INTERPRETING THE CHEMICAL COMPOSITION OF FLUID INCLUSIONS: THE CONNECTION TO BULK WATER ANALYSES

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Analyses of the cation and anion concentrations in fluid inclusions have become relatively widespread in the literature, and greatly extend the range of crustal environments for which the fluid chemistry is known. We have compiled a database of both saline fluid inclusion analyses, ranging from low-grade metamorphic to magmatic systems, and bulk fluid analyses from oilfield and geothermal drilling.

Many chemical trends are similar for both data sets. For example, suites of high-T (magmatic) fluid inclusion analyses (obtained by both single inclusion and bulk crush-leach techniques) show similar relationships between transition metal concentrations and chloride to oilfield brines, indicating similar speciation despite very different temperatures and absolute metal levels (Figure 1).

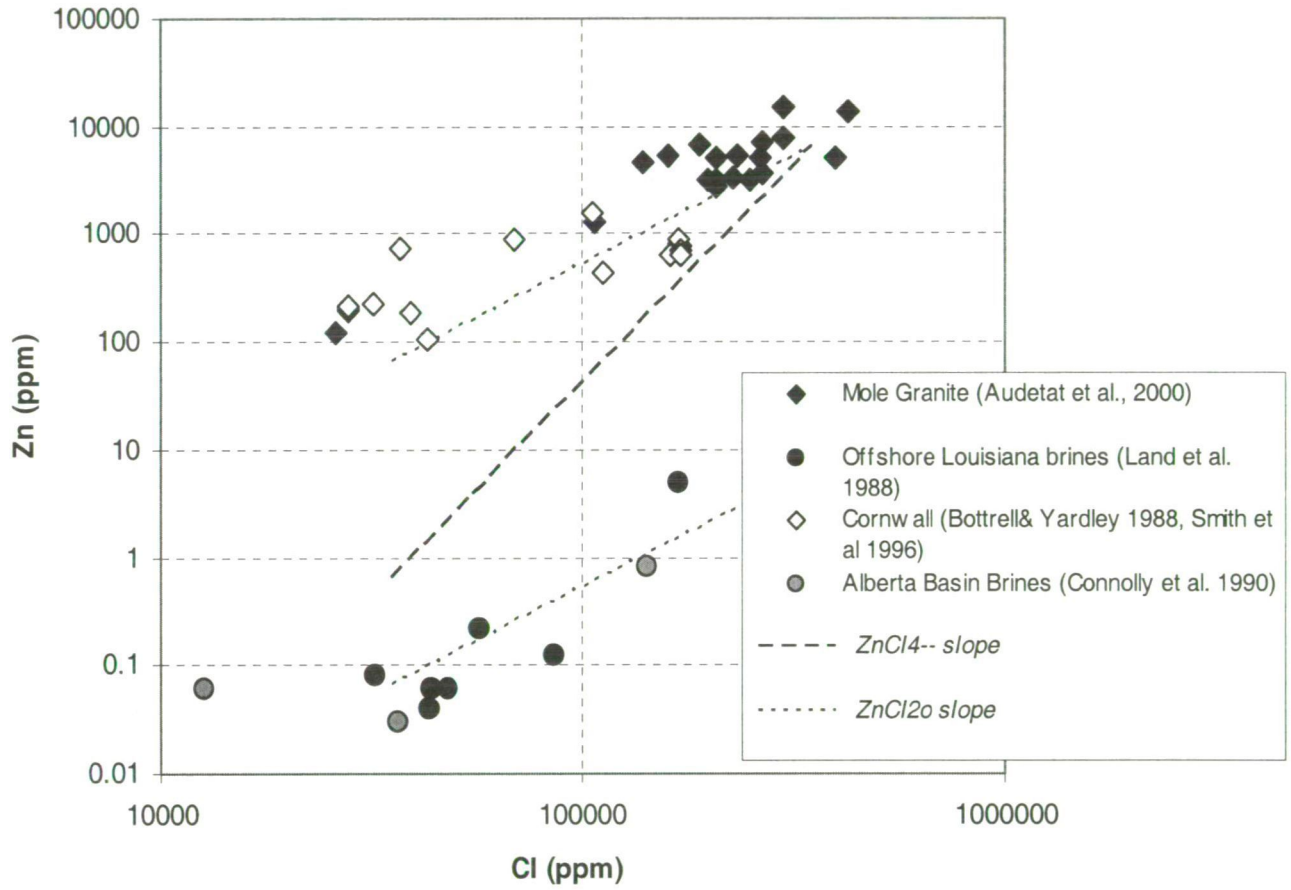

Figure 1: Relationship between Cl for fluids from 2 contrasting settings. Circles, oilfield brines, diamonds, magmatic fluid inclusions.

Transition metals vary in concentration systematically with temperature as well as salinity, and these trends also are continuous from low-T oilfields through metamorphic fluid inclusions, geothermal brines and magmatic fluid inclusions. (Figure 2).

We conclude from these results firstly that the analytical techniques applied to fluid inclusions today are sufficiently robust to yield reliable results at a useful level for interpretation. However the consistent trends over such a wide range of crustal conditions are themselves a remarkable demonstration of the relatively narrow range of chemical environments in the crust. Common rock assemblages must limit fO_2, pH and aH_2S within rather narrow limits for salinity and temperature to emerge as such dominant controls on metal levels in fluids.

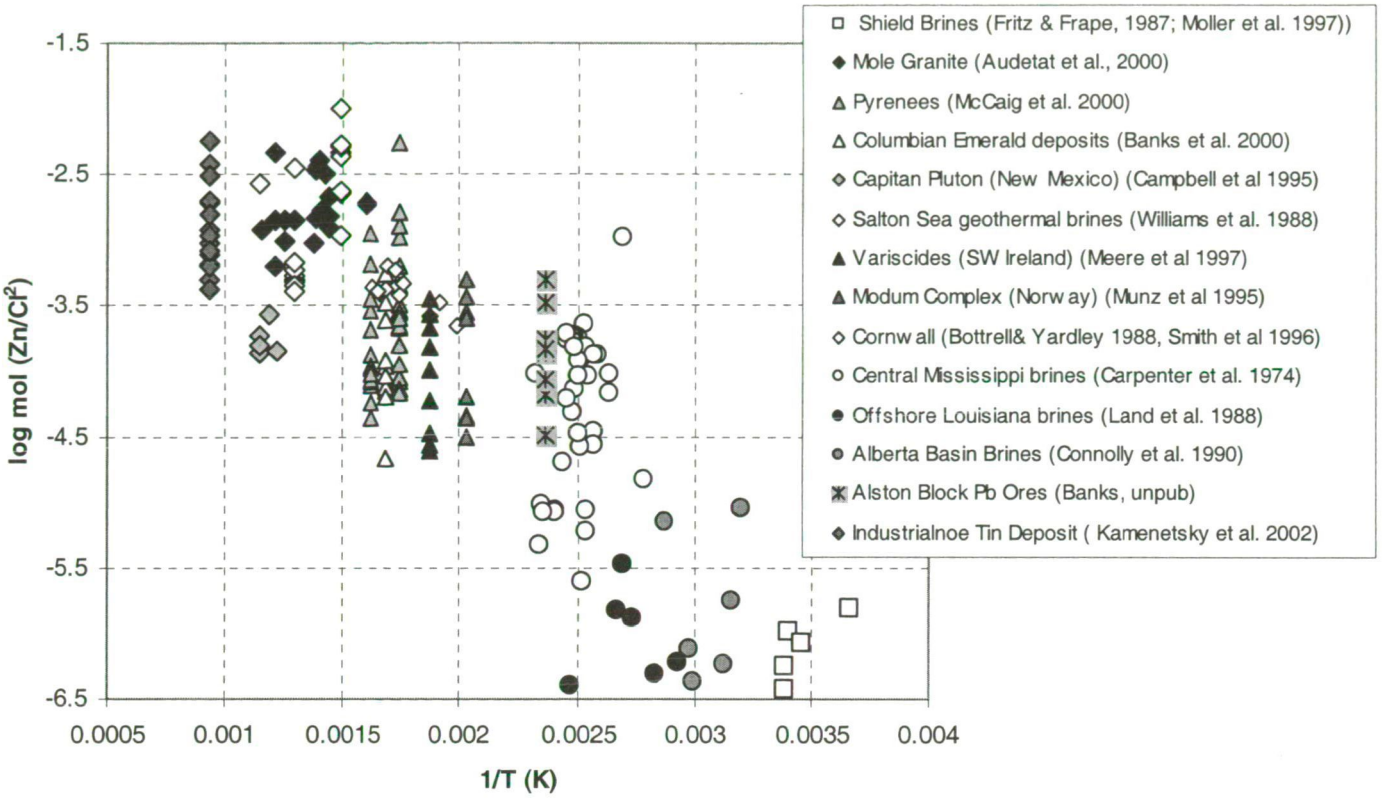

Figure 2: Relationship between Zn/Cl^2 of oilfield and geothermal brines, and fluid inclusions, plotted against measured or estimated temperature of the fluid (trapping T for inclusions). Squares - shield brines, circles – oilfield brines, triangles – metamorphic fluid inclusions, diamonds – magmatic fluid inclusions and geothermal brines

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