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Flow of the partially molten continental crust during Miocene orogenic collapse in Naxos, Greece

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The deep continental crust typically experiences partial melting during collision. The mechanical strength of the high-grade metamorphic units undergoing anatexis is drastically decreased as melting takes place. This presumably rapid change in the strength of the upper part of the lithosphere profoundly affects other orogenic processes including the unroofing of high-grade units and plate kinematics. A better understanding of crustal flow processes requires analysis of strain in large migmatitic domains. The application of magnetic fabric techniques to migmatites has recently offered new insights on the complex relationships between tectonics and anatexis. The young migmatitic domain of Naxos offers exceptional exposures to investigate such processes.

Magnetic fabrics provide fast and accurate information on strain principal axes. The anisotropy of magnetic susceptibility (AMS) has been measured on cubic specimens cut from oriented diatexite samples collected across the Naxos gneiss dome (130 stations). The bulk magnetic susceptibility (K) is in general low (2-100 x 10^{-6} [SI]), suggesting the magnetic properties are carried mostly by biotite. The hysteresis properties measured on the same samples reveal that the northern part of the dome hosts a few pockets of ferromagnetic gneisses in which the magnetic properties are determined by magnetite. The degree of magnetic anisotropy (Pj) is in general around 1.1 but locally

can reach up to 1.3. The shape factor (T) shows a positive correlation with Pj, i.e., the more magnetic samples are more oblate. The magnetic foliation is strongly correlated with the foliation measured directly on the outcrop. The advantage of using magnetic fabrics in this context concerns the determination of a linear fabric, which cannot be reliably measured in the field. At the scale of the hand specimen and of the outcrop, the AMS technique demonstrates that migmatites have a consistent fabric. Pj and T should not be regarded as reliable strain parameters in this case because the magnetic carriers and their concentration vary between specimens (proportion of melanosome) and between outcrops. Also, in paramagnetic migmatites, Pj reflects the intensity of LPO up to a saturation level determined by the most magnetically anisotropic silicate present in the rock (e.g., $P \leq 1.38$ for biotite). The strength of the fabric can be evaluated by the degree of dispersion (J') between specimens of the same station using a variation of the J-index (Bunge, 1982). The J'-index may allow better analysis of melt distribution and strain partitioning in partially molten systems.

A high density of structural data is needed to define the kinematic of dome development. The new results on the Naxos gneiss dome also confirm that even if migmatites are intrinsically heterogeneous materials, they still flow in bulk at a large scale (spaghetti bowl analog). Hence their structural complexity masks their remarkable fabric simplicity.