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ALUM MINERALS IN WYOMING
(including alunite)

by

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Illustration

Introduction

Alum minerals are salts of aluminum and potassium sulfate. They are formed by reactions of sulfuric acid with potassium-rich rocks.

Gray and black shales and organic rocks such as coal often contain pyrite. Under normal surface weathering conditions, this pyrite will oxidize forming sulfuric acid, which then reacts with the clay minerals in the rocks to produce minor amounts of alum minerals. The most common alum mineral is alum [$KAl(SO_4)_2 \cdot 12H_2O$], formed by the reaction of sulfuric acid with potassic clay minerals such as illite. Because alum is water soluble, it is carried in ground and surface waters from the rocks in which it formed into drainages and fossil and modern playa lakes in Wyoming where it precipitates and is now found associated with evaporite and detrital deposits. At these sites, the concentrations of alum minerals are greatly diluted by abundant saline minerals.

In recent and older volcanic terrains, gas vents, fumaroles and hot springs contain sulfuric acid which reacts with rocks adjacent to conduits and, if the

water flow is sufficient, rocks in nearby drainages. As the reactions proceed, sulfuric acid is used up, so these gases and waters lose their acidity father from their sources. Because the supply of sulfuric acid is greater in fumaroles and and hot springs than in oxidized pyritic shales, alum deposits in volcanic terrains contain higher concentrations of alum minerals than those in oxidized pyritic shales.

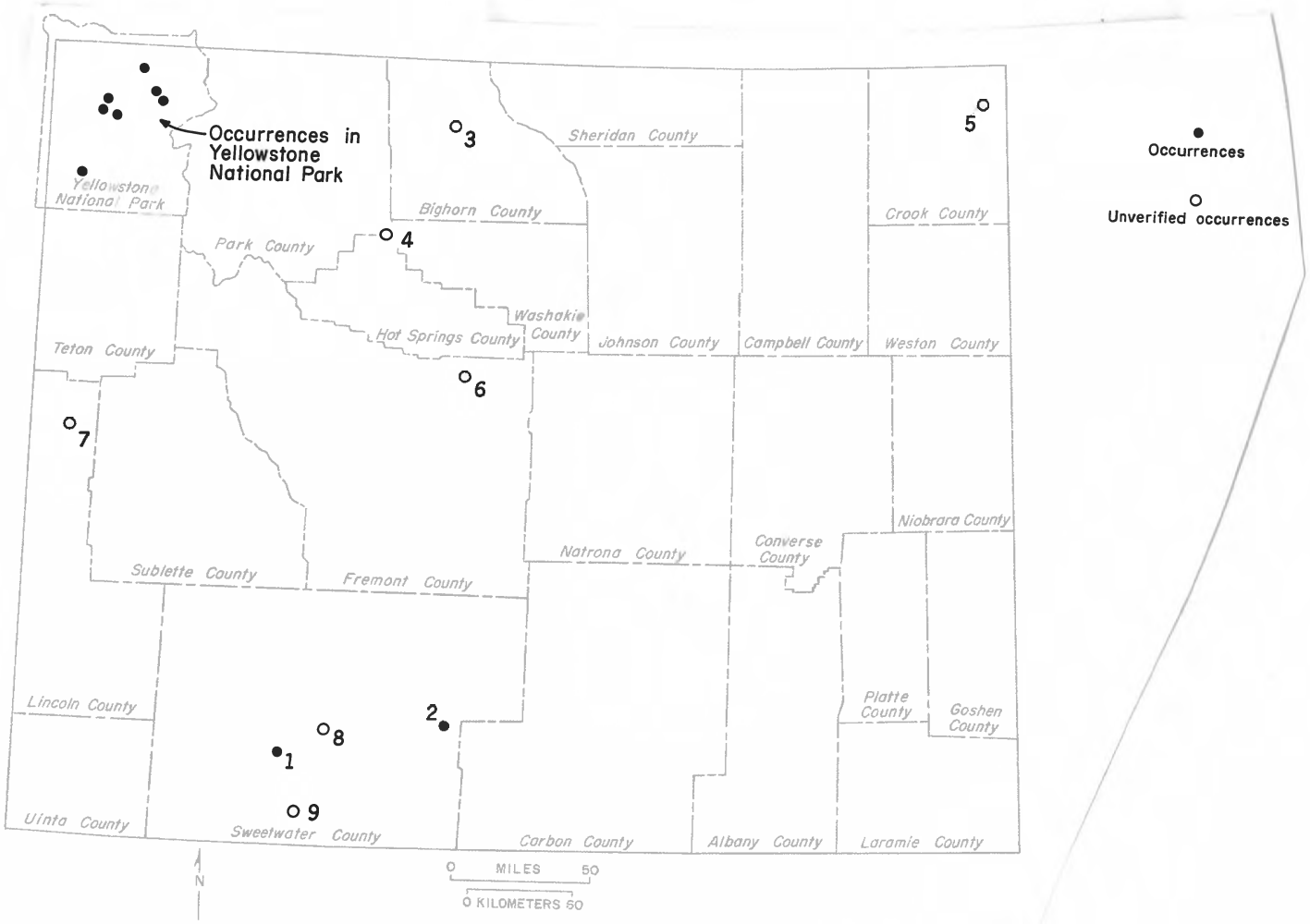
In addition to alum, there are four other alum minerals reported in Wyoming. Aluminite [$Al_2SO_4(OH)_4 \cdot 7H_2O$] and ammonium alum (also known as tschermigite) [$NH_4Al(SO_4)_2 \cdot 12H_2O$] are associated with carbonaceous shales and coal, while alunogen [$Al_2(SO_4)_3 \cdot 18H_2O$] and alunite (also called alum stone or alum rock) [$KAl_3(SO_4)(OH)_6$] are common in altered volcanic rocks and are occasionally present in claystones and shales.

Some alum mineral deposits in volcanic areas have been mined in the past in Utah, Nevada and Arizona, and prospects have been examined in New Mexico and Colorado (after Hall and Bauer, 1983). In Wyoming, alum minerals are found in Yellowstone National Park associated with recent volcanic activity. Alum

minerals are also present in Cretaceous shales, recent and older playa lake deposits, recent drainages and on Aspen Mountain (map p. 4).

Alum minerals have numerous uses. Alum is used in medications, water purifiers, tanning chemicals, paper processing chemicals and as a fixer (mordant) for textile dyes. Between the 15th and 20th centuries, alunite was used as the raw material source of alum. Alum is now produced synthetically. During World War I, alunite was used as a replacement for potash fertilizer. During and after World War II, alunite was considered as a source of aluminum. The processing of bauxite ore for aluminum, however, has diminished this use of alunite (Hall and Bauer, 1983).

During the 1970's, a new project to extract aluminum from alunite was planned. A large deposit of alunite in the Wah Wah Mountains of southwestern Utah was the recommended source of ore. Some of this ore was processed successfully in a pilot plant in Golden, Colorado. This pilot plant used several technological innovations and produced fertilizer as a by-product. Despite these advances, a producing plant was never built (Hall and Bauer, 1983).



1. Aspen Mountain
2. Wamsutter Rim
3. Stucco
4. Tatman Formation
5. Alum Creek
6. Bonneville
7. John's River
8. Bitter Creek
9. Sweetwater County

Index map showing occurrences of alum in Wyoming.

Occurrences

(The number preceding each occurrence refers to the index map, p. 4)

Sweetwater County

1)	Aspen Mountain	trench	N1/2 sec. 26, T.17N., R.104W.
		drill hole	NE1/4NE1/4 sec. 34, T.17N., R.104W.

Eight to twelve feet of white claystone exposed in a bulldozer trench at this locality contains 60 to 90 percent alunite. The claystone is overlain by less than 30 feet of overburden. A drill hole one mile southwest of the bulldozer trench penetrated six feet of white claystone in the same horizon at a depth of 145 feet. This implies that this alunite occurrence is of considerable extent. The claystone occurs interstratified with conglomerate, sandstone, limestone and claystone of probable early Tertiary age.

Chemical analyses of two samples of alunite-bearing rock from this area are shown below. This alunite was identified by x-ray diffraction, and the chemical analyses below do not conform to the usual composition of alunite.

SiO_2	8.0%	16.0%
Al_2O_3	32.0	29.5
Fe_2O_3	1.5	0.4
MgO	0.5	1.0
CaO	0.1	0.1
K_2O	6.8	5.8
TiO_2	0.1	0.1
Li_2O	0.01	0.01
Na_2O	0.58	0.49
SO_3	37.0	33.0
	86.59	86.4

The origin of the deposit is not known. The small amount of pyrite in the rocks precludes oxidation of pyrite as the origin of sulfuric acid for the formation of the alunite, and a hydrothermal source of sulfuric acid is not

apparent. Silicification is present on the surface just north of the trench. This silicification could be an indicator of previous hydrothermal activity in the area. The nearest known igneous rocks are in the Leucite Hills, 20 to 30 miles north of this area (Love and Blackmon, 1962).

2) Wamsutter Rim T.19N., R.94W.

About three miles south of Wamsutter, ammonium alum (tschermigite) is present in a ledge of black shales that is traceable for three miles (Erickson, 1922) along the Wamsutter Rim. This shale could be in the main body of the Eocene Wasatch Formation or in the Laney Member of the Green River Formation (deposited in a paleo-playa lake). Ammonium alum forms the cementing material for fragments of ammonium alum, brown carbonaceous shale, nodules of yellow jarosite and a few scattered gypsum crystals (Erickson, 1922). Analyses of eight 160 pound channel samples gave 2.48 percent ammonium alum (Boyle, 1923, in Osterwald and others, 1966).

Yellowstone National Park

Allen and Day (1935) note that alum, alunogen and alunite are present in sulfate-dominated (alkaline) thermal areas in the Park. They specifically note one or more of these minerals in the Norris and Shoshone Geyser Basins, in Hot Spring Basin, at Calcite Springs and Artists Paint Pots and in the vicinity of Broad Creek and Mary Mountain.

Unverified occurrences

3) Big Horn County

Jamison (1911) reports the presence of large deposits of alum in Big Horn County at unspecified locations. Correspondence between H.D. Thomas and E.F. Burchard dated May 25, 1942, suggests the location may be in the Amsden Formation near Stucco, Wyoming, and that the alum mineral is alunite. This locality is probably on Sheep Mountain.

4) Big Horn, Park, Hot Springs and Washakie Counties

Correspondence between E.F. Burchard and H.D. Thomas dated May 22, 1942, shows a chemical analysis of an alum mineral that might be aluminite. It is stated in the letter that the alum mineral came from a Lower Eocene carbonaceous shale in the Bighorn Basin. This shale is probably in the Tatman Formation, which is exposed on Tatman Mountain, and between Fifteen Mile and Gooseberry Creeks. The Tatman Formation has been interpreted as being deposited in shallow lacustrine and shoreline environments, like the Green River Formation (Van Houten, 1944).

5) Crook County

Alum was reported along Alum Creek (Day, 1888). This creek is in T.55N., R.61 and 62W.

6) Fremont County

A mile or two north of the Bonneville "Mercury" prospect (sec. 12, T.39N., R.93W.), a claim holder reported alum and sulfur. Hagner (1942) mentions it, but he did not visit this site. The sulfur might actually be jarosite (chemically like alunite but containing iron in place of aluminum).

7) Lincoln County

Alum was reported in Cretaceous rocks along the John's River in Uinta County (Day, 1888). The reference to the John's River is probably for the John Day River located in what was then northern Uinta County. The John Day River is now the Greys River in Lincoln County.

8 and 9) Sweetwater County

Aughey (1886) noted an occurrence of alunogen on Bitter Creek, stating that fine specimens were to be found.

Alum is reported along streams in Sweetwater County near the Colorado-Wyoming State Line (Day, 1888), and Jamison (1911) reports the presence of large deposits of alum in Sweetwater County at unspecified locations.

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