Geophysical Research Abstracts
Vol. 18, EGU2016-5326, 2016
EGU General Assembly 2016

Controls and implications of anisotropy across a strain gradient within granodiorite, Serifos, Western Cyclades

Élyse Gaudreau (1), France Lagroix (2), Élise Cossette (1), David Schneider (1), and Bernhard Grasemann (3)

(1) University of Ottawa, Earth Sciences, Ottawa, Canada (egaud052@uottawa.ca), (2) Institut de Physique du Globe de Paris, Paris, France, (3) University of Vienna, Vienna, Austria

In order to evaluate the assumption that the crust behaves as an isotropic material in complex structural settings, we integrate crystallographic preferred orientation (CPO) and anisotropy of magnetic susceptibility (AMS) data across a strain gradient within a Miocene granodioritic intrusion on Serifos island, Western Cyclades. One of the consequences of anisotropic crust is the variation in seismic wave velocity with the direction of propagation, which is largely controlled by the CPO of anisotropic minerals such as micas. The magnetic fabric of variably deformed granodiorite is used to characterize weakly defined tectonic fabric and thus complements the CPO data. Granodiorite samples exhibit very low strain to mylonitic fabric across the crustal-scale shear zone, recording progressive deformation through the ductile to brittle transition. CPO data was collected using electron backscatter diffraction and seismic properties were calculated using Voigt-Reuss-Hill averaging of the single minerals' elastic stiffness tensor. Quartz CPO is very strong in the weakly deformed samples recording basal and prism {0001}<a> slip. Furthermore, bulging recrystallization and undulose extinction in quartz as well as feldspar grains that exhibit brittle deformation structures are indicative of 300-400 °C temperatures. The mylonite has a very weak CPO for the quartz phase and exhibits prism {0001}<a> slip. The higher strain samples also reveal dynamic recrystallization and grain size reduction of quartz, plagioclase, potassium feldspar and biotite, which are characteristic of 400-500 °C temperatures. Orthoclase and anorthite possess a weak CPO in all samples. The S-wave anisotropy calculated from the CPO data of the weakly deformed granodiorite is the highest of all samples (max: 8%), and the anisotropy of the mylonite is the weakest of all samples (max: <3%). AMS data yields mainly oblate fabrics and the magnetic foliations and lineations correlate with microscopic and macroscopic structural observations. Most samples exhibit a bulk magnetic susceptibility between 30 and 5000 μSI, suggesting that the magnetic signature is due to both paramagnetic and ferrimagnetic minerals. Hysteresis loops and thermomagnetic curves specify pseudo-single domain magnetite as the main ferrimagnetic mineral. Paramagnetic and ferrimagnetic minerals can exhibit distinct subfabrics, and differentiating between the two using the anisotropy of remanence is essential for semi-quantifying local deformation. The magnetic fabric, coupled with the tectonic fabric inferred from CPO data, gives unique insight into the character of anisotropic minerals in a complex structural setting. For instance, the AMS foliations for samples with ill-defined syntectonic emplacement fabric have a similar orientation to that of fast P-wave propagation, a trait consistent with samples that have a macroscopic foliation. The analysis of anisotropic minerals is therefore fundamental for incorporating seismic anisotropy into large-scale geophysical models.