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The role pre-orogenic hydration of midcrustal granitoids for greenschist facies shear zones

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The understanding of fluid sources inside medium grade conditions in the continental crust without overturned isotherms are difficult reconcile. Fresh granitoids contain only low amounts of water that are stored in minerals stable until partial melting. One potential water source in such crustal settings might be previous near surface alteration of such quartzo-feldspatic rocks (and basic rocks), which that get subsequently metamorphosed. To test this hypothesis, we investigate shear zones and host rocks in the Haslital granitoids of the Aar-massif (Central Alps, Switzerland). The hosts are dominated by quartz, biotite, chlorite and heavily altered feldspars, whereas the shear zone mylonites contain re- and neocrystallized fresh feldspars, two micas and epidote. The fluid in the host is mainly stored in alteration phases (white mica, epidote) of feldspars. During re- and neocrystallisaton of such a system, fluids stored in the alteration phases get reorganized together with trace-elements and isotopes. We compare such rock types using geochemical data. Grant diagrams show no bulk chemical changes (e.g., REE pattern and U/Th ratios) between the mylonites and surrounded altered granitoid, whereas the petrography between these rocks changed. Some small scale (cm-sized) cataclasites in the center of the shear zone are better described as mafic dyke and did not fit the geochemical patterns of the mylonites and host granitoids. The pre-shear zone existing alteration is a likely fluid source during shear zone formation [1]. The Pb isotopic composition of the feldspars with the Pb isotope evolution of the granitoids suggests that the Pb isotope composition of feldspars includes components inherited by redistributing Pb mobilized from variably U-/Th-enriched phases within the granitoids themselves. The combination of chemical data and microstructural observations indicate: (1) U-/Th-enriched phases, as for example allanite, are included in shear zone deformation; (2) the fluid source is, at least partly, located inside the host rock; and (3) fluid related changes developed before the shear zone deformation (mainly during the alteration stage). Epidote U/Pb ages indicate a Permian age for such alteration [1].

[1] Peverelli et al. (2022). Geology, 50, 1073-1077.