

Hydrated aluminum hydroxy-fluoride, a ralstonite-like mineral at Big Southern Butte, Snake River Plain, Idaho

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Disseminated hydrated aluminum hydroxy-fluoride, with the general formula $Al_{16}(F,OH)_{48} \cdot 12-15 H_2O$, occurs in pale pink to pale yellow and white hydrothermally-altered rhyolitic rocks, and it may constitute 40 percent by volume. The occurrence is at an elevation of about 6,400 feet (2,130 m) above mean sea level in the NE 1/4, sec. 22, T. 1N, R. 29 E, on the northwest side of Big Southern Butte, the most prominent landmark about 60 km NW of the city of Blackfoot. This occurrence is noteworthy because it is the site of near-surface (<100 m depth) hydrothermal alteration that produced a ralstonite-like mineral without significant Na or Mg, which previously have been considered essential components of ralstonite.

Quantitative chemical data for this ralstonite-like mineral are given in Table 1, along with the cell dimensions. Quantitative electron microprobe data were obtained at 10 kV with the beam defocused to 10 microns. Analyzed biotite, fluor-phlogopite, Al_2O_3 , KCl, and CaF_2 were used as standards. The K-line intensity data for each element in specimen A50976 were processed by Magic IV, and the results were identical to those obtained without ZAF corrections. Significant chlorine and potassium are substituted for the anion and cation, respectively, in one specimen (Table 1). Quantitative analyses for Mg, Li, Be, B, and NH_3^+ (Kjeldahl method) revealed less than 0.03 weight percent of each in specimen A50976. Quartz, sanidine, and tridymite are the common associated minerals readily recognized by transmitted-light petrographic methods; these are believed to be relict from the rhyolite. Specimen Sobu-OF contains massive halite, quartz, and albite. According to X-ray diffraction studies of bulk samples, scanning electron microscopy, electron microprobe studies, and petrographic studies, we conclude that the ralstonite-like mineral, halite, and albite are of hydrothermal origin. Fluorite is sparse, and topaz was not found. The ralstonite-like mineral is optically isotropic, and occurs as compact masses of submicron-size grains. The largest crystals, shown on Figure 1, are 10- to 15-

micron octahedra observed only in one of four specimens. Some rosettes of crystal aggregates occur perched on coarsely crystalline halite. Grains of

Table 1. Mineralogical data for hydrated aluminum hydroxy-fluoride in four specimens from Big Southern Butte, Snake River Plain, Idaho

Specimen no.	A50976	Sobu-A,A	Sobu-B	Sobu-OF
Element	Weight percent			
K	2.1 (0.2)	0.17 (0.04)	0.15 (0.02)	0.26 (0.10)
Na	0.27 (0.01)	0.18 (0.05)	0.16 (0.04)	0.28 (0.07)
Ca	0.08 (0.03)	<0.07	<0.07	<0.07
Al	25.9 (0.2)	27.3 (0.3)	26.8 (0.4)	27.2 (0.2)
Cl	2.8 (0.4)	0.26 (0.20)	0.23 (0.15)	0.06 (0.07)
F	33.1 (1.2)	41.2 (1.1)	40.4 (1.5)	42.2 (1.3)
OH calculated	21.4	15.3	15.0	14.4
H ₂ O by difference	14.3	15.6	17.3	15.6
	Atomic percent (for F+OH+Cl = 48)			
K	0.83	0.07	0.06	0.10
Na	0.18	0.08	0.11	0.19
Ca	0.03	-	-	-
Al	14.98	15.66	15.86	15.76
Cl	1.24	0.12	0.10	0.02
F	27.13	33.46	33.86	34.70
OH	19.64	14.43	14.04	13.27
H ₂ O	12.4	12.89	15.30	13.58
	Cell dimensions (Å)			
a =	9.861(4)	9.799(3)	9.791(3)	-

Values given for weight percent are the mean, with the standard deviation in parentheses, based on 17-39 electron microprobe analyses for each element in each specimen, except for Sobu-OF which is based only on 5-7 analyses for each element. Mg is less than 0.10 in all analyses.



Fig. 1. Scanning electron photomicrograph of hydrated aluminum hydroxy fluoride octahedra, Sobu A, from Big Southern Butte, Snake River Plain, Idaho. Bar scale is 10 microns. (Photo by James Nishi, U.S.G.S.)

hematite and magnetite(?) 5 to 15 microns in size are present in polycrystalline aggregates.

Cell dimensions of $a = 9.791(3)$ to $9.861(3)\text{\AA}$ (Table 1) and the intensity of the strongest X-ray diffraction lines (Table 2) are more similar to the diffraction parameters of synthetic hydrated aluminum hydroxy-fluoride (Cowley and Scott, 1948) than to the 9.92 to 10.02\AA for natural ralstonites studied by Pauly (1965). The index of refraction of the ralstonite-like mineral in specimen A50976 (Table 1), determined by Ray E. Wilcox, ranges from 1.460 to 1.464 using focal masking.

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Table 2. X-ray powder diffraction data for hydrated aluminum hydroxy-fluoride (A50976), Big Southern Butte, Snake River Plain, Idaho

hkl	$d, \text{\AA}$	I
111	5.72	100
311	2.97	60
222	2.85	25
400	2.46	20
422	2.01	10
333,511	1.899	15
440	1.743	20
531	1.667	5
620	1.563	3
533	1.503	5
622	1.485	5
444	1.423	3
731,553	1.284	5
822,660	1.161	5
662	1.129	2
$a = 9.861(4)$		

Diffractionmeter, scan rate $1^{\circ} 2\theta$ per inch; $\text{CuK}\alpha = 1.54178\text{\AA}$, Ni filter

References

- Cowley, J. M. and T. R. Scott (1948) Basic fluorides of aluminum. *J. Am. Chem. Soc.*, 70, 105.
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