Trace and Minor Elements in Galena:

A Reconnaissance LA-ICP-MS study

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TRACE ELEMENTS IN GALENA

ABSTRACT

Many minor/trace elements can substitute into the crystal lattice of galena at various concentrations. *In-situ* LA-ICP-MS analysis and trace element mapping are used to obtain minor/trace element data from a range of natural galena specimens aiming to enhance understanding of the governing factors that control minor/trace element partitioning. The coupled substitution $Ag^{+} + (Bi, Sb)^{3+} \leftrightarrow 2Pb^{2+}$, is confirmed by data obtained, although when Bi and/or Sb are present at high concentrations (~> 0.002 mol.%), site vacancies most likely come into play through the additional substitution $2(Bi, Sb)^{3+} + \square \leftrightarrow 3Pb^{2+}$. Galena is the primary host of Tl in all mapped mineral assemblages. Thallium is likely incorporated into galena along with Cu through the coupled substitution: $(Ag, Cu, Tl)^{+} + (Bi, Sb)^{3+} \leftrightarrow 2Pb^{2+}$. Tin can reach significant concentrations in galena, particularly when the latter formed via metamorphic recrystallisation. Tin is concentrated in galena, likely via the substitution: $Sn^{4+} + \square \leftrightarrow 2Pb^{2+}$, involving the creation of lattice vacancies, or $Sn^{2+} \leftrightarrow Pb^{2+}$. Tin and In concentrations show a strong positive correlation across the sample suite indicating that the availability of these elements is intimately linked in natural systems. Cadmium and minor Hg can be incorporated into galena; the simple isovalent substitution $(Cd, Hg)^{2+} \leftrightarrow Pb^{2+}$ is inferred. Significant oscillatory compositional zoning, and lesser sector zoning of minor/trace elements (Ag, Sb, Bi, Se, Te) is confirmed, for the first time, in galena from two epithermal ores. Zoning is attributed to slow crystal growth into open spaces within the vein at relatively low temperatures. The datasets generated increase understanding of the nature and distribution of minor/trace elements in galena, and partitioning between galena and coexisting minerals. These data have several applications in the minerals industry, particularly in studies of mineral deposit genesis, ore processing and, potentially, also in mineral exploration.

KEYWORDS

Galena, trace elements, minor elements, Laser-ablation inductively coupled plasma mass spectrometry, compositional zoning, substitution mechanisms

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