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Volatile Transport and Fluid-Rock Interaction in Aplites and Pegmatites Associated with the Crystallization of Anatectic Melts, Naxos, Greece

Alan Matthews (alan@vms.huji.ac.il)[1], **Benita Putlitz** (benita@geo.uni-potsdam.de)[2],
Vitaly Gutkin (vit@cc.huji.ac.il)[1] & **Yariv Hamiel** (yarivh@cc.huji.ac.il)

[1] Institute of Earth Sciences, Hebrew University of Jerusalem, Jerusalem 91904, Israel
[2] Institut für Geowissenschaften, Universität Potsdam, D-14415 Potsdam, Germany

At high metamorphic grades, the behavior of fluid may become closely related to the formation and crystallization of anatectic silicate melt, which acts as a temporary volatile reservoir. At temperatures above the initiation of melting, the melt will dissolve fluid released during metamorphic dehydration reactions and the volatiles will only be released when temperatures have subsequently decreased and the melts crystallize. This study investigates the transport of the volatiles released during the crystallization of the anatectic melts in the high-grade 'leucogneiss core' of the island of Naxos in the Aegean. An important manifestation of this retrograde process appears to be the formation of tourmaline-bearing aplites and pegmatites. These occur in the leucogneiss core, but are most marked in the immediately overlying metamorphic rocks (the Lower Series of schists and gneisses) where they outcrop with size and frequency that decrease with distance from the core. Age studies (Andriessen et al, 1991) and field relations suggest that they are the focus of channelled movement into the overlying metamorphic country rock of hydrous magmas derived from crystallizing partial melt in the leucogneiss core.

Aplites and pegmatites are frequently considered to be the product of late stage melt crystallization, where water exsolves as a separate phase and may advect into the country rock. Thus, exometamorphic alteration is to be expected in the vicinity of the aplites and pegmatites and is indeed observed in the form of retrograde silica-metasomatic alteration of dolomites, calcite-marbles and ultramafics rocks, (Baker and Matthews, 1994; Katzir et al., 1999). More surprising is that the aplites and pegmatites appear to undergo fluid-rock interaction as they progressively distance from core. This is manifested by a significant increase in the $\delta^{18}O$ of quartz and tourmaline from values of mostly 11-13 per mil and 9.5 - 11.5 per mil, respectively, in the core and Lower Series immediately adjacent to the core, to values of *ca* 14 - 16 per mil and 10.5 -- 12.5 per mil, respectively, in samples located relatively distant from the core. Comparison of these ranges with the $\delta^{18}O$ values of the metamorphic host rocks, suggests that fluid-rock exchange has taken place between the aplites/pegmatites and the host-rock. Several mechanisms can be suggested to account for this exchange, The first is diffusional and is possibly related to the mechanics of transport of aplites and pegmatites. Although loosely they can be described in the field as discontinuous dikes, they in fact do not cut straight up through the host-rock, but 'zig-zag' through it with a significant degree of layer-parallel travel. Naxos was beginning to undergo shallow northward-dipping ductile extension at the peak of metamorphism (Buick, 1991), which would have provided a favoured layer-parallel direction for transport of hydrous magmas. Thus, in moving up through the Lower Series, the aplites and pegmatites traveled relatively long distances, which could have provided the time necessary for diffusive exchange with the host rock. The second possibility is that the intrusion of the country rock commenced under water-undersaturated conditions, where fluids from the host rock could have been drawn into the magma phase and brought about the isotopic exchange. Present work is aimed at examining the viability of these processes, through more detailed study of the field relations and petrography, boron isotope geochemistry of tourmaline, and theoretical studies of dike propagation rates.

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