Geophysical Research Abstracts
Vol. 17, EGU2015-8999, 2015
EGU General Assembly 2015

Microstructural study of the Mertz shear zone, East Antarctica. Implications for deformation processes and seismic anisotropy.

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The Mertz Shear Zone (MSZ; 146°E 67°S; East Antarctica) is one major lithospheric-scale structure which outcrops on the eastern edge of the Terre Adélie Craton (Ménot et al., 2007) and that could connected with shear zones of South Australia (e.g., Kalinjala or Coorong shear zone (Kleinschmidt and Talarico, 2000; Gibson et al., 2013)) before the Cretaceous opening of the Southern Ocean. Geochronological and metamorphic studies indicated an MSZ activity at 1.7 and 1.5 Ga respectively in amphibolite and greenschists facies conditions. The deformation affects both the intermediate and lower crust levels, without associated voluminous magma injection. Granulite crop out in the area of the MSZ. They were dated at 2.4 Ga (Ménot et al., 2005) and could represent some preserved Neoarchean tectonites. These rocks show various degrees of deformation including penetrative structures that may display comparable features with that observed in amphibolite and greenschists facies rocks, i.e. NS-striking and steeply dipping foliation with weekly plunging lineation. In the field, cinematic indicators for the MSZ argue for a dominant dextral shear sense. We proceed to optical analysis and crystallographic preferred orientation (CPO) measurements using EBSD technique in order to better constrain the deformation processes.

Our results highlight (1) a microstructural gradient from highly deformed rocks (mylonites), forming plurimetric large shear bands and showing evidences of plastic deformation, to slightly deformed rocks in preserved cores with no evidences of plastic deformation or with a clear strong static recrystallization; (2) CPO of minerals related with variations on deformation conditions. Feldspar and quartz CPO argue for plastic deformation at high temperature in the most deformed domains and for the absence of deformation or an important stage of static recrystallization in preserved cores; (3) uncommon CPO in orthopyroxene which are characterized by [010]-axes perpendicular to the foliation and [001]-axes parallel to the lineation. These CPO seem to be related to static recrystallization processes.

Seismic properties of amphibolite and granulite rocks from the MSZ were calculated in order to evaluate the impact of deformation observed in amphibolite and granulite tectonites to seismic anisotropy. Computations were performed from measured CPO, single crystal elastic stiffness matrix, modal composition and density of characteristic samples. P- and S-waves anisotropies of the cratonic crust affected by the MSZ are small and even tend to be isotropic in the case of S-waves propagating vertically in the crust. These results permit us to better discuss seismic studies and in particular SKS analysis which were recently carried out in this area (Lamarque et al., 2015).