Multidisciplinary characterization of fluid sources in ductile shear zones (Armorican Massif, Variscan belt, France)

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Ductile shear zones are sites of significant fluid circulation and hydrothermal alteration where metamorphic, magmatic and surface-derived fluids meet. Characterization of the meteoric source of crustal fluids can be used to better understand ore deposition and mineralization at the orogen scale or for stable isotope paleoaltimetry reconstructions. Microstructural, thermometry, geochronological and hydrogen (δD) and oxygen ($\delta^{18}O$) isotope data from syntectonic peraluminous granites from ductile shear zones in the Armorican Massif permit to determine the source of fluids present during deformation. Furthermore, they allow to study the spatial and temporal evolution of localized deformation and fluid-rock interaction across these Variscan fossil hydrothermal systems, including the timing and duration of fluid flow and water-mineral isotope exchange.

At the regional scale, a 41‰ difference in δD_{water} values amongst mylonitic leucogranite emplaced along strike-slip and detachment zones highlights a mixing relationship between metamorphic/magmatic fluids (δD_{water} ~ -33‰) and meteoric fluids with δD_{water} values as low as -74‰. The mixing between surface-derived and deep fluids is further supported by fluid inclusions aligned along synkinematic structural planes in quartz grains from detachment footwalls. They contain very low to medium salinity water (0 to 7 wt% eq. NaCl) and have intermediate δD and $\delta^{18}O$ values.

We focus on the Quiberon detachment zone (QDZ) where synkinematic muscovite and tourmaline crystallized and equilibrated with deuterium-depleted surface-derived fluids during high-temperature deformation supported by titanium-in-muscovite thermometry and microstructures. $^{40}Ar/^{39}Ar$ data on muscovite and U(-Th)/Pb geochronology on zircon, monazite and apatite from syntectonic leucogranites, together with microstructural data, suggest that meteoric fluid-rock-deformation interactions started at ~320 Ma and played a major role in leaching uranium at ~305 Ma. U-Th/Pb data from migmatites located below the QDZ strengthen the idea that meteoric fluids infiltration, detachment activity, syntectonic leucogranite emplacement and migmatization were coeval and allowed the development of a sustained hydrothermal system.

Mots-Clés : Variscan; Armorican Massif; detachment; shear zone; fluid-rock interactions; meteoric fluids; hydrogen isotope; oxygen isotope; thermometry; $^{40}Ar/^{39}Ar$; U(-Th)/Pb; fluid inclusions

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