RELATIVE HYDROTHERMAL SOLUBILITIES OF FERBERITE AND SCHEELITE IN GRANITOID ENVIRONMENTS

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In order to better understand mineralizing processes in granitoid-related W deposits, solubility and speciation calculations have been carried out in the system Ca-Fe-W-Cl-O-H using an internally-consistent, critically-evaluated database of relevant thermodynamic data. The simultaneous solubilities of scheelite and ferberite in NaCl-HCl-H_2O solutions were calculated at temperatures from 200-600ºC, pressures from 500-1000 b, pH from 3-6 and mNaCl from 0.1-5.0 mol/kg H_2O, conditions relevant to many W deposits. The calculations indicate that: (1) solubilities of scheelite/ferberite can reach hundreds to thousands of ppm as the species H2WO4, HWO4-, WO42-, NaHWO4, and NaWO4-. Thus, Cl-, F-, CO32- complexes, or more exotic species, are not required to form an ore deposit; (2) W concentrations in equilibrium with scheelite and ferberite increase strongly with increasing T, increasing NaCl concentration and decreasing pH, but is only weakly dependent on P; (3) the Ca/Fe ratio of a fluid in equilibrium with both W minerals decreases strongly with increasing T, i.e., the field of stability of scheelite expands with increasing temperature, so that the late-stage replacement of ferberite by scheelite requires an increase in the Ca/Fe ratio concomitant with any putative cooling; (4) the Ca/Fe ratio is relatively independent of pH; and (5) the effect of NaCl concentration on this ratio changes as a function of T and P. At 400ºC the ratio is independent of, or decreases with, increasing NaCl; at higher T, the ratio first decreases and then increases with increasing NaCl. These results generally agree with experimental data not used in parameterizing the model.