Mineral textures and fluid inclusion characteristics of ore samples from the Guanajuato district, Mexico

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Successful exploration for mineral deposits requires tools that the explorationist can use to distinguish between targets with high potential for mineralization and those with lower economic potential. In this study, we describe a technique based on petrographic and fluid inclusion characteristics that may be applied in exploration for precious metal deposits to identify areas of high-grade mineralization.

The Guanajuato mining district in Mexico is one of the largest silver producing districts in the world with continuous mining activity for nearly 500 years. Ore shoots in the district are localized along three major northwest trending vein systems, the La Luz, the Veta Madre and the Vetas de la Sierra. Mineralization in the district shows much variability between and within individual deposits, from precious metal-rich to more base-metal-rich zones, and from gold-rich to silver-rich zones. Ore textures also vary and include void space that formed during multiple fissuring events, banded quartz veins, massive quartz veins and stockworks. More than 1,400 samples representing all the different mineralization styles were collected from all three vein systems in the Guanajuato mining district, and the mineral textures and fluid inclusion characteristics of each sample have been defined. In addition, each sample was assayed for Au, Ag, Cu, Pb, Zn, As and Sb.

Selected mineralized samples from the central part of Veta Madre that contain up to 249 g/t of Au and 13,600 g/t Ag shows homogenization temperatures from 184 to 300 °C and salinities of 0 to 5 mass% NaCl. Barren samples show the same range in homogenization temperature but slightly lower salinities of 0 to 3 mass% NaCl. Fluid inclusions in the mineralized samples contain detectable Au and Ag, using laser ablation ICP-MS (Fig. 1).

Samples from the Guanajuato district show a wide range in silica textures. Some of these textures, including colloform texture, plumose texture and jigsaw texture, are indicative of rapid precipitation, such as occurs when fluids boil. Other mineral phases, including illite, rhombic adularia and bladed calcite are also indicative of rapid growth and are characteristic of boiling systems. Because boiling is an effective mechanism for precipitating gold and silver from hydrothermal fluids, the presence of mineral textures indicative of boiling is a desirable feature in exploration. In many samples, textural evidence for boiling is supported by coexisting liquid-rich and vapour-rich fluid inclusions, or Fluid Inclusion Assemblages consisting of only vapour-rich inclusions, suggesting “flashing” of the hydrothermal fluids. Textural and fluid inclusion evidence for boiling has been observed in the deepest levels of the Guanajuato mining district, suggesting that additional precious metal resources may occur beneath these levels.

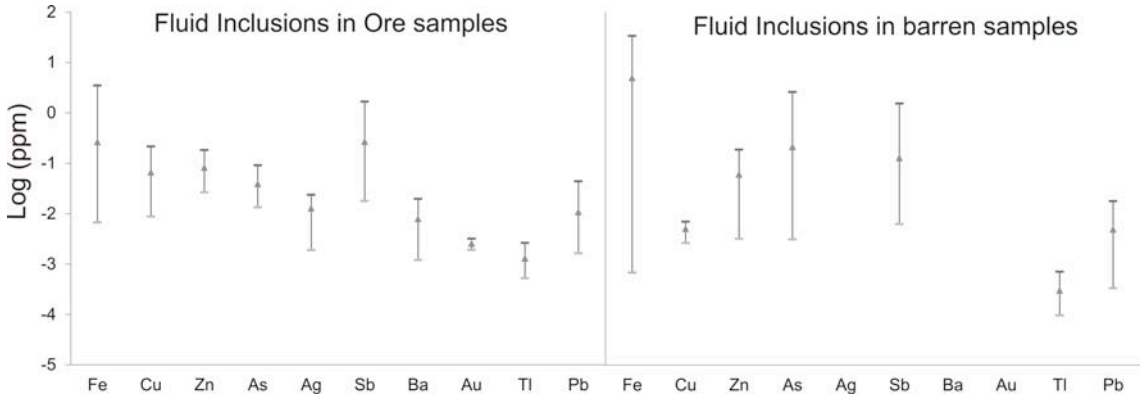

Fig. 1. Laser ablation ICPMS analysis of individual fluid inclusions assemblages in mineralized samples (left) showing the presence of Au and Ag. Inclusions from barren samples (right) do not show Au or Ag.