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Shear zone broadening driven by metasomatism: an example from the Roffna metarhyolite (Suretta nappe, eastern central Alps)

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Ductile shear zones in continental crust play a critical role in the accommodation of deformation at crustal scale. They are also pathways for fluid and therefore the loci of metamorphic and metasomatic reactions.
These fluid-rock interactions (reactions and metasomatism) control the behaviour of the shear zone and may be one of the driving force for the development of the shear zone and its lateral propagation (widening). Our goal in this contribution is to quantify the role of these chemical processes on the shear zone formation.
The present study focuses on shear zones in the Roffna metarhyolite, in the Suretta nappe (Penninic Domain, Eastern Central Alps). This early Permian massif intruded the older basement and was affected only by Alpine tectonics. The ductile deformation is characterized by a shear zone network from millimetric to plurimetric scale developed under blueschist facies conditions. Mass transfer results show gains in MgO, K2O and H_2O coupled with losses in CaO and Na2O with increasing strain. The main mineralogical change along the gradient is the growth of phengite and quartz at the expense of K-Feldspar and plagioclases. The appearance of a small amount of epidote and a small decrease in the amount of biotite is also observed.
In our conceptual model of shear zone formation, the ultramylonite is assumed to be produced by infiltration metasomatism. In contrast the intermediate rocks between the protolith and the highest strain rock is assumed to be the result of diffusion metasomatism. Therefore the amount of lateral propagation is controlled by the kinetics of diffusion and equilibration of the host rock. To test this hypothesis we have compared shear zones with different thickness which should represent various degree of equilibration of the host rock at the conditions of the deformation and fluid-rock interactions.
Using a suite of PT and chemical potential computed phase diagrams, we are able to model the reaction path involved during the equilibration process between the host rock and the highest strain zone.
Our work provide new insights into the role of chemical processes on the formation of shear zone.