Quantification of microscale processes in high-pressure rocks

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Petrologists and structural geologists are driven by the same essential curiosity about metamorphic processes involved in mountain building and they use different tools to understand them. Eclogite-facies rocks are, on one hand, one of the most beautiful and important metamorphic rocks because they can serve as witnesses of the evolution of orogenic belts. On the other hand, when we want to quantify processes taking place in these rocks, their microstructures often belong to the most mysterious ones.

Recent decades have been connected with an impressively accelerating pace in the development and availability of new analytical techniques to earth scientists. Interestingly, the smaller the scale considered, the more heterogeneous an apparently uniform rock sample is, especially eclogite-facies rocks. This heterogeneity is not only characterized by variation in chemical composition but also in mechanical properties. The mechanical effects may influence element transport and mineral assemblage in rocks which can, in turn, significantly control the mechanical-chemical coupling rates and mechanisms of various processes in high-pressure rocks. Considering the interplay of metamorphic reaction and mechanical properties in our quantification approaches is critical for correct interpretation of the observations. In my contribution, I will show major applications of the new quantification approaches, the accompanying obstacles and the consequences for our petrological interpretations.

Several new theories and quantification approaches have been recently suggested for systems under stress (*e.g.*, Wheeler, 2014), mostly based on the observations from deformation experiments focused on the quartz-coesite transition. I will discuss this topic in my contribution as well. I think that it is important to document whether it is pressure or maximum principal stress that dramatically affects the mineral reactions. I will show that it is essential to quantify the stress/pressure distribution in the sample before any complex thermodynamic interpretations is made.

Wheeler, J., 2014. Dramatic effects of stress on metamorphic reactions. *Geology* 42:647–650.