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Dehydrating slabs - mechanisms, flow structures, and rates

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In the Tianshan mountains (China) it is possible to study initial eclogitisation of blueschists (i.e. slab dehydration) and the associated fluid flow regime in well-exposed fragments of an oceanic subduction zone. 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, slab-derived fluid formed these veins and selvages.
The main driving forces behind mineral reactions are variations in composition, temperature, and pressure. We suggest that the observed change of compositions within these selvages is a function of their formation. Temperature variations within a meter scale are negligible in non-magmatic systems, thus leaving pressure as the only variable to change. The observed dehydration selvages and related chemical changes can be explained by adapting the concept of porosity waves. Such a porosity wave has 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. Modelling of diffusive fluid-mediated transport of Li-concentration and isotopes show that the rates of fluid release are similar to convergence rates and do match those found for melt extraction at mid ocean ridges.