Experimentally derived distribution coefficients for the partitioning of Zn between brine and dolomite

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A significant portion of worldwide Zn production comes from sediment-hosted Zn deposits. Sedimentary brines are widely recognized as the principle precipitating fluids involved in the formation of these deposits. It has been hypothesized that the enrichment of Zn in these deposits is due to Zn enrichment of the ore forming brines. However, direct determination of ore fluid Zn via fluid inclusion analysis has been problematic due to the small volume of fluid inclusions, potential interference from Zn in the mineral matrix or from Zn bearing accidentals, i.e. minute mineral particles entrained in fluid inclusions during mineral precipitation.

An alternate method of determining ore fluid Zn concentration is provided by element partitioning theory. In element partitioning theory, at equilibrium the concentration of Zn in solid solution in a mineral is related to the concentration of Zn in the coeval fluid by a distribution coefficient. Dolomite is commonly ore-stage in sediment-hosted Zn deposits and is known readily to substitute Zn for Mg in its crystalline lattice. These properties make dolomite a strategic mineral for determining ore fluid Zn concentration using element partitioning theory. However to date, experimental distribution coefficients (*D*s) for the partitioning of Zn between dolomite and brine have not been published.

The goal of this study was to determine *D* values experimentally for the partitioning of Zn between dolomite and brine under conditions typical of sediment-hosted Zn deposit formation. To this end, suites of dolomite precipitation experiments were performed at temperatures of 125, 150, 175, and 200° C, pressures up to 10 MPa, initial aqueous Zn concentrations of 10, 100, and 1000 ppm, and experimental intervals of 10 to 80 days. X-ray diffraction analysis confirmed the precipitation of crystallographic dolomite. The elemental compositions of the dolomite precipitates were measured using LA-ICP-MS and the compositions of the coeval fluids were measured using ICP-AES or ICP-MS and IC. Following analysis, temperature specific *D* values were calculated from the Zn/Mg ratios measured in the dolomite precipitates and their coeval fluids. The calculations give an equilibrium *D* value of 75±10 at 200° C and indicate a trend of declining *D* values with decreasing temperature.