Late Carboniferous paleoelevation of the Variscan Belt: a stable isotope paleoaltimetry study in the French Massif Central

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We present the first stable isotope paleoaltimetry estimates for the internal zones of the eroded Variscan Belt of Western Europe based on the hydrogen isotope ratios (δD) of muscovite from syntectonic leucogranites that have been emplaced at ~315 Ma. We focus on the Limousin region (Western Massif Central, France) where peraluminous granites are spatially associated with strike-slip and detachment shear zones that developed as a consequence of Late Carboniferous syn- to post-orogenic extension and merge to the northwest with the South Armorican Shear Zone.

The NE corner of the Millevaches massif is located at the junction between brittle and ductile fault systems that acted as preferential pathways for Earth surface-derived fluids. These meteoric fluids penetrated the crust at depth and reached the ductile segment of the low-angle Felletin detachment zone. Using microstructural, thermometry, hydrogen isotope geochemistry and $^{40}Ar/^{39}Ar$ geochronological data, we show that these Variscan meteoric fluids interacted with hydrous silicates during high temperature deformation between at least ~318 and ~310 Ma. Based on the measured $\delta D_{Muscovite}$ values ranging from -116 to -105‰ in mylonitic leucogranite and a temperature of hydrogen isotope exchange of 540 ± 51°C deduced from the Ti-in-muscovite geothermometer, we calculate an average $\delta D_{meteoric\ water}$ value of -96 ± 8‰.

For paleoaltimetry purposes, we reference our hydrogen isotope record of ancient meteoric fluids from mylonitic rocks to time-equivalent (~300 Ma) oxygen isotope records retrieved from freshwater shark remains preserved in the Bourbon l'Archambault (BA) basin that developed in the external zones of the orogen. Using a hydrogen isotope lapse rate of -22‰/km, a ~76‰ difference in $\delta D_{meteoric\ water}$ values between the Millevaches massif and the BA basin (δD_{water} = -20 ± 6‰) permits paleoaltimetry estimates attaining 3400 ± 700 m. Obviously, we are limited in extrapolating isotope elevation relationships into the distant past; however, the rather large difference in δD values between the foreland basin and the orogeny interior suggests that the hinterland of the Variscan belt of western Europe acted as a barrier to moisture from the south-south-east and was probably high enough to induce an orographic rain shadow to the north.

Mots-Clés : Variscan; shear zone; detachment; Massif Central; hydrogen isotope; $^{40}Ar/^{39}Ar$ geochronology; meteoric fluids; stable isotope paleoaltimetry

Merci de ne rien inscrire dans cette zone et ne pas modifier les marges des pieds de page et entêtes.