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Stable isotope composition of fluid inclusions in quartz minerals : New method for paleoaltimetry

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Paleoaltimetry is a powerful tool to study tectonic, climate and surface processes interactions. Indeed, stable isotope composition of meteoric water can be correlated with the elevation of reliefs. The δ18O and δD of orogenic rainfall decrease while the elevation increase. Current paleoaltimetric methods based on stable isotope, including the study of pedogenic carbonates and micas associated with fault or shear zones, represent an indirect way to obtain stable isotope « paleometeoric fluid » composition. These methods do not provide simultaneously the δ18O and δD values implying the use of isotope exchange equation, source of signficant errors (up to +/- 1000m).

We have developed a new method which allow to directly acces at both the δ18O and δD of « paleometeoric » fluids with a good precision and margin of error less than +/- 200m . This method has been developed on the stable isotope composition of fluid inclusion trapped in quartz veins. The developed experimental protocol allows to extract small quantity of fluid (~10mL) and directly analyse both the δ18O and δD with a OA-ICOS Spectroscopy. Tested on 18 Miocene alpine quartz veins from the Mont-Blanc and the Chenaillet massifs the stable isotope composition of the fluids fit very well with meteoric isotopic signature and highlight the robustness of stable isotope ratio through geological time.

More over, our results indicate that Miocene precipitation was way more positive (-4,8 to -9 ‰ for δ18O and -38,2 to 68,8‰ for δD) in the Mont-Blanc massif area than modern precipitation (-12,9 to -18 ‰ for δ18O and -101,1 to -144,25‰ for δD) which indicate that the massif was still at low elevation at this time. In contrast the « paleoprecipitation » of the Chenaillet massif fall in the same range than modern precipitation (-83 to -120,3 ‰ for δD and -11,8 to -16,9 ‰ for δ18O) which indicate this massif has already reached his present altitude (~ 2500m).