Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 328

Mobility of Elements Associated With Deformation of the Izera Granite (Izera-Karkonosze Block, SW Poland)

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The Izera (a.k.a. Rumburk) granite (ca. 510Ma) makes up the major rock variety building northern part of the Izera-Karkonosze Block (IKB). This unit was repeatedly deformed during Variscan orogeny under amphibolite to greenschist facies retrogressive conditions. The deformations and metamorphism were localised in the shear zones of scale ranging from a few centimetres to several tens of metres, which were often reactivated during consecutive episodes. One of the widest shear zones parallels the Intra-Sudetic fault, considered as a major strike-slip fault, bounding two different tectono-stratigraphic units.

In a typical shear zone, undeformed granite gradually passes through augen- (and sometimes laminated) gneiss into fine-laminated mylonite. The lithological changes are accompanied by the mineral reactions: breakdown of feldspar into zoisite and muscovite, sericitization, chloritization of biotite, growth of chequered albite and flame perthite etc. In an extreme case, the most intensive deformational/mineralogical changes can yield phyllonite.

Deformations also caused substantial geochemical changes. In all studied shear zones both major and trace elements (including REE) were mobilized. Analyses from gneisses and mylonites, normalized to undeformed granite, show either enrichment or depletion of major elements, without obvious regularities. The consistent low mobility is shown only by Si and Al, while behaviour of other elements changes drastically. E. g. Na, nearly immobile in one shear zone suffers nearly 90% loss in another.

Behaviour of REE is less erratic. Generally, they show either consistent depletion or enrichment. On the spider plots these changes cause only shifts of the REE patterns without changes in shape of the general trends. On the Nb/Y and Rb/Y+Nb discrimination diagrams the projection points from the particular shear zones fit into one environment field. However, in one case the change was substantial enough to shift projection points into the fields of different geotectonic environments, relative to undeformed granite.

Localization of the metamorphic and geochemical changes within the shear zones strongly points to deformation-driven processes assisted by fluid flow. Dynamic recrystallization surely enabled the mineral reactions, which produced rheologically softer minerals. This caused further localization of deformation, which enabled channelizing of fluids, which in turn boosted mineral reactions etc. Highly variable character of geochemical changes in the IKB shear zones implies rather local then regional controls on the mobility of elements.