Mineral-fluid interactions and time-integrated fluxes in tin-bearing greisens, Krušné hory (Erzgebirge) Mts., Central Europe

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Hydrothermal fluids are major mass transport agents in the lithosphere and reactive fluid flow underlies alteration and ore-forming mechanisms in diverse settings. In contrast to our advanced knowledge of alteration mineralogy and geochemistry, little is known about the volume of fluids responsible for specific mineralization or about the nature of replacement, i.e. dissolution-precipitation reactions on the microscale. We use alteration zoning of cassiterite-bearing greisens from the Krušné hory (Erzgebirge) Mts. in Central Europe as model example to interpret the fluid-mineral reaction mechanisms and calculate the time-integrated fluid fluxes. The greisen veins and swarms are hosted by highly evolved Li-F-P-rich biotite and zinnwaldite granites with topaz and tourmaline. Magmatic plagioclase ($An_{<10}$) and K-feldspar ($Or_{>84}Ab_{<16}$) exchanged Na and K prior to greisenization. Dark micas are represented by lithian annite continuosly evolving to zinnwaldite, whereas white mica corresponds to lithian Fe-bearing muscovite. Greisenization occurs in several stages: (i) breakdown of feldspars to quartz and sericite or muscovite. Silicification and muscovite formation are spatially decoupled and represent dissolution-precipitation process, which requires local transport of Al, (ii) replacement of dark mica by celadonitic muscovite under volume-conserved conditions. This reaction requires significant Al addition and Mg, Fe release, (iii) breakdown of muscovite to topaz and quartz. This is a dissolution-precipitation reaction under Al-conserved conditions but declining fugacity of HF, and (iv) hydraulic fracturing and open-space filling by quartz greisens and monomineralic veins. Thermodynamic simulation of fluid-mineral interaction during disequilibrium infiltration in a pressure-temperature gradient reveals that the formation of mica-quartz and topaz-quartz greisens requires time-integrated fluid fluxes 10^2 to 10^3 m^3 fluid per m^2 rock, and the corresponding fluid flow rate of 10^{-10} to 10^{-8} m s^{-1}. The formation of a single greisen vein with a typical volume of 10^3–$5\cdot10^4$ m^3 would thus require 10^5–$3\cdot10^7$ m^3 aqueous fluid that must have exsolved from an intrusion measuring 80-700 m in each dimension. This approach illustrates use of reaction stoichiometries and non-equilibrium transport theory in estimating fluid fluxes in hydrothermal ore-forming processes.

Calcification rate and carbon-isotope fractionation in coccolithophore calcite through laboratory culture experiments

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The physiology of marine calcifiers such as haptophytes substantially affects the fractionation of carbon isotopes into biominerals. The resultant offset from equilibrium fractionation is often referred to as the "vital effect". The geological record of climate and the composition of seawater reconstructed from sedimentary biominerals is therefore not completely faithful. The aim of this work is to examine and quantify this biologically-induced distortion of the carbon isotopic signature in coccoliths in order to develop a mechanistic understanding of the vital effect in the coccolithophores, determine species-specific fractionation factors to derive the actual composition of seawater, and eventually be able to reconstruct climates more reliably using species separation techniques for fossil coccoliths.

Calcifying strains of haptophytes were subjected to a series of perturbation experiments in the laboratory in order to determine the effect of changes in the physico-chemical composition of the ambient environment (temperature, DIC level, pH, calcium concentration and phosphate concentration) on that of the biominerals and the organic matter. For all these experiments and for all the species, the partitioning of carbon into photosynthetic versus calcification pathways seems to be the primary driver of differences in the carbon isotopic composition of coccoliths. A second-order but still important parameter to consider for interpreting carbon isotopes is the active mechanisms used by the cells to concentrate carbon (CO_2) within the chloroplast and the coccolith vesicle. Empirically revealed through *p*H and TDIC perturbation experiments, variations in CCM efficiency can lead to 4‰ offsets between species. Finally, frequent malformations of coccoliths are observed for specimens grown under carbon limited conditions, or when cells reach their physiological maximum division rate.

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