Fire Assaying of Telluride Ores

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Problems Associated with Telluride Ores - This technical note provides information on the problems experienced during telluride-ore assays and explains how routine procedures can be developed that are suited to telluride ores.

Sampling

The majority of telluride ores (which are mined) contain less than 0.1% telluride; while the mineral itself contains as much as 40% gold. Thus, telluride ores can be heterogeneous and may require a fine sample grind to provide a representative sample for subsequent assay. Therefore, all assay splits should be pulverized to at least 80% passing 150 mesh prior to Fire Assay.

Figure 1, pouring crucibles during Fire Assay

Fusion Process

During the fusion process, tellurium is oxidized to TeO and reports to the slag phase via the following reaction:

$$2\ PbO\ (litharge) + Te = Pb_2O + TeO$$ [1]

It is extremely important that the tellurium is completely oxidized and transferred to the slag during the fusion step. A high tellurium concentration during cupellation results in gold losses. To maximize the degree of oxidation, 25% excess litharge should be added to every fusion (regardless of sample type). This additional requirement adds to operating costs but ensures quality assay results for tellurides and other problem causing ores such as base-metal sulfides.

Cupellation

In the event that complete oxidation is not achieved during the fusion, the product button will consist of a Pb-Te-Au-Ag alloy (silver due to the addition of an "inquart" weighing approximately 4 milligrams). Significant levels of tellurium in the button during cupellation decreases the alloy's surface tension. The resulting molten metal "wets" the surface of the cupel, causing gold absorption by the cupel and/or poor coalescence of the doré bead. Bugbee[1] states that this is the primary mechanism for gold losses and that losses by volatilization are rare. He further states that the "wetting" problem may be minimized by ensuring that the lead/tellurium ratio in the button is greater than 80, and by utilizing magnesia cupels.

Therefore, every cupellation should be performed in a magnesia cupel, and the average lead-button weight (before cupellation) should be 30 grams. By applying Bugbee's lead/tellurium ratio of 80 and assuming the worst case (i.e. no tellurium is oxidized during the fusion), a tellurium value of 2% or greater in the sample would have to exist to create a "wetting" problem. Since most economic telluride occurrences are at less than 0.1% (except for telluride concentrates), difficulties are seldom noticed with the fire assaying of telluride ores.

In the event that significant tellurium levels are present during cupellation, fire assayers should be trained to "read the signs" of tellurium interference. The "wetting" problem is easily identified by the shape of the molten lead surface. In a normal cupellation, the high surface tension associated with the lead alloy produces a convex surface. If significant tellurium is present, the surface tension of the alloy is reduced and the bead will be concave. Tellurium also produces a pinkish color on the cupel surface that fades upon cooling, and doré beads that contain tellurium have a frosted appearance. -T. Albert

Figure 2, unloading the Fire Assay furnace

1 Bugbee, Edward E., "*A Textbook of Fire Assaying*", Colorado School of Mines Press, Golden, CO, pg. 119, 201-204, (1940).

Other References:

Smith, Sydney W., "*The Behavior of Tellurium in Assaying*", Trans I.M.M. 17, pg. 463.

Holloway, G.T. and Pease, L.E.B., "*The Assay of Telluride Ores*", Trans. I.M. M. 17, pg. 175.