# Kilometric to micrometric structures of the Madagascar granulitic crust and its relation with melt

[1]Martelat J.-E., [2]Schulmann K., [1]Randrianasolo B., [3]Lardeaux J.-M., [4]Hasalova P., [5-6]Ulrich S.
[1]*Université Joseph Fourier & Savoie, OSUG-LGCA, UMR 5025, Grenoble Chambéry, France*
[2]*Université Louis Pasteur, CGS, UMR 7516, Strasbourg, France*
[3]*Université S. Antipollis LST, UMR 6526, Nice, France*
[4]*Monash University, School of Geosciences, Faculty of Science Australia*
[5]*Charles University, IPSG, Albertov, Praha 2, Czech Republic*
[6]*Geophysical Institute, Czech Academy of Sciences, Praha 4, Czech Republic*

Southern part of Madagascar Island exposes rocks equilibrated under granulite facies (800°C -6 kbar). The main high - temperature metamorphic event is developed during late Panafrican-Cambrian East-West shortening associated with the development of vertical transpressive shear zones (SZ). The "Ankaramena - Ihosy – Satrokala" granulitic area (200 x 200 km) exhibits anastomosed lithospheric shear zones. Major North – South SZ (Ihosy SZ, Zazafostsy SZ, 5-15 x > 350 km) and minors (1-3 x < 140 km) shear zones developed in lithologically homogeneous quartzo – feldspathic high grade gneisses. The ductile shearing is associated with partial melting leading to development of pocket of leucosomes and stromatitic migmatites. The melting reaction occurs via biotite dehydration melting associated with increase of K-feldspar modal content, growth of orthopyroxene and magnetite with complex exsolution of ilmenite. We concentrated our analysis on the melt-absent rocks at the outcrop scale and we followed microstructural evolution of high grade gneisses with increasing strain gradient. Back scattered imaging, electron back scattered diffraction and quantitative microstructral analysis involving evaluation of crystal size distribution, grain boundary statistics and grain shapes analyses were performed across several profiles. Gneiss matrix studied samples is formed by strongly perthitic feldspar, highly lobated quartz and oligoclase and surround large elongate quartz aggregates. The microstructural profiles across the shear zones exhibit grain size decrease from 1-0.5 mm (median value) to 200 μm (median value). In the most deformed samples size of all phases converge and show smaller grain size spread. Axial ratio of grains is high and close to 2. Rocks exhibit weak shape preferred orientation of all phases at small angle to foliation plane and high standard deviation. The grain boundary frequencies are marked by random to regular grain contact distribution due to presence of numerous interstitial phases (quartz, plagioclase, K-Feldspar). The interstitial phases correspond to melt pocket located at high energy triple point junctions. Strongly perthitic alkali feldspar is associated with intese exsolution of pure albite strings which probably suffered important coarsening. Crystallographic preferred orientation of K-feldspar is compatible with activity of (010)[001] slip system, while quartz blebs show activity of prism <c> slip system. We interpret these microstructures as the result of crystal plasticity, chemically induced grain boundary migration, and contribution of intergranular melt promoting extreme weakness of felsic lower crust. Low melt volume (5%) remains constant in these rocks and affect important volume inside the Zazafotsy shear zone. We suggest that the melting process play important role in the development of Madagascar shear zones.