

Deep penetration of meteoric water in Variscan ductile shear zones

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The Variscan belt of Western Europe is well exposed in the Armorican Massif (AM) and the French Massif Central (FMC). They are both characterized by strike-slip shear zones and detachment zones that developed as a consequence of Late Carboniferous post-orogenic extension. Syntectonic peraluminous granites are spatially associated with strike-slip shear zones and form the footwall of the detachment zones. Therefore, the structural, geochemical and geochronological study of synextensional granitic plutons greatly helps in understanding extension phenomena. Combining microstructural, hydrogen isotope (δD) and fluid inclusion analysis of granitic mylonite samples, we aim at understanding the spatial and temporal relationships among microstructure development, localization of strain and fluid-rock interaction.

Overall hydrogen isotope ratios of syntectonic hydrous silicates result in δD values that suggest an interaction with meteoric fluids. In the AM, $\delta D_{\text{muscovite}}$ values from samples collected along the South Armorican shear zone (~ -80 to -50%) are more positive than $\delta D_{\text{muscovite}}$ values from samples from detachment zones (~ -90 to -75%). In the FMC, $\delta D_{\text{muscovite}}$ are typically the most negative, with values as low as -101% . Fluid inclusions in quartz grains are composed of low to very low salinity water as indicated by temperatures of ice melting ranging from -2.5 to -0.5°C . The study of fluid inclusions therefore supports the idea that meteoric water infiltrated the mylonitic footwall of these shear zones. In addition, minimum temperatures of entrapment have been measured between 150 and 300°C which is in good agreement with the temperature of deformation deduced from quartz microstructures.

These new results suggest that surface derived-fluids penetrated down to the brittle-ductile transition of crustal-scale deformation zones that controlled the demise of the Variscan orogen at ~ 300 Ma.