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Element mobility related to low temperature (<150°C) hydrothermal activity: implication for (U-Th)/He apatite dating

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The Têt fault hydrothermal system in the eastern Pyrenees displays about 30 hot springs along its surface trace with temperatures ranging from 29 to 73°C. The fluid circulation at depth has been previously highlighted by tectonic and hydrochemical studies [1,2]. These studies show that the circulation of hydrothermal fluids is initiated by the topographic gradient, that these fluids reach a maximum temperature of 150°C at depth and that their ascent is located in the most permeable portion of the fault damage zone.

Along the fault, we performed a comparative study by coupling (U-Th)/He dating on apatite (AHe) and REE analyses along four main sampling profiles both with and without hydrothermal activity [3,4]. We also measured dissolved gas content in water (He, Ne, H2, O2, N2, CH4, CO2) of different hot spring clusters which provides evidence of fluid-mineral interactions at depth. In the vicinity of hot springs, apatites have low REE contents and show an important intrasample age dispersion (0.3 - 50.2 Ma) with mostly AHe ages younger than those obtained outside the damage zone of the different profiles (15 - 25 Ma) unaffected by fluid circulation, except for GAL profile. The young and scattered AHe ages in hydrothermalized samples cannot be explained by volume diffusion models but require mobility of both parent and daughter elements of the (U-Th)/He system during fluid interaction. Consistently, the analysis of the hot water shows a high concentration of helium, from 10 to 100 times the content of the river water.

This study shows that the AHe thermochronometer can be highly impacted by low temperature hydrothermal circulation along a fault damage zone. Therefore, cooling histories from mountain belts where hydrothermal (paleo)-circulations are evidenced along faults must be considered with caution.

[1] Taillefer, A., Guillou-Frottier, L., Soliva, R. et al. (2018). Geochemistry, Geophysics, Geosystems. 19(12), 4 972-4995. https://doi.org/10.1029/2018GC007965

[2] Taillefer, A., Milesi, G., Soliva, R., et al. (2021). Tectonophysics, 228710. https://doi.org/10.1016/j.tecto.2020.228710

[3] Milesi, G., Soliva, R., Monié, P., et al. (2019). Terra Nova, 31(6), 569-576. https://doi.org/10.1111/ter.12429

[4] Milesi, G., Monié, P., Münch, P., et al. (2020). Solid Earth, 11(5), 1747-1771. https://doi.org/10.5194/se-11-1747-2020