CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
3550 N. Central Ave, 2nd floor
Phoenix, AZ, 85012
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

The following file is part of the John E. Kinnison mining collection

ACCESS STATEMENT

These digitized collections are accessible for purposes of education and research. We have indicated what we know about copyright and rights of privacy, publicity, or trademark. Due to the nature of archival collections, we are not always able to identify this information. We are eager to hear from any rights owners, so that we may obtain accurate information. Upon request, we will remove material from public view while we address a rights issue.

CONSTRAINTS STATEMENT

The Arizona Geological Survey does not claim to control all rights for all materials in its collection. These rights include, but are not limited to: copyright, privacy rights, and cultural protection rights. The User hereby assumes all responsibility for obtaining any rights to use the material in excess of "fair use."

The Survey makes no intellectual property claims to the products created by individual authors in the manuscript collections, except when the author deeded those rights to the Survey or when those authors were employed by the State of Arizona and created intellectual products as a function of their official duties. The Survey does maintain property rights to the physical and digital representations of the works.

QUALITY STATEMENT

The Arizona Geological Survey is not responsible for the accuracy of the records, information, or opinions that may be contained in the files. The Survey collects, catalogs, and archives data on mineral properties regardless of its views of the veracity or accuracy of those data.

UNIVERSITY OF ARIZONA

Report Cover

Subject Solubility of the sulfide minerals, including selenides, tellurides, antimonids & arsenides

Name

Class

Date May 1953

University of Arizona - Bookstore
(TUCSON)

SOLUBILITY OF THE SULFIDE MINERALS

Including selenides, tellurides, antimonides and arsenides

By

R. E. Geer

and

J. E. Kinnison

Tucson, Arizona
May 1, 1953

SOLUBILITY OF THE SULFIDE MINERALS

Including selenides, tellurides, antimonides and arsenides

EXPLANATION OF TABLES

The following tables show the solubility of sulfide and related minerals in hydrochloric and nitric acid. Other solvents are listed in the column labeled "OTHERS". Any residue or precipitate, left after the reaction of the mineral with the solvent, is recorded in the "PPT" column immediately following the related acid. Any additional data are recorded in the "REMARKS" column. All data has been compiled directly from the cited bibliography, with no speculation by the writers. In instances where datum is unavailable, some fair conclusions may possibly be drawn by comparison with minerals of similar chemical composition.

The minerals are divided into types and groups, and listed in accordance with the system used in the seventh edition, volumn I, of Dana's system of minerology.

ABBREVIATIONS

Aq Reg	Aqua regia
Conc	Concentrated
Dcmp	Decomposed
Dil	Dilute
Ins	Insoluble
PPT	Precipitate
Prt	Partly
Sl	Slightly
Sol	Soluble
↓	Precipitate
↑	Gas

BIBLIOGRAPHY

Brush, G. J., and Penfield, S. L., 1898, Manuel of determinative minerology, sixteenth edition: John Wiley and Sons, Inc., 312pp.

Comey, A. S., and Hahn, D. A., 1921, A dictionary of chemical solubilities--Inorganic, second edition: The Macmillan Co., 1141pp.

Hodgman, C. D., Coolbaugh, M. F., and Senseman, C. E., 1918, Handbook of chemistry and physics, seventh edition: The Chemical Rubber Co., 553pp.

Palache, C., Berman, H., and Clifford, F., 1944, Dana's System of minerology, Vol I, seventh edition: John Wiley and Sons, Inc., 834pp.

Segerblom, W., 1927, Properties of inorganic substances: The Chemical Catalog Co., 226pp.

Smith, O. C., 1946, Identification and qualitative analysis of minerals: D. Van Nostrand Co., Inc., 351pp.

TYPE	GROUP	MINERAL	FORMULA	HCl	PPT	HNO_3	PPT	OTHERS	REMARKS
$Am\ X_n$; m:n > 3:1	Tetradymite	Tellurobismuthite	Bi_2Te_3			Sol			
		Tetradymite	Bi_2Te_2S			Sol	S		
		Gruenlingite	Bi_4TeS_3						
		Joseite	Bi_3TeS			Sol	S		
		Wehrlite	Bi_3Te_2 (?)						
		Nagyagite	$Pb_5Au(Te,Sb)_4S_{5-8}$ (?)			Sol	Au	Sol Ag Reg - S↓ ; sometimes AgCl↓	
	Copper Arsenide	Algodonite	Cu_6As			Sol			
		Domeykite	Cu_3As	Ins		Sol			
		Horsfordite	Cu_5Sb						
		Cocinerite	Cu_4AgS						
A_3X		Dyscrasite	Ag_3Sb	Ins		Sol			
		Stibiopalladinite	Pd_3Sb					Sol Ag Reg	
A_2X	Argentite	Argentite	Ag_2S			Sol Conc	S	Sl Sol KCN ; Sol citric acid + KNO_3	
		Aguilarite	$Ag_2(Se,S)$						
		Naumannite	Ag_2Se			Ins dil Sol Conc			
		Digenite	$Cu_{2-x}S$			Sol			
		Berzelianite	Cu_2S	Prt Sol		Dcmp		Sol NH_4OH ; Sol KCN ; Prt Sol H_2SO_4	
		Crookesite	$(Cu,Tl,Ag)_2Se$			Sol			
		Eucairite	$CuAgSe$			Dcmp			
		Hessite	Ag_2Te			Sol			
		Petzite	Ag_3AuTe_2			Dcmp	Au		
	Chalcocite	Chalcocite	Cu_2S			Sol	S		Green sol in HNO_3 NO_2↑
		Stromeyerite	$AgCuS$			Sol	S		
		Acanthite	Ag_2S			sol Conc		Sl Sol KCN	
A_3X_2		Maucherite	$Ni_{11}As_8$	Prt Sol		Sol Conc			
		Umangite	Cu_3Se_2			Sol			
		Bornite	Cu_5FeS_4	Sol.	S	Sol	S		
A_4X_3		Dimorphite	As_4S_3			Sol			
		Rickardite	Cu_4Te_3			Sol			
		Weissite	Cu_5Te_3						
AX	Galena	Galena	PbS	Sol Conc Prt or completly	PbCl	Dcmp Conc	S, $PbSO_4$		H_2S↑ in HCl
		Clausthalite	PbSe			Sol Cold	Se on warming		
		Altaite	PbTe			Sol	"		
		Alabandite	MnS	Sol Prt or completly				Sl Sol alcohol	H_2S↑ in HCl
		Oldhamite	CaS	Sol	S				H_2S↑ Dcmp by boiling water
		Sphalerite	ZnS	Sol				Sl Sol alcohol	H_2S↑ in HCl
		Metacinnabar	(Hg,Fe,Zn)S						
		Tiemannite	HgSe	Ins		Ins		Sol Ag Reg	
		Coloradoite	HgTe			Sol	H_2TeO_3		
		Chalcopyrite	$Cu_2Fe_2S_4$	Ins		Dcmp	S		Green sol in HNO_3

TYPE	GROUP	MINERAL	FORMULA	HCl	PPT	HNO_3	PPT	OTHERS	REMARKS
AX (cont.)		Coloradoite	$HgTe$			Sol	H_2TeO_3		
		Chalcopyrite	$CuFeS_2$	Ins		Dcmp	S		Green sol in HNO_3
		Stannite	Cu_2FeSnS_4			Dcmp	S		
		Wurtzite	ZnS	Sol				Sl Sol alcohol	$H_2S\uparrow$ in HCl
		Greenockite	CdS	Sol		Sol	$Cd(NO_3)_2$, S	Sol H_2SO_4	$NO\uparrow$ in HNO_3, H_2S in HCl
		Voltzite	ZnS_4O	Dcmp					$H_2S\uparrow$ in HCl
		Pyrrhotite	$Fe_{1-x}S$	Dcmp	S	Sol	S		$H_2S\uparrow$ in HCl
	Niccolite	Valleriite	$Cu_2Fe_4S_7$ (?)						
		Niccolite	$NiAs$			Sol Conc	As_2O_3		
		Breithauptite	$NiSb$	Ins		Ins		Sol Aq Reg	
		Millerite	NiS	Ins		Sol			Dcmp by hot water; Beyrichite, apparently the same composition, is Sol in HCl
		Pentlandite	$(Fe,Ni)_9S_8$			Sol			Green sol in HNO_3
		Cubanite	$CuFe_2S_3$			Dcmp	S		
		Sternbergite	$AgFe_2S_3$					Sol Aq Reg - S↓ AgCl↓	
	Covellite	Covellite	CuS	Difficultly Sol Conc		Sol	S	Sol KCN	Green sol in HNO_3
		Klockmannite	$CuSe$	Prt Sol		Dcmp		Prt sol H_2SO_4; Sol NH_4OH	Data not based on natural mineral
		Cinnabar	HgS	Ins		Sol		Sol Na_2S, Sol K_2S, Sol Aq Reg	
		Realgar	AsS	Ins		Sol	S	Sol Caustic alkalies; Sol K_2S; Sol $NAHCO_3$; Dcmp Aq Reg	
		Cooperite	PtS	Ins		Ins		Sol $(NH_4)_2S_x$; Ins Aq Reg	
		Braggite	$(Pt,Pd,Ni)S$						PdS Sol HCl
		Herzenbergite	SnS	Sol conc				Sol $(NH_4)_2S_x$	
		Empressite	$AgTe$			Sol			
		Muthmannite	$(Ag,Au)Te$			Sol	Au		
A_3X_4	Linnaeite series	Linnaeite	Co_3S_4	Ins or Prt Sol		Dcmp	S		
		Siegenite	$(Co,Ni)_3S_4$	Ins		Dcmp	S		
		Carrollite	Co_2CuS_4	Ins		Dcmp	S		
		Violarite	Ni_2FeS_4	Ins		Dcmp	S		
		Polydymite	Ni_3S_4	Ins		Dcmp	S		
		Daubreelite	Cr_2FeS_4	Ins		Sol	None		
		Bodenite	$(Co,Ni,Fe)_3(As,Bi)_4$ (?)			Sol			
A_2X_3		Orpiment	As_2S_3	Ins		Sol	S	Sol Caustic alkalies; Sol Aq Reg	
	Stibnite	Stibnite	Sb_2S_3	Sol when pure		Dcmp	Sb_2O_3 (white) on dilution	Sol alcohol; Sol NH_4HS; Sol K_2S; Sol citric acid	Yellow tarnish with KOH
		Bismuthinite	Bi_2S_3	Sol		Readily Sol	White basic salt on dilution		
		Guanajuatite	Bi_2Se_3	Slowly Sol		Oxidized			
		Kermesite	Sb_2S_2O	Sol					
AX_2	Pyrite	Pyrite	FeS_2	Ins		Sol Conc	S		
		Bravoite	$(Ni,Fe)S_2$						
		Laurite	RuS_2					Ins aq Reg; Ins potassium disulfate	
		Sperrylite	$PtAs_2$					Slightly attacked by Aq Reg	
		Haverite	MnS_2	Sol Conc	S				$H_2S\uparrow$ in HCl

TYPE	GROUP	MINERAL	FORMULA	HCl	PPT	HNO_3	PPT	OTHERS	REMARKS
AX_2 (Cont)	Pyrite (cont.)	Sperrylite	$PtAs_2$					Slightly attacked by Ag Reg	
		Haverite	MnS_2	Sol Conc	S				$H_2S\uparrow$ in HCl
		Penroseite	$(Ni,Cu,Pb)Se_2$			Sol			Effervescence in HNO_3
	Cobaltite	Cobaltite	CoAsS			Sol	As_2O_3, S		Arsenic odor in HNO_3
		Gersdorffite	NiAsS			Dcmp	As_2O_3, S		
		Ullmannite	NiSbS			Dcmp		Sol Aq Reg - S↓	
	Loellingite	Loellingite	$FeAs_2$			Sol	As_2O_3		
		Safflorite	$(Co,Fe)As_2$			Sol			
		Rammelsbergite	$NiAs_2$			Sol			
		Pararammelsbergite	$NiAs_2$			Sol			
		Marcasite	FeS	Ins		Sol conc	S		More easily sol than Pyrite
	Arseno-pyrite	Arsenopyrite	FeAsS			Dcmp	S		
		Glaucodot	$(Co,Fe)AsS$			Dcmp	S		Pink Sol in HNO_3; Completly sol when Fe-free
		Gudmundite	FeSbS						
		Wolfachite	$Ni(As,Sb)S$ (?)			Dcmp	see Remarks		In HNO_3 a separation of S and antimony and Arsenic oxides
		Lautite	CuAsS			Sol			
	Molybdenite	Molybdenite	MoS_2			Dcmp	MoO_3 (white)	Sol Aq Reg	
		Tungstenite	WS_2	Ins		Ins		Sol Aq Reg	
	Krennerite	Krennerite	$AuTe_2$						
		Calaverite	$AuTe_2$					Dcmp Aq Reg - ± AgCl↓ ; Sol Conc H_2SO_4 - Au↓ - red sol	
		Sylvanite	$(Ag,Au)Te_2$			Sol	Au	Sol Aq Reg - AuCl↓	
		Melonite	$NiTe_2$			Sol			
		Parkerite	Ni_3S_2			Sol			Effervesence in HNO_3
AX_3	Skutterudite	Skutterudite	$(Co,Ni)As_3$			Sol	As_2O_3		
		Smaltite	$(Co,Ni)As_{3-x}$			Sol			
		Nickel-Skutterudite	$(Ni,Co)As_3$						
		Chloanthite	$(Ni,Co)As_{3-x}$			Sol (?)			
		Niggliite	$PtTe_3$						PtTe & $PtTe_2$ slowly sol conc HNO_3