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STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
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PILLOW-SHAKERS

Once I had a small dog. He was about three-quarters Boston bull, one-quarter mystery spaniel, one-quarter "coon dog", and the rest just pooch. He was the most playful, the cutest, cunningest, and the most worthless piece of brindle dog flesh that ever buried a bone, - and how we loved him! He didn't have any unusual habits, at least none for which he was well-known, affectionately or otherwise, in the community. I always hoped that he would some day pluck an errant two-year-old out of the wading pool in the park, or get bitten by a newspaperman, or in some manner become the hero of an episode sufficiently outstanding to mark him as a dog apart; but he always seemed to be in the wrong place at the right time.

But there was one thing in which this particular canine really excelled. He would take some limp object - we soon fixed up a small burlap and rag pillow - and just shake the hell out of it. He would go 'round and 'round and growl and take on, and really put on a show. The larger the audience at these impromptu performances, the greater the amount of vigor and feeling that was put forth by the lone actor. And the act usually continued as long as the audience cared to watch. As our attention died down, pooch's enthusiasm would wane; but he would keep a weather eye for a new-comer or some evidence of renewed attention. Either would set the dog off on another hysterical round of shaking the daylights out of the rag pillow.

There was always an element of uncertainty about these dog shows that added zest to such occasion. At the height of each of these paroxysms of pillow punishing, the dog would let go his hold in some manner and the pillow would go sailing off in some unpredictable direction. There was the time when the missile struck Aunt Jennie in the face and she all but swallowed her new teeth. Then, there was the evening the new Methodist preacher came up from the valley. The Reverend was squatting on his heels in the living room egging the dog on during one of the latter's most ferocious rag sessions when the pillow let go and smacked his reverence right in the noodle. It caught him off balance and right in front of the big, pot-bellied stove. As he toppled, the red-hot bowl of the stove seared the Reverend's back side and he howled like a banshee. There was the odor of singed serge and scorched preacher as he did a sitting broad jump that took him halfway to the kitchen sink where he sat himself in a big basin of water that someone had conveniently left. I'll always thank that dog for showing one man how to be himself.

Now, there are just a lot of people who go through life as "pillow-shakers". You'd be surprised how many there are, right now, even in this terribly serious war emergency. They're in the shipyards, the mines, the big industries, and especially in the distended personnels of the many Federal agencies. The "shakers" tie into a job and just shake hell out of it.

When it begins to get old, they cool off and slow down, until they remember that payday is coming, or the boss may be looking, then they grab the job in their teeth and start growling and bustling around and putting on a show again. They are ostensibly occupied with something, and that is as far as their thought on the matter goes. A dog's shaking the guts out of a rag pillow never gets the dog anything but exercise, because there's nothing constructive about shaking a pillow. The pillow comes out of the ordeal at best no better than it went in, so all the energy was wasted. That's pretty much the case with a lot of people. Some even have good intentions, and all the vigor in the world, and their show is always put on when the audience is largest, but we have never heard of a worker of that kind building a better mouse trap. God knows we need good mouse traps built in this war emergency.

E.K.N.

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COLUMBIUM AND TANTALUM

Introduction

The twins, columbium and tantalum, are very similar, especially in their geologic associations and in most of their chemical characteristics. Columbium, however, has a specific gravity only half that of tantalum (8.4 as against 16.6), melts at a temperature several hundred degrees below tantalum, and is more easily worked (more malleable and ductile) than tantalum.

Discovery

In 1801, C. Hatchett discovered a new element in an ore which had been sent to England more than one hundred years before by John Winthrop, first governor of Connecticut. It was named columbium after Columbia, the poetic name of America; and the mineral was called columbite. Tantalum was identified the following year by A. G. Ekeberg in some Finnish minerals resembling columbite. The name comes from Tantalus of Grecian mythology, because of the tantalizing difficulties encountered in dissolving the mineral in acids. Two similar elements were noticed by H. Ross (1844) in a German sample of columbite; one corresponded with the tantalum of Ekeberg; the other was called niobium after Niobe, the mythical daughter of Tantalus, Hatchett's columbium was evidently a mixture of these two elements.

Tantalum has preserved its individuality. Columbium and niobium are now considered synonymous, the former the generally accepted term, although the latter is preferred in Germany.

Occurrence

Commercially, columbium and tantalum are derived almost entirely from columbite and tantalite - columbate and tantalate of iron and manganese, both having the type formula $(Fe,Mn)(Cb,Ta)_2O_6$. The two elements occur also as minor constituents in several minerals, especially in association with the rare earths. These two minerals almost always occur together in an isomorphous series, sometimes one predominating, sometimes the other. The purest columbite comes from Nigeria, which long has supplied the United States with the major part of its needs. The best tantalite is found in the Pilbarra district of Western Australia, where concentrates containing up to 80 percent Ta_2O_5 (averaging about 65 percent) and less than 10 percent Cb_2O_5 have been obtained. Deposits have been uncovered in Belgian Congo bearing somewhat more tantalum than the Nigerian product. The Black Hills in South Dakota have produced intermittently since 1904, the concentrates containing up to 40 percent Ta_2O_5.

Columbite and tantalite are known to occur only in granites and pegmatite veins, associated with quartz, microcline, albite, cassiterite, tourmaline, wolframite, mica, etc. Many mines are located in detrital material derived from this parent rock. In the Pilbarra district of Australia both the lode and the detritus are worked profitably.

The rarer columbium and tantalum minerals, as indicated by their known occurrences, are associated with columbite and tantalite and are found alone only very rarely and in extremely small quantities.

Mineralogy

Since the two minerals are end members of an isomorphous series, grading insensibly from columbite, the nearly pure columbate, on one end, to tantalite, the nearly pure tantalate, on the other, the physical properties are best considered as of one mineral with variations between the limits of the end members. The crystal system is orthorhombic. Twins are common, usually heart-shaped contact twins, but penetration twins are also found. The crystals are prismatic, often occurring as short, rectangular prisms with the three pinacoids prominent. Thin tabular crystals also occur. One cleavage is rather distinct, parallel to the front prism face. Another cleavage, parallel to the side prism face, and hence at right angles to the first cleavage, is less distinctly developed. Fracture is subconchoidal to uneven. The mineral is brittle, has a hardness of 6, and the specific gravity ranges from 5.3 to 7.3, increasing with the amount of tantalum. The luster may vary from sub-resinous to sub-metallic, sometimes being brilliant. The color is black, sometimes showing a brownish tone. The streak varies from dark red to black.

Other minerals which contain high percentages of columbium and tantalum and which may well be ores if found in sufficient quantities are:

(a) Pyrochlore, a columbate of the cerium metals, calcium and other bases, with titanium, thorium, fluorine. It is isometric and commonly shows octahedral cleavage. The hardness is 5 to 5.5 and the specific gravity is about 4.3. Its color is some shade of brown (reddish-brown to a blackish-brown); the luster is vitreous, resinous on a fracture surface.

(b) Fergusonite, a metacolumbate (and tantalate) of yttrium with erbium, cerium, uranium; also iron, calcium, etc. It is tetragonal, and the crystals are pyramidal or prismatic in habit. It is brittle, has a hardness of 5.5 to 6, and the specific gravity is generally about 5.8. It may diminish to 4.3 if hydrated. The color is brown-black and the streak is pale brown.

(c) Samarskite, a columbate and tantalate of iron, calcium, uranium oxide, etc., and the cerium and yttrium metals. It is orthorhombic, crystallizing in rectangular prisms with roughened faces. One cleavage parallel to the side prism face is imperfectly developed. The fracture is conchoidal. It, too, is brittle. The hardness is 5 to 6, the specific gravity 5.6 to 5.8. It has a vitreous to resinous luster, often splendent. The color is velvet black and the streak, dark reddish-brown.

Field identification of columbite and tantalite

The occurrence of columbite-tantalite in granites or pegmatites or in detrital material derived therefrom should serve as a lead toward identifying this mineral. Its rectangular, prismatic form, its high specific gravity, and the sub-metallic luster, often with irridescent surface, are distinctive. Wolframite and tourmaline are probably most likely to be confused with it, especially wolframite. Tourmaline is rhombohedral, also shows prismatic form, but the faces are strongly striated vertically and the crystals are often much rounded, almost barrel shaped. The specific gravity of tourmaline is not more than half that of columbite. Wolframite is monoclinic, but often occurs in crystal forms very similar to those of columbite-tantalite, both prismatic and tabular. The prismatic faces of wolframite, however, usually show vertical striations. Cleavage is less well developed in wolframite than in columbite-tantalite. The specific gravity of columbite-tantalite is lower than that of wolframite, but specimens especially rich in tantalum are heavy enough to be indistinguishable from wolframite.

Uses

The uses of these metals are chiefly the result of their extreme resistance to corrosion, their gas absorbing qualities, their hardness, and their high melting points.

Stainless steels bearing columbium can successfully withstand high temperatures. They are welded more easily and resist corrosion better than the ordinary stainless steels. Columbium in chrome steel reduces air hardening and the physical properties, especially impact strength, are stabilized. Metallic columbium is similar to tantalum but is more workable and ductile.

Tantalum has been used in spinnerets for rayon making machines because of its resistance to corrosion. An electrolytically formed tantalum oxide coats the tantalum metal, is almost diamond hard, and is equally resistant to corrosion. There is no apparent wear or distortion to the spinneret holes. Tantalum was once used for metallic filament lamps. It replaced the old carbon filaments, being more efficient, but in turn has been superseded by tungsten for the same reason. Tantalum is used in electrolytic rectifiers (battery chargers) because of its pronounced valve action. Tantalum wire will permit an electric current to flow in only one direction, thus changing alternating current to pulsating direct current. Because of its hardness and its resistance to corrosion, tantalum is suitable for use in laboratory apparatus, dishes, calorimeters, cathodes, spatulas, and in dental tools. The metal is said to be unaffected by any chemicals or antiseptics used in dentistry or surgery. However, at high temperatures it oxidizes too readily and becomes brittle. For this reason it has found only limited use.

One of the greatest uses of tantalum, and certainly the most strategic use at the present time, is for the filaments and grid wires in vacuum tubes, which are used in radio broadcasting and receiving, X-rays, etc. Its remarkable faculty for absorbing gas at high temperatures enables it to act as its own "getter." Its high melting point is another beneficial property. It has a tensile strength two and one half times that of platinum, and next to tungsten it possesses the highest melting point and the lowest vapor pressure of all metallic elements.

In general it should be said that the material most sought after is columbite with a very small content of tantalum and tantalite with a very small content of columbium.

Metallurgy

The columbite-tantalite is finely crushed and fused with potassium hydroxide, converting the tantalum and columbium into soluble tantalates and columbates. The melt is then leached with water and filtered. The solution is neutralized with hydrofluoric acid which changes the columbium and tantalum into double fluorides with potassium. The potassium-tantalum fluoride is precipitated. The columbium, in the form of potassium fluoxycolumbate, being twelve times as soluble as the tantalum compound, remains in solution.

To obtain tantalum metal, tantalic acid is precipitated from the double fluoride and ignited, giving the oxide. This oxide is then reduced "in vacuo" to give the metal. (Aluminum may be used for this reduction.)

Metallic columbium can be obtained from the molten potassium fluoxycolumbate by electrolysis.

Chemical Tests

The chemical tests for columbium and tantalum are quite difficult and advanced tests, such as are given in Scott's Standard Methods of Chemical Analysis, should be consulted for accurate analyses. Two methods for qualitative determinations are outlined below:

1. The powdered mineral is mixed with an excess of potassium pyrosulfate and the mixture is fused in a platinum loop. The crushed melt is digested with ten drops of a solution composed of 5 percent sulfuric acid and 1 percent tannic acid. The digested mixture is

filtered by means of a micro-centrifuge or a micro-filtering device. The residue ranges in color from yellow to orange. The color of the residue is determined by the proportion of the two elements in the original mineral.

2. To distinguish between wolframite and columbite and tantalite, fuse powdered mineral with ammonium hypophosphite. If the melt is blue, wolframite may be present. If the melt is colorless and contains fine black particles add concentrated hydrochloric acid, bring to boiling, and add a small piece of metallic tin. An intense blue color indicates the presence of Cb and Ta.

The most positive identification of columbium and tantalum is obtained by spectrographic analysis.

Markets

In 1939 imports of columbium ore into the United States were reported by the U. S. Bureau of Mines as 109,132 pounds, valued at $37,062, or approximately 34 cents a pound. Over the same period imports of tantalum ore amounted to 56,561 pounds, valued at $82,990, or approximately $1.47 a pound.

The refined metals are worth several dollars a pound. Tantalum is critically essential for war use and the War Production Board would be greatly interested in a supply of tantalite.

The Metals Reserve Co. has posted the following price schedule for tantalite ores F.O.B. New York:

Percentage of Ta_2O_5 Contained in Tantalite Ore	Price per Pound Ta_2O_5 Contained	
40%	$1.25	
41	1.30	
42	1.35	
43	1.40	
44	1.45	
45	1.50	
46	1.55	
47	1.60	
48	1.65	
49	1.70	
50	1.75	
51	1.79	
52	1.83	
53	1.87	
54	1.91	
55	1.95	
56	1.99	
57	2.03	
58	2.07	
59	2.11	Maximum SnO_2 - 3.00%
60	2.15	Maximum TiO_2 - 3.00%
61	2.19	Combined Ta_2O_5 plus
62	2.23	Cb_2O_5 - 70% Minimum
63	2.27	
64	2.31	
65	2.35	
66	2.40	
67	2.45	
68	2.50	
69	2.55	
70	2.60	

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J. Paul Fitzsimmons

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MINING NOTES

During 1942, James K. Remson, Grants Pass, mined chrome at his Cyclone Gap property, located in Del Norte County, California, just south of the Oregon line. This chrome was hauled to the Metals Reserve depot at Grants Pass and then shipped to Sacramento. As soon as road conditions permit, operations at Cyclone Gap will be resumed. The U. S. Forest Service built several miles of access road to this property in 1942.

Mr. W. E. Marrion, Coquille, Oregon, has been mining manganese ore at the McAdams property, located near the Coos-Curry county line, east of Langlois. This ore has been hauled to the Metals Reserve ore purchasing depot at Coquille. Operations are continuing, and shipments will be resumed during March.

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CLEARING HOUSE

76-CH Powell Creek Mining Co. - Leon C. Osteyee, secretary, 580 Market St., San Francisco, wishes to sell mine equipment consisting of 160-c.f.m. portable G-D compressor, drifter, stoper, 3/4 yd. mine car, blasting machine, blacksmith outfit, 8" galv. ventilator pipe, 2000 feet mine rails, 2000 feet of 3/4" and 1" iron pipe, ore sacks, and miscellaneous tools and mine appliances. These items are located at Williams, Oregon, about 20 miles from Grants Pass, nearest shipping point.

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77-CH For Sale: Sirocco dust collector and suction blower nearly new. For details write Walter Osborne, Pistol River, Oregon.

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"The shortages of raw materials and manpower in this country are such that we cannot expect to end the steel problem by simply increasing steel-making capacity until it is sufficient to provide for all possible uses. We must instead determine the amount of the various kinds of steel which we will need to win the war and then proceed to increase steel-making capacity to that amount. Consequently throughout the war we must expect to have less steel that we could profitably use and we must make sure that the steel which we have is allocated and used efficiently and skillfully."

- Senator Mead of New York in "Additional Report, Interim Report on Steel", (Report No. 10, Part 3).

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