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Chemical characterization of the fluid phase in magmatic intrusions with applications to ore generation

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Ore genesis, when associated with felsic magmatism, develops from metals scavenging from the melt into the fluid phase. Its composition includes water, CO_2, Sulphur under several possible speciation, and halogens, mainly F and Cl. The respective influence of those elements is examined by computing the theoretical electronegativity and chemical hardness of the fluid phase. Those parameters provide efficient indications on their attractive power for metals. Hence a fluid phase made harder by the addition of F attracts hard metals, such as Sn and W. Conversely, the addition of S, or Cl, lowers the hardness of the bulk fluid, making it more attractive for soft elements, such as Cu and Mo. The chemical character of the fluid phase also explains the discrepancy existing between metal solubility in the melt and in the fluid phase. It results from the change in oxidation state induced by a hard fluid, promoting oxidation, for instance from Sn(II) to Sn(IV) or reduction in case of a soft fluid phase, from Mo(VI) to Mo(IV).