Origin of H_2 and CO adsorbed on talc and chlorite from the Trimouns-La Porteille deposit (Pyrenees)

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Located in the St Barthelemy massif (northeastern Pyrenees) the Trimouns-La Porteille talc-chlorite deposit is one of the largest worldwide. Resulting of metasomatose of marbles, micaschists and pegmatites, this deposit attests of large fluids percolation in the crust. Its formation being synchronous of the mid-cretaceous pyrenean extension, it is considered as a relevant target to characterize the origin of fluids circulating during the hyper-thinning of the crust. By an original way, our work propose to use paleo-gas adsorbed on minerals surfaces as proxy to discuss the origin of fluids. In this study, gas adsorbed on typical samples of talc and chlorite have been identify, quantify and their stable isotope compositions (δD and $\delta^{13}C$) have been measured.

For all samples, various amounts of H_2, CO and CO_2 have been measured. Only H_2 and CO have been quantified. H_2 and CO desorbed from samples ranges between 0.7 to 7.4 ppm and between 3.0 to 35.3 ppm respectively. The lowest values correspond to talc and the highest to chlorite from pegmatites. For chlorite from micaschiste, desorbed H_2 and CO have intermediate values. The H_2/CO ratio varies between 1.7 to 9.3 independently of the lithologies. Finally, preliminary stable isotope results show homogeneous compositions between -258‰ to -224‰ (± 5‰) for δD_{H2} and between -27.6‰ and -25.7‰ (± 1‰) for $\delta^{13}C_{CO}$.

Suprisingly, H_2 which is an apolar molecule, can be adsorbed in significant amount on talc and chlorite. This behavior questions the mobility of H_2 under hydrothermal conditions. Indeed the variable amounts of H_2 and CO desorbed from the different lithologies question how these two gas bond to talc and chlorite surfaces (chemisorption or physisorption). Finally, the homogeneity of stable isotope compositions of H_2 and CO suggests a single origin for these two reduced gases. Are they coming from deeper in the crust or are they in-situ produced by Fisher-Tropsch synthesis?