GALLIUM AND GERMANIUM POTENTIAL IN ALASKA

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UNITED STATES DEPARTMENT OF THE INTERIOR

Donald P. Hodel, Secretary

BUREAU OF MINES

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

ppm	Parts per million
%	Percent

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ABSTRACT

The U.S. Bureau of Mines is currently conducting a mineral study of the gallium and germanium potential in Alaska as part of the critical and strategic minerals program. Gallium and germanium are produced as by-products from the processing of some aluminum, zinc, coal, phosphate, and copper ores. Through literature research and geochemical analyses of selected mineral samples twenty-two mineral properties were identified as having high (>50 ppm gallium and/or >10 ppm germanium) gallium or germanium concentrations. The potential for gallium and/or germanium in Alaska is currently unknown because of insufficient data. This study indicates that the most likely potential sources of gallium and germanium are from Alaska's large massive sulfide and coal deposits, but more sampling of all possible sources is needed.

INTRODUCTION

The Bureau of Mines (Bureau) is evaluating occurrences of critical and strategic minerals in Alaska as part of the minerals studies mandated under the Alaska National Interest Lands Conservation Act (ANILCA)(Public Law 96-487). The objective of this program is to locate deposits that could be mined should a prolonged national

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shortage develop. This report summarizesthe available information on gallium and germanium deposits as a basis for future field and laboratory research.

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BUREAU OF MINES INVESTIGATION

Research into the sources of gallium and germanium started in 1983 with a literature search of U.S. Geological Survey, Bureau, and State of Alaska publications. The literature search revealed that most of the mineral deposits in Alaska do not have published gallium and germanium values; therefore, analyses of selected mineral samples from a small number of Alaskan mineral deposits were made. Gallium and germanium are predominantly recovered from ore concentrates; therefore, most of the analyses were restricted to select mineral specimens and concentrates. Semi-quantitative emission spectrographic analyses

were made by Skyline Labs, Inc. of Wheat Ridge, Colorado. The detection limits are 10 ppm for gallium and 20 ppm for germanium.

RESULTS

Gallium and germanium are widely dispersed trace elements in the earth's crust with an average crustal abundance of 15 ppm for gallium and 1.5 ppm for germanium. However, gallium and germanium sources have not previously been identified in Alaska and analyses are rare in the literature.

Gallium

Gallium has an affinity for aluminum and sulfur. Gallium occurs in only two known mineral phases: gallite ($CuGaS_2$) and soehngerite ($GaOH_3$), which have only been found in Africa. Gallium is economically recoverable during the processing of some aluminum (bauxite, kaolin), zinc (sphalerite), coal (coal ash), phosphate and phosphate flue dust, and copper ores. The recoverable gallium concentrations are listed on table 1.

Eighteen Alaskan mineral deposits were identified as possible sources of gallium during this investigation (fig. 1). Gallium concentrations from less than 10 to 70 ppm were noted in sphalerite samples from the Hannum (8) [2/], Dickey, Whoopee Creek, and Red Dog prospects (table 2).

2/Underlined numbers in parentheses refer to references listed at the end of this report.

TABLE 1. - Recoverable Gallium and Germanium Concentrations in Ore Deposits

Ore	Concentrations in ppm	
	Gallium	Germanium
Aluminum:		
Bauxite	Average 50	ND
Kaolin	10 - 80	ND
Zinc:		
Sphalerite	10 - 200, Average 50	10 - 50
Coal Ash	10 - 3,000	Up to several %
Phosphate:		
Ore	<100	ND
Flue dust	250 - 600	ND
Copper	10 - 18,000	Up to several %

ND No data

TABLE 2. - Analytical results from selected mineral specimens and concentrates (results are in ppm unless noted otherwise)

Location	Sample No.	Ga	Ge	Cu(%)	Zn(%)	Pb(%)	Comments
Dickey.....	Ga-7	50	<20	NA	34.5	NA	Fine-grained sphalerite
Whoopee Creek.	78PRUJ625D	70	70	NA	15	6.2	Sphalerite, galena
Do.....	78PRUJ652F	50	70	NA	20	16.5	Do.
Do.....	78PRUJ652K	30	50	NA	31	0.71	Sphalerite
Red Dog.....	Ga-4	10	100	NA	48	1.7	Coarse-grained sphalerite
Do.....	Ga-5	70	<20	NA	19.5	12.5	Fine-grained sphalerite
Do.....	RD-59	10	50	NA	25	10	Sphalerite, galena
Do.....	RD-62	10	70	NA	33	9.8	Do.
Do.....	RD-63b	<10	100	NA	16	1.5	Do.
Do.....	RD-68	15	50	NA	20	14	Gossan
Do.....	RD-71	<10	20	NA	6.9	4	Sphalerite,galena
Do.....	RD-78	15	30	NA	10	0.7	Sphalerite
Do.....	RD-91	<10	30	NA	30	12	Sphalerite,galena
Drenchwater...	77PRUJ61	20	100	NA	11	5.1	Sphalerite, galena
Story Creek...	78PRUJ278	10	70	NA	9	6.1	Do.
Rua Cove.....	RC-3	70	<20	0.5	NA	NA	Massive pyrrhotite
Do.....	2921	50	<20	1.0	NA	NA	Chalcopyrite, pyrrhotite
Latouche slump	2623	50	<20	>1.0	0.7	NA	Do.
Jonesy.....	2786	50	<20	>1.0	0.5	NA	Do.
Knights Island Development Co	5200	50	<20	>1.0	0.3	NA	Do.
Do.....	3969	100	<20	3.25	0.11	NA	Do.
East of Windy Craggy.....	3LW23	50	<20	NA	NA	NA	Chalcopyrite
Midas.....	Ga-7	50	<20	13	NA	NA	Chalcopyrite
Glacier Bay...	65049	15	20	NA	NA	NA	Massive chalcopyrite

NA Not available

P. D. Rao (9) identified gallium concentrations of 14 to 71 ppm from coal ash and 28 to 127 ppm in the ash of float products from the Matanuska coal field. Gallium concentrations from 32 to 81 ppm in coal ash and 36 to 112 ppm from ash of float products was identified in samples from the Bering River coal field (9).

Gallium concentrations from 50 to 100 ppm were identified in copper specimens with greater than 1% copper from a prospect east of Windy Craggy, Midas, Knights Island Development Co. Louis Bay, Jonesy, Rua Cove, and Latouche Slump (table 2). Copper specimens with greater than 50 ppm gallium were also reported in the literature from the Reynolds-Alaska Landlocked Bay prospect, Threeman Mine, Schlosser Mine, Ready Bullion prospect, and from the Iliamna quadrangle (1, 10).

An area geochemically high in gallium and germanium has been reported in the Kantishna Mining District (4). The significance, if any, of this anomaly is unknown at the present time.

Germanium

Germanium is concentrated in topaz (up to 700 ppm) and to a lesser extent in cassiterite, garnet, and micas from rocks rich in fluorine, such as some pegmatites and greisens. Germanium forms the minerals germanite [$Cu_3(Fe, Ge)S_4$], argyrodite (Ag_8GeS_6), reneirite [Cu_3(Fe, Ge, Zn)(S, As)$_4$], canfieldite (Ag_8SnS_6), ultrabasite (28PbS.11A_2S.GeS_2.2Sb_2S_3), iotite [$Pb_3GeO_2(SO_4)_2(OH)_2$], and stottite [$FeGe(OH)_6$].

Germanium is economically concentrated in zinc and copper sulfides and coal. Germanium substitutes for zinc in sphalerite. Major con-

centrations of germanium are found in deposits which contain chalcopyrite, bornite, enargite, and tennantite. It has been reported in the copper ores of Butte, Montana; Chuquicamata, Chile; Cerro dePosco, Morococha, Quivuvilca, and Casapalca, Peru; Bor, Yugoslavia; and Apex, Utah. The recoverable germanium concentrations are listed in table 1.

Noteworthy germanium values (20 to 100 ppm) have been reported in six deposits in Alaska. Germanite was identified in some bornite (Cu_5FeS_4) samples from the Bornite deposit (11). A sample of massive chalcopyrite ($CuFeS_2$) from Glacier Bay contained 20 ppm germanium (table 2). Samples with high zinc values from Red Dog, Whoopee Creek, Story Creek, and Drenchwater Creek contained high germanium values (table 2) (2, 3).

POTENTIAL

Gallium and germanium are predominantly recovered as by-products from the processing of aluminum, zinc, coal, phosphate, and copper ores. The greatest potential for production of these elements will be from large currently known, sulfide deposits in Alaska such as Red Dog and Bornite. However, analyses from any Alaskan ore deposit, are insufficient to identify specific gallium and germanium potentials.

CONCLUSIONS AND RECOMMENDATIONS

Twenty-two deposits with high gallium and/or germanium values have been identified in Alaska, but their significance as future sources of these metals is unknown. Because of the lack of pertinent chemical

data from Alaskan ore deposits, bulk samples should be collected from the ore zones of aluminum, zinc, coal, phosphate, and copper deposits in order to properly assess their gallium and germanium potentials.

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