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Multiple reactivation of the Rennick Geodynamic Belt (northern Victoria Land, Antarctica): insights from inversion of fault slip data

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The Rennick Geodynamic Belt (RGB, East Antarctica) is a regionally sized, ca N-S trending, deformation zone (length > 100 km) where a dense fault network separates tectonic units of northern the Victoria Land, to the W from the East Antarctic Craton, to the E.

The RGB is long known to have been active since Cambrian-Ordovician times up to recent, but its framework and geodynamic evolution is still debated and partially investigated. The long-lived tectonic activity led to a great structural complexity, due to the superposition and polyphasic reactivation of regional faults. Such complexity is reflected by the numerous (in some cases contrasting) tectonic reconstructions of the RGB area.

In this contribution we explore the present-day tectonic framework of the RGB, investigating the stress field that possibly characterised the last geodynamic events in the area. We base on selected datasets of fault-slip data and fractures density (collected by the Authors in various PNRA Italian Antarctic expeditions) and combine fault-slip data inversion with the azimuthal orientation of faults and the spatial distribution of fractures intensity across the RGB.

To obtain a more robust portrait of the RGB geodynamic evolution, two different software based on different fault-inversion methods were used in this study: DAISY (Windows, version 3.5) and FSA (MAC, version 36.5x7i). The software DAISY implements the multiple Monte Carlo convergent method and provides the best orientation of the principal paleostresses with an estimate of the error quantified by the factor MAD (Mean Angular Deviation, corresponding to 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 MAD. Differently, the FSA software combines a random grid search of the stress tensors following a Monte Carlo approach, under the univocal condition of fulfilment of the frictional constraint (i.e. the fault plane must form with an orientation that satisfies the Mohr-Coulomb yield criterion, i.e. $t/s_n = \tan f$ with t = shear stress, s_n = normal stress and f = angle of internal friction). Additionally, this software allows a direct examination 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/s_n ratio.

The paleostress tensors were computed from 373 fault-slip data collected in 34 structural stations on site. Results from this multi methodological approach revealed:

(i) the existence of two, N-S oriented geotectonic provinces (namely the Bowers Mts province to the W and Usarp Mts to the E) characterized by the different spatial distribution of brittle deformation, more intense in the Bower Mts domain.

(ii) The superposition of two recent (Meso-Cenozoic) major tectonic events, with prevalent strike-slip kinematics and characterized by faults reactivation with right-lateral movement overprinting a previous left-lateral one.