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Polymetallic Au-Rich Melts in Hydrothermal Systems and Their Roles in Gold Enrichment

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Low-temperature polymetallic melts can scavenge gold from aqueous fluids and may be instrumental in the formation of some hydrothermal lode gold deposits. However, it is likely that metallic melts and their roles in gold enrichment have gone unrecognized in many gold deposits. This is due to the difficulty in recognizing textures that can be related to metallic melts and a lack of awareness that hydrothermal ore mineral assemblages can melt at low temperatures.

We present evidence for precipitation of Au-Ag-Te-rich melt directly from hydrothermal fluids and subsequent entrapment as melt inclusions in quartz veins of the Xiaoqinling lode gold district, central China. Au-Ag-Te-rich inclusions start to melt at a temperatures as low as 135°C, much lower than the eutectic of the Au-Ag-Te system at 304°C; native gold in contact with Au-Ag tellurides starts to melt at a temperature as low as 220°C. We also present textural evidence left by migration of melt inclusions, which can be used to distinguish previously trapped polymetallic melt inclusions from mineral inclusions.

We propose that Au-Ag-Te–rich melts formed through adsorption-reduction of metals on pyrite and quartz surface. Although quartz is often regarded as a chemically inert mineral, surface defect sites on quartz have a high capacity to reduce metals. We propose that polymetallic melt inclusions trapped early in the crystallization history of the host mineral could migrate to the crystal surface and enter into contact with aqueous fluids. The same effect can also be achieved by fracturing of the host mineral. In this way, relatively low volumes of polymetallic melts can continue to scavenge gold from the multiple pulses of ore fluids that are commonly involved in the formation of large gold deposits, without a requirement for the ore fluid to be saturated with the gold.