CHARACTERISTICS AND DISTRIBUTION OF MINERAL TEXTURES AND FLUID INCLUSIONS IN THE EPITHELIAL Ag-Au DEPOSITS AT GUANAJUATO, MEXICO

ABSTRACT: 1419

INTRODUCTION

Over the past three decades there have been numerous studies of the physical and chemical environment in both active terrestrial geothermal systems and their fossil equivalents, the epithermal precious metals deposits. It is now well known that metallogenesis in these deposits is generally related to boiling (Figure 1). Theoretical and experimental data indicates that boiling can be an effective mechanism to deposit gold in the epithermal environment. Gold can be deposited if the fluid pH increases or decreases, or if the oxygen fugacity increases or decreases (Figure 2). The goal of this study is to determine if there is a correlation between gold and silver grades and the presence and abundance of fluid inclusion and/or mineralogical/ textural characteristics of boiling in order to develop a simple technique that can be used to explore epithermal systems.

GEOLOGIC SETTING

The Guanajuato Mining District (GMD) is located at the southern end of the Sierra Madre Occidental Occenoe-Cuernavacan Ranges province and between the Sierra Madre Oriental and the Tlate-Mexico volcanic belt (Crawford et al., 1982) (Figure 3). The GMD is part of a northward trending belt of all-lead-rich deposits that parallels the eastern flanks of the Sierra Madre Occidental (Randal et al., 1994). Aranda-Gómez et al. (2003) divide the rocks in this area into a "basal complex" and a "cover complex." The basal complex consists of metamorphosed marine sediments of Messinian to early Tertiary age, while the Cenozoic cover rocks are composed of continental sediments and subvolcanic volcanic rocks. The Cenozoic volcanism has been divided into seven episodes (Aranda-Gómez et al., 2003), ranging in age from 11 Ma to 0 Ma. Foliation to intermediate volcanism that occurred from 27 to 21 Ma produced the rock units and structures that host the mineral deposits (Goldschmidt et al., 2003).

PLAN VIEW OF VISTA MADRE AND SURFACE SAMPLE LOCATIONS

A total of 855 samples were collected along a 4 km strike length of the Vista Madre from both surface outcrops and underground locations, including drill core (Figure 4). The accessibility of underground workings in the San Vicente, Catarina, and Potosi Mines, three of the Guanajuato Mines, allowed for the collection of three dimensional geologic controls. The northern part of Valenciana Mine was not accessible because this area was flooded and access was prohibited. Collection of samples of surface outcrops and underground samples on that contained transparent minerals that could be examined for fluid inclusions, especially quartz and calcite. The best samples were outcrop samples in the "basal complex" that extend toward the center of the vein and a "thick" section approximately 75 mm thick was prepared. One half of each sample was assayed for gold (Au), silver (Ag), copper (Cu), lead (Pb), zinc (Zn), arsenic (As) and antimony (Sb).

PETROGRAPHY

Samples were examined using a petrographic microscope to identify the minerals and to classify the textures of quartz and calcite (Figure 5 and 6) (every sample contained quartz and about one quarter also contained calcite). Next, the sample was examined systematically to identify fluid inclusion assemblages (FIA) and the type of fluid inclusions in each FIA were noted. An FIA represents a group of fluid inclusions that were all trapped at the same time (Goldshmidt and Blackburn, 1994; Bodnar, 2003). FIA’s could be composed of two or more inclusions trapped during precipitation of the fluid phase, or may contain secondary inclusions that are trapped along fractures in the host phase at some time after the fluid phase has formed. FIA’s in samples from the Vista Madre were further classified as containing either no, few, or many liquid-rich inclusions with consistent liquid-vapor ratios, or containing coexisting liquid-rich and vapor-rich inclusions with a broad range is liquid-vapor ratios (Figure 7).

APPLICATION IN EXPLORATION FOR EPITHELIAL PRECIOUS METAL DEPOSITS

Boiling features are absent or rare in samples collected along a traverse perpendicular to the Vista Madre (Figure 10). This suggests that if an explorationist observes these features in samples collected during exploration that an environment favorable to precious metal mineralization is nearby. Similarly, good evidence for boiling is observed in the deepest levels of the Vista Madre that have been sampled in the mines and drill cores, suggesting that abundant precious metal reserves are likely beneath the deepest levels (Figure 11).

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REFERENCE


