



Empirical calibration of the oxygen isotope fractionation between chlorite and quartz

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Chlorite and quartz are common minerals in many rocks influenced by diagenesis, low up to high grade metamorphism, as well as in many hydrothermal ore deposits. Often their presence in veins and rocks is directly related to fluid transport and fluid-rock-interactions. Although common, this assemblage covers a large range of temperature (from $<200^{\circ}\text{C}$ to 650°C) in which hydrothermal, mesothermal and hypothermal reactions occurred. Recent advances for thermometers based on the thermodynamics of compositional changes in chlorite are very encouraging, hence they may be compared to the temperature dependant oxygen isotope fractionation between chlorite and quartz in order to calibrate the latter. Most of the experimental calibrations on oxygen isotope fractionations between chlorite, quartz and water have been made at high temperature, but it is questionable if these can also be extrapolated to lower temperatures. Given the difficulty of conducting experiments on oxygen isotope exchange as well as synthesizing silicates at low temperatures ($<500^{\circ}\text{C}$), another approach is to use nature as a laboratory. The first results of oxygen isotope fractionation between quartz and chlorite are presented in this study. This calibration uses an empirical, field based and mineralogical approach on different Mg-Fe chlorite and quartz bearing rocks. Samples were collected from a number of different places in the Alps, Corsica, Pyrenees, and the Ardennes, places where the temperature is well-constrained by independent methods. Special attention was taken on the textural equilibrium of chlorite and quartz and the chlorite compositions were determined. Samples presenting no textural equilibrium were systematically rejected. Moreover, all chlorite used in this calibration so far, has a composition with Fe/Mg ratio varying between 0.5 and 0.6 only. The first results show that a correlation between chlorite-quartz fractionation (with $\Delta^{18}\text{O}_{qtz-chl} \approx \delta^{18}\text{O}_{qtz} - \delta^{18}\text{O}_{chl}$) and temperature estimated from chlorite composition and regional relationships exist. The encouraging preliminary results will hopefully lead to an empirical oxygen isotope quartz-chlorite thermometer, which can then be used for thermometric studies of low-grade metamorphic and diagenetic systems.