

HYDROTHERMAL GEOCHEMISTRY OF PT AND PD: RELATIVE ROLES OF CHLORIDE AND BISULFIDE COMPLEXES

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To obtain high concentrations of Pt and Pd as chloride complexes in aqueous fluids up to 300°C, high salinity, low pH and/or high oxygen fugacity is required. Solubilities greater than a few tenths of ppb Pt or Pd can only be obtained in the hematite stability field at temperatures up to 300°C and moderate pH. At low temperatures, under near-neutral and mildly reducing conditions, bisulfide complexes are calculated to result in orders of magnitude higher solubilities of Pt and Pd than chloride complexes. The maximum attainable solubilities of Pt and Pd as bisulfide complexes under geologically reasonable conditions are to tenths of ppb to tens of ppb. However, under the more severe and unusual conditions where chloride complexes predominate it is possible to obtain several tens of ppm or more.

Deposits of Pt and Pd formed under a sufficiently favorable combination of high temperature, high oxygen fugacity, high salinity and low pH to permit Pt-Pd transport as chloride complexes include porphyry Cu-Au, sediment-hosted stratiform (redbed) Cu-Co and unconformity-type U-Ni-Co-Au. Bisulfide complexation is likely to have been important in transporting Pt-Pd in lower temperature hydrothermal solutions buffered to relatively reducing conditions (by pyrite and/or pyrrhotite) and slightly acidic to neutral pH (by feldspar, chlorite, epidote, amphibole, etc.), irrespective of salinity. Such environments include seafloor hydrothermal vent fluids, black shales and Pt-Pd enrichments in ophiolites, as well as deposits such as the Messina ores in South Africa, the footwall ores at Sudbury, Ontario, and the mineralization in the Salt Chuck Intrusion, Alaska.