Geophysical Research Abstracts, Vol. 8, 07039, 2006
SRef-ID: 1607-7962/gra/EGU06-A-07039

Microdiapirs as indicators of the dynamic nature of intraplutonic contacts: evidence from the Fürstenstein Intrusive Complex (Bavarian Forest, Germany)

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Intraplutonic contacts (i.e. interfaces between individual magma batches within one pluton) are, similar to phase boundaries in other physico-chemical systems, characterized by gradients, in particular by thermal and compositional gradients. These gradients should make them dynamic places within the magma chamber system. Consequently, they can play an important role for processes forming a magma chamber. So-called »microdiapirs« (Weinberg et al. 2001) - up to 100 cm high and 50 cm wide cylindrical structures bordered by convex-upward and up to 5 cm thick mafic schlieren, which are usually situated close to intraplutonic contacts - may indicate the dynamic nature of intraplutonic contacts: According to Weinberg et al. (2001), microdiapirs form from melt pockets within a granitic magma which rise buoyantly in response to their lower density with respect to their surrounding. Melt segregation and ascent might be initiated by recharging of the magma chamber. If this hypothesis is true, microdiapirs should contain a magmatic fabric as well as a geochemical signature different from their host granite.

To test the supposed nature and origin of these structures, microdiapirs within the Variscan Fürstenstein Intrusive Complex (FIC, southwestern part of the Bohemian Massive) were investigated with respect to their magnetic susceptibility (MS), its anisotropy (AMS) and their whole rock geochemistry. Microdiapirs occur in the FIC within the Tittling granite (TG), a medium-grained biotite granite, close to its boundary with the Saldenburg granite, a coarse-grained granite with up to 5 cm long K-

feldspar megacrysts.

Detailed MS mappings and laboratory measurements revealed the diapir rims to have high MS values (in the range of $5*10^{-4}$ SI to $1*10^{-3}$ SI) compared to the diapirs' interior and surroundings ($1*10^{-4}$ SI to $3*10^{-4}$ SI) due to the enrichment of biotite and ore minerals within them. Thermomagnetic measurements confirmed the presence of ferrimagnetic magnetite besides paramagnetic biotite in the diapir rims, while the diapirs' interior and exterior contain only paramagnetic biotite as MS carrier. AMS measurements showed that the magnetic fabric within the diapirs differs significantly from the magnetic fabric generally observed within the TG. The overall fabric of the TG is characterized by a steep NE-SW-trending magnetic foliation and magnetic lineations which follow a girdle distribution along this foliation. The magnetic fabric of the diapirs consists of steep lineations and a NNE-SSW-girdle distribution of the foliation poles. The low eccentricity of all AMS ellipsoids indicates their flow fabric nature. Obviously, the diapirs' interior preserves a magmatic flow fabric different from the overall flow within the TG as postulated by the hypothesis about the nature of microdipairs of Weinberg et al. (2001).

Whole rock geochemistry investigations showed further significant differences between the diapirs and the surrounding TG. In particular, trace element patterns of the diapir rims and interiors resemble each other, while they differ strongly from those of the host granite. Although some of these similarities might be casual or the result of differing processes in different parts of one diapir, at least the enrichment in Rb in the diapir rims and their interior point to the fact that they both stem from a different magma than the host granite. The microdiapirs probably represent a residual magma of the TG after removal of plagioclase, as suggested by the low amounts of Sr within both, the diapirs' rims and interiors relative to the TG in their surroundings. Moreover, partial depletion in La, Ce and Th indicate fractionation of monazite into the host TG magma.

In conclusion, the results of our investigations suggest that the microdiapirs of the FIC are indeed pockets of a residual melt which developed into melt conduits with a specific magmatic flow fabric. The presence of these structures is evidence for the dynamic nature of intraplutonic contacts.

Reference

Weinberg, R.F., Sial, A.N. & Pesoa, R.R. (2001): Magma flow within the Tavares pluton, northeastern Brazil: Compositional and thermal convection. Bull. Geol. Soc. Amer., 113, 508-520.