified by the MAD (Mean Angular Deviation) factor, that is the average angular deviation between the measured pitch of the kinematic vector on the fault plane and the predicted one by applying to the fault the computed paleostress. At each step, faults are uniquely associated to the stress tensor that provides the lowest angular divergence.
The Fsa software (Célérier, 1999) combines a random grid search of the stress tensors following a Monte Carlo approach, with a subsequent check of satisfaction of the frictional constraint (i.e. the fault plane must form with an orientation that fulfils the Mohr-Coulomb yield criterion, the ratio between the shear (t) and the normal stress (sn) equals tan φ, where φ is the angle of internal friction). The software actually allows a direct inspection of the reduced Mohr circle of the calculated stress tensors, so that we can select the one with the largest number of faults showing a high t/sn ratio.
The combination of the results from the inversion methods gives a more robust picture of the evolution of the paleostress fields through times and allows to unravel the complex tectonic activity along the RGB in the broader framework of East Antarctica evolution.
In particular, the analyses performed through both methods suggest a superposition of two stress tensors and confirm the prevalent strike-slip kinematics of the RGB faults.

Célérier, B., 1999. Fault Slip and Stress Analysis (Fsa). Available at: <http://www. isteem.univ-mont2.fr/PERSO/celerier/software/fsa.html>.