IDENTIFICATION OF THE COMMONER TELLURIDES

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Introduction

This paper is based on a study of one hundred polished sections from the La Plata, Colorado mining district, twenty-five sections from the Eastern Ontario gold area, and twelve sections from Cripple Creek, Colorado. The writer wishes to express his thanks to Mr. E. B. Eckel of the U. S. Geological Survey for the use of the La Plata collection, to Mr. R. D. Hoffman, Mining Geologist, New York City, for the specimens from Cripple Creek, and to the managements of the Lake Shore, Toburn, Wright-Hargreaves, Macassa and Dome mines for the specimens from those properties. The writer is especially indebted to Dr. M. N. Short of the University of Arizona for helpful criticism and permission to use the data which appears in his "Microscopic Determination of the Ore Minerals," *U. S. Geological Survey, Bulletin 825*, 1931.

Identification of the Tellurides

Considerable difficulty attends the identification of the tellurides. In hand specimens the bright silvery-white color is exhibited by a number of other minerals, and the relatively small amount of material present, in even high grade ore, is usually insufficient for satisfactory physical, blowpipe, and ordinary wet chemical tests. The simplest test is the cherry-red color imparted to hot concentrated sulphuric acid by a fragment of a telluride mineral, but the writer has found that with very small amounts of material this test is not always reliable.

The most satisfactory method of identification of the tellurides is by means of chemical and etch tests on polished sections of ores under the reflecting microscope. The technique and application of this method are fully described by Short.[1] In his systematic scheme of identification the unknown is first treated with standard etch reagents, which closely determine the position of the unknown in the determinative tables. Microchemical analysis is then used when necessary to confirm the identity of the mineral.

It has been the writer's experience that etch tests on tellurides are not particularly reliable, due probably to the fact that it is rarely possible to place a drop of reagent within the area occupied by a single telluride mineral. It seems better therefore, when working with ores known to con-

[1] Short, M. N., Microscopic Determination of the Ore Minerals: *U. S. Geol. Survey, Bull.* **825** (1931).

tain tellurides, to first make the microchemical tests for tellurium on a likely unknown, which may be followed by additional microchemical or etch tests. In any case confirmatory microchemical tests should be made to insure positive identification.

Additional difficulty is encountered in the case of tellurides containing both gold and silver. Sylvanite, calaverite and krennerite are so nearly identical in composition that on many specimens the usual etch and microchemical tests described in *Bulletin 825* will not differentiate between them. Identification can be accomplished by the application of concentrated HNO_3 with subsequent development of characteristic etch cleavage as described by Short.[2] The writer has found that the reaction of concentrated nitric on other tellurides than those above is highly characteristic and materially aids in their identification.

Description of the Tellurides

A compilation of the distinguishing characteristics of the commoner tellurides follows.

Altaite—PbTe

Color, galena white; hardness B; nearly sectile. Isotropic, but some specimens exhibit weak anomalous anisotropism Cubical cleavage is prominent in most specimens, as exhibited by two sets of cleavage cracks at right angles, but does not show triangular pits like galena.

HNO_3 (1:1)	—Effervesces vigorously and stains dark gray.
HCl	—Some specimens effervesce vigorously and turn black, others tarnish iridescent, still others are negative.
KCN	—Negative.
$FeCl_3$	—Quickly stains iridescent.
KOH	—Negative.
$HgCl_2$	—Negative.
HNO_3 (Conc.)	Stains iridescent.

Altaite gives strong microchemical tests for lead with potassium iodide, and for tellurium with cesium chloride.

Calaverite—(Au, Ag) Te_2

Color, light yellow to pinkish-white; hardness C. Strongly anisotropic, polarization colors are light gray, brown, dark gray. Some specimens show multiple twinning.

HNO_3 (1:1)	—Effervesces faintly, surface stains either creamy-brown or iridescent, then black. After acid is washed off a shingly etch cleavage, usually with little or no parallelism, appears.
HCl	—Negative.
KCN	—Negative.
$FeCl_3$	—Most specimens are negative, some stain a light brown.
KOH	—Negative.
$HgCl_2$	—Negative.
HNO_3 (Conc.)	Stains creamy-brown. After acid is washed off a parallel etch cleavage appears in one direction only.

[2] Short, M. N., Etch tests on calaverite, krennerite and sylvanite: *Am. Mineral.*, **22**, 667–674 (1937).

Calaverite gives a good microchemical test for silver with potassium mercuric thiocyanate, but the reaction with potassium bichromate may be negative. It gives strong tests for gold with pyridine-HBr solution and for tellurium with cesium chloride.

Coloradoite—HgTe

Color, light pinkish gray; hardness C, appears sectile in small grains. Isotropic.

HNO_3 (1:1)	—Most areas negative, some slowly stain light brown to iridescent.
HCl	—Most specimens negative, others slowly stain dark gray to black.
KCN	—Negative.
$FeCl_3$	—Stains differentially, iridescent.
KOH	—Negative.
$HgCl_2$	—Negative.
HNO_3 (Conc.)	Some specimens stain iridescent, others negative.

Coloradoite gives strong microchemical tests for mercury with cobalt nitrate and potassium thiocyanate, and for tellurium with cesium chloride. The mineral must be taken into solution with fresh aqua regia and the microchemical test for mercury should be run on a known mineral until the technique of this test is perfected.

Hessite—Ag_2Te

Color, light gray; hardness A; nearly sectile. Most specimens are strongly anisotropic and show multiple twinning; polarization colors white, steel-blue, bornite-pink. The writer has never seen a specimen of isotropic hessite and the isometric character is open to question.

HNO_3 (1:1)	—Most specimens stain quickly black without effervescence, some stain lightly iridescent.
HCl	—Slowly stains black, some areas are negative.
KCN	—Some specimens slowly stain black; action usually requires more than one minute and on some specimens is negative.
$FeCl_3$	—Quickly stains iridescent.
KOH	—Negative.
$HgCl_2$	—Stains brown to iridescent.
HNO_3 (Conc.)	—Stains dark gray.

Hessite gives strong microchemical tests for silver both with potassium mercuric thiocyanate and potassium bichromate, and for tellurium with cesium chloride. The mineral closely resembles argentite in polished section, but as it is not completely sectile will yield a powder upon scratching, whereas argentite yields only metallic shavings.

Krennerite—(Au, Ag)Te_2

Color, creamy white; hardness C. Strongly anisotropic, polarization colors light gray, yellow, brown. Some grains show multiple twinning.

HNO_3 (1:1)	—Effervesces weakly to strongly and stains creamy-brown to dark brown. When acid is washed off a shingly etch cleavage, usually with little or no parallelism, may appear. Some areas give a good etch cleavage in two directions.
HCl	—Negative.
KCN	—Negative.
$FeCl_3$	—Stains light yellow.
KOH	—Negative.
$HgCl_2$	—Negative.
HNO_3 (Conc.)	Stains creamy-brown. When acid is washed off a parallel etch cleavage appears in two directions at right angles to one another, giving a brick-like pattern.

Krennerite gives a good microchemical test for silver with concentrated NH_4OH, but the reaction with potassium bichromate may be negative. It gives strong tests for gold with pyridine-HBr solution and for tellurium with cesium chloride.

Petzite—$(Ag, Au)_2Te$

Color, galena white; hardness A; nearly sectile. Isotropic.

HNO_3 (1:1)	—Quickly stains iridescent to dark gray, usually without, but on some specimens with faint effervescence.
HCl	—Some specimens stain iridescent, others negative.
KCN	—Some specimens negative, some slowly stain light brown.
$FeCl_3$	—Quickly stains brown.
KOH	—Negative.
$HgCl_2$	—Slowly stains brown.
HNO_3 (Conc.)	Stains dark brownish-bronze. After drop is washed off, an irregular shingly etch cleavage without parallelism appears on most specimens.

Petzite gives a strong microchemical test for silver with potassium mercuric thiocyanate; with potassium bichromate the test may fail, but with care can usually be obtained. It gives strong tests for gold with pyridine-HBr solution and for tellurium with cesium chloride. Although nearly sectile, like hessite, it is much lighter in color and may exhibit less perfect cubical cleavage and triangular pits than galena. It is a much rarer mineral than hessite.

Sylvanite—$(Au, Ag)Te_2$

Color, silvery-white to creamy-white, lighter than calaverite; hardness C. Strongly anisotropic, with multiple twinning; polarization colors light gray, brownish-gray, dark gray.

HNO_3 (1:1)	—Stains iridescent. Some specimens effervesce faintly, others do not. A parallel etch cleavage in one direction only appears before the acid is washed off.
HCl	—Negative.
KCN	—Negative.
$FeCl_3$	—Most areas negative, some stain light yellow.
KOH	—Negative.
$HgCl_2$	—Negative.
HNO_3 (Conc.)	A parallel etch cleavage in one direction only appears before the acid is removed.

Sylvanite gives a good microchemical test for silver with potassium mercuric thiocyanate, but the test with potassium bichromate may be negative. It gives a strong test for gold with pyridine-HBr solution and for tellurium with cesium chloride.

Tellurium—Te

Color, silvery-white, somewhat lighter than krennerite and calaverite, distinctly lighter than hessite; hardness B. Strongly anisotropic, polarization colors light to dark gray.

HNO_3 (1:1)	—Stains black with vigorous effervescence.
HCl	—Fumes tarnish some areas, others negative.
KCN	—Negative.
$FeCl_3$	—Slowly stains light brown or yellow. Action weak and on some specimens practically negative.
KOH	—Negative.
$HgCl_2$	—Some specimens stain light brown, others negative.
HNO_3 (Conc.)	Stains light brown to iridescent.