Geophysical Research Abstracts,
Vol. 10, EGU2008-A-08117, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-08117
EGU General Assembly 2008

Drying porosity waves: add fluids to dry up

Timm John (1), Yuri Y. Podladchikov (1), Andreas Beinlich (2), Reiner Klemd (2)

(1) Physics of Geological Processes PGP, University of Oslo, Norway;
(timm.john@fys.uio.no), (2) Mineralogisches Institut, Universität Würzburg, Germany

The conversion of blueschist into eclogite is a very important and ubiquitous metamorphic transformation that takes place along low geothermal gradients at convergent plate boundaries. It is associated with changes in rheology, with earthquakes and arc magmatism and has been at the centre of geodynamical and petrological research for several decades. The associated high-pressure / low-temperature conditions have always suggested that deformation and fluids are essential ingredients when unraveling the related field observations.

In the Tianshan mountains in China it is possible to study initial eclogitisation (i.e., dehydration) of blueschists and the associated fluid flow regime. Field evidence shows that the preferential flow field of released slab fluids is highly channelized and that these fluids tend to react with their wall rocks, thereby serving as agents for the mobilisation and transport of trace elements. In some cases, we observed well-developed reaction selvages formed along several-meter long exposed veins. Within these selvages, the degree of eclogitisation -and thus dehydration- increases towards the vein. The petrological and structural observations, however, suggest that an external fluid formed these veins and selvages. Thus a paradox is created: such systems dehydrate as a consequence of added fluids.

The main driving forces behind mineral reactions are variations in composition, temperature, and pressure. Our hypothesis is that any observed change of composition within the selvage is a function of its formation, and thus the overall metasomatic effect of the selvage formation should be one output of the model. Temperature variations within a meter scale are negligible in non-magmatic systems, thus leaving pressure as the only variable to change. One way to overcome the dehydration-by-fluid-

addition paradox could be to reproduce the observed dehydration selvages and the related chemical changes by adapting the concept of porosity waves (Connolly and Podladchikov 2007). Such a porosity wave would have an over-pressured fluid head that produces the pathway through the rock followed by an under-pressured tail, causing a zone of a certain thickness around the pathway to be drained. There would be a fluid-pressure gradient across this zone, which could be approximated by a water fugacity (f_{H2O}) gradient. We evaluate whether this predicted change in the f_{H2O} is able to induce the dehydration reactions that we observe in the field.

Connolly J, Podladchikov Y (2007) Decompaction weakening and channelling instability in ductile porous media: Implications for asthenospheric melt segregation. Journal of Geophysical Research 112, B10205. doi:10.1029/2005JB004213.