Mineral Report MR81-6

UPDATED REPORT ON THE TWIN BUTTES FELDSPAR-LIMESTONE-FLAGSTONE PROPERTY, ALBANY COUNTY, WYOMING

by

W. Dan Hausel

July 6, 1981

UPDATED REPORT ON THE TWIN BUTTES FELDSPAR-LIMESTONE-FLAGSTONE PROPERTY, ALBANY COUNTY, WYOMING

INTRODUCTION

The Twin Buttes Corporation's property lies immediately south of Sybille Canyon in the central portion of the Laramie Range. This property contains substantial resources of flagstone, limestone, potassium and sodium-rich feldspar-bearing rock. Potential mining markets for this property would be for flagstone production for commercial building material, and feldspar production for use as a fluxing agent for the manufacture of glass. The use of the anorthositic rocks as a source of alumina has been discussed by Hagner (1951), Harrer (1954), and Osterwald and others (1966), but as long as low-cost aluminum-rich bauxites are available to the United States, the aluminum potential of the anorthosites would be essentially non-existent.

The potential development of a glass industry in this region of Wyoming was previously discussed by Hausel (1981). This region in Albany County not only contains resources of feldspar-rich rock, but resources of nearby limestone and glass sands are also available.

Location and accessibility

The property lies on the Baldy Mountain $7\frac{1}{2}$ minute quadrangle and on the western flank of the central Laramie Range. Baldy Mountain located within Sec. 8, T. 18 N., R. 72 W., is covered by ten lode claims and four placer claims all owned by the Twin Buttes Corporation (Figure 1).

The property is accessible by unimproved dirt road which intersects Albany County 11 about 2 miles east of the property. Albany County 11 trends north for 6 miles where it intersects Albany County Road no. 12. From Albany County 12, State Route 34 lies 6 miles to the west. At this junction, the Union Pacific railroad lies about 8 miles to the west, and Laramie lies approximately 26 road miles to the south.

Additionally, a four-wheel drive road runs directly west of the Twin Buttes property. From this road, the Union Pacific railroad is located within eleven miles of the feldspar deposit (Figure 2). This road would require grading and widening if chosen as haulage access.

GEOLOGY

Introduction

Baldy Mountain (the Twin Buttes property in section 8) is capped by Paleozoic sediments of the Casper Formation (Figure 3). The sediments are formed predominantly of marine carbonates that were deposited in a Pennsylvanian-age shallow sea. The upper section of the limestone is jointed parallel to the surface. This produces an attractive flagstone.

The limestones are underlain by two different types of feldspar-bearing rock. A red to pink porphyritic potash feldspar rock forms dikes and sill-like bodies that intrude a black to gray sodium-rich feldspar-bearing rock (anorthosite). The anorthositic rocks are part of a batholith which intruded metasedimentary rock sequences of the Laramie Range about 1.5 billion years ago. The reddish granitic (potash-feldspar) rocks probably intruded the anorthosite complex during the emplacement of the Sherman Granite batholith at about 1.4 billion years ago.

Paleozoic sediments (limestone-flagstone)

The cap rocks of Baldy Mountain (Figure 3) are cabonate rocks of the Casper Formation. These rocks are limestones. The estimated average calcium carbonate content of these rocks is 80% (Exhibit A). Near the top of the sediments, the limestone contains parallel joints that are responsible for the formation of flat sheets and blocks of flagstone. This flagstone is attractive because of its unique sponge-like texture (Exhibit B).

The limestone is underlain by a thin basal conglomerate. In hand specimen, samples of this conglomerate contain rounded sand-sized to cobble-sized pebbles of quartz, feldspar, and limestone cemented by a carbonate matrix. This conglomerate was examined by scintillometer surveys for radioactivity, but only one small localized zone on the northeastern edge of the sediments contained above background radioactivity (radioactivity of this localized area was only about two times that of background and is not considered anomalous).

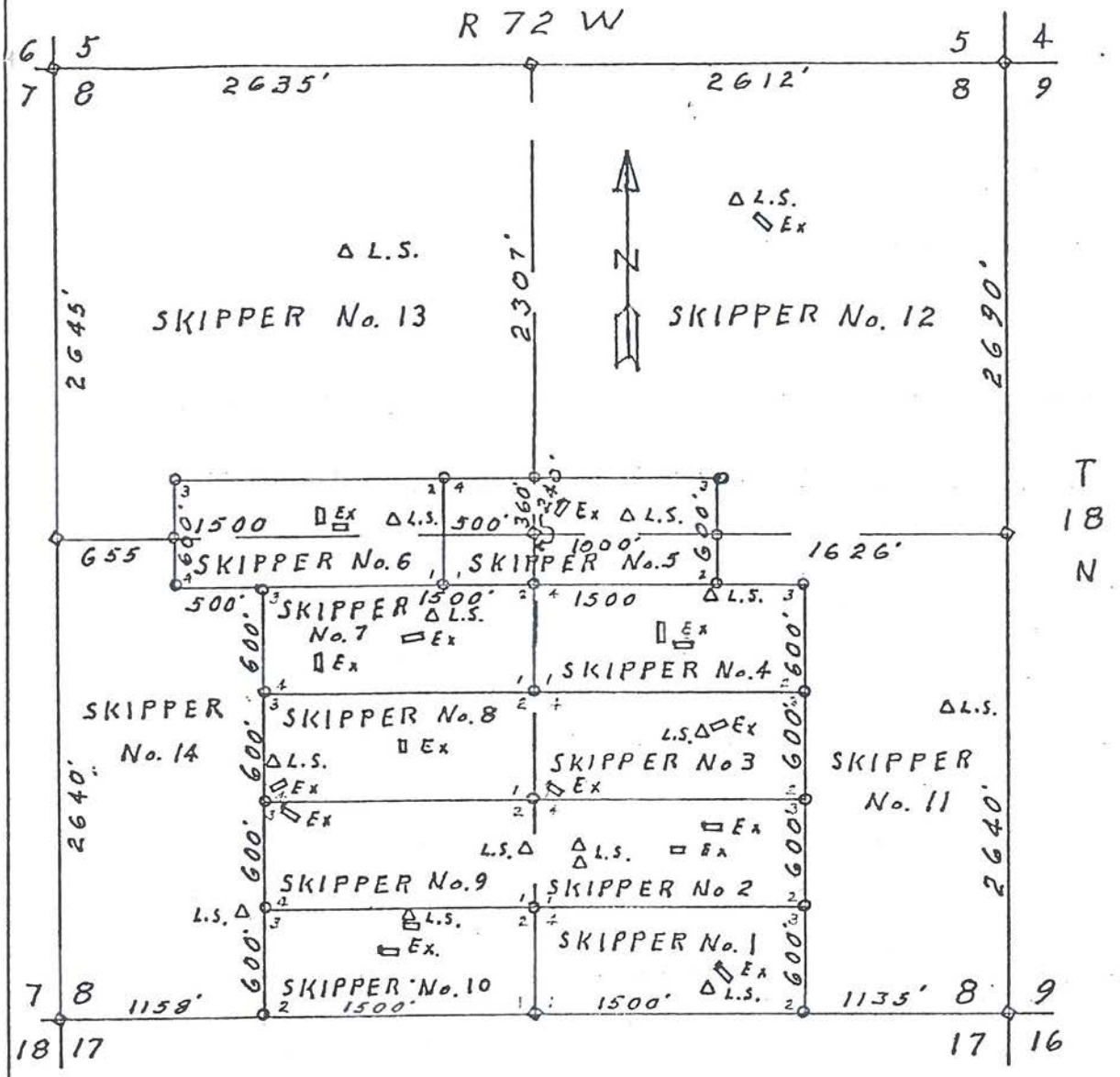
The thickness of the limestone has not been determined by drilling. However, field mapping suggests that the limestone may obtain a maximum thickness of 125 feet (see cross-section A-A', figure 3). One estimate reported in Exhibit A suggests that at least 60,000 cubic yards of limestone cap Baldy Mountain. This figure is undoubtedly greatly underestimated as suggested by Figure 3.

Potassium feldspar porphyry

These rocks form sill-like bodies and dikes of red to pink granitic rocks that are intrusive to the anorthosite. Along the base of the eastern flank of Baldy Mountain, one potash-rich sill forms a ridge of reddish rock which is readily observable on the property, and on aerial photography. The dip of the two north trending sills (Figure 3) that crop out on the eastern flank of Baldy Mountain is approximately conformable to the base of the overlying limestone. Dips of the other dikes and sills were not determined. It should be noted that the dip of the upper sill shown in cross-section A-A' (Figure 3) is interpreted to parallel the base of the limestone and should thus lie under the anorthosite on the western edge of Twin Buttes property. However, if the average dip of this sill is less than that of the limestone, it could pinch out under the limestone on the western flank of the hill. Only drilling could prove the presence of the potash-feldspar-bearing sill under the anorthosite in the southwestern corner of the property.

The feldspar-porphyry sills contain associated granitic rocks similar


TWIN BUTTES PROPERTY
BALDY MOUNTAIN
8607
TWIN BUTTES
LARAMIE MOUNTAINS
ALBANY CO. 12
ALBANY CO. 11
GUIDE ROCK
7214
YAUNT MOUNTAIN
RED MOUNTAIN
POE MOUNTAIN
SHEEP MOUNTAIN
SHEEP ROCK
ROUND TOP
7392
Norton Pass
PLATTE COUNTY
LARAMIE COUNTY
Lambert
Farthing
Altus
Horse Creek
RAGGED TOP MOUNTAIN
POWELL MOUNTAIN
SHERMAN HILL
GREEN TOP MOUNTAIN
PILOT HILL
Bosler
Wyoming
Howell
Laramie
Fairground
Substation
Radio towers
Brees
Quarry
Quarries
Mine Camp
Windmill
Ranch
0
5 Miles
Scale 1:250,000
(Figure 2)



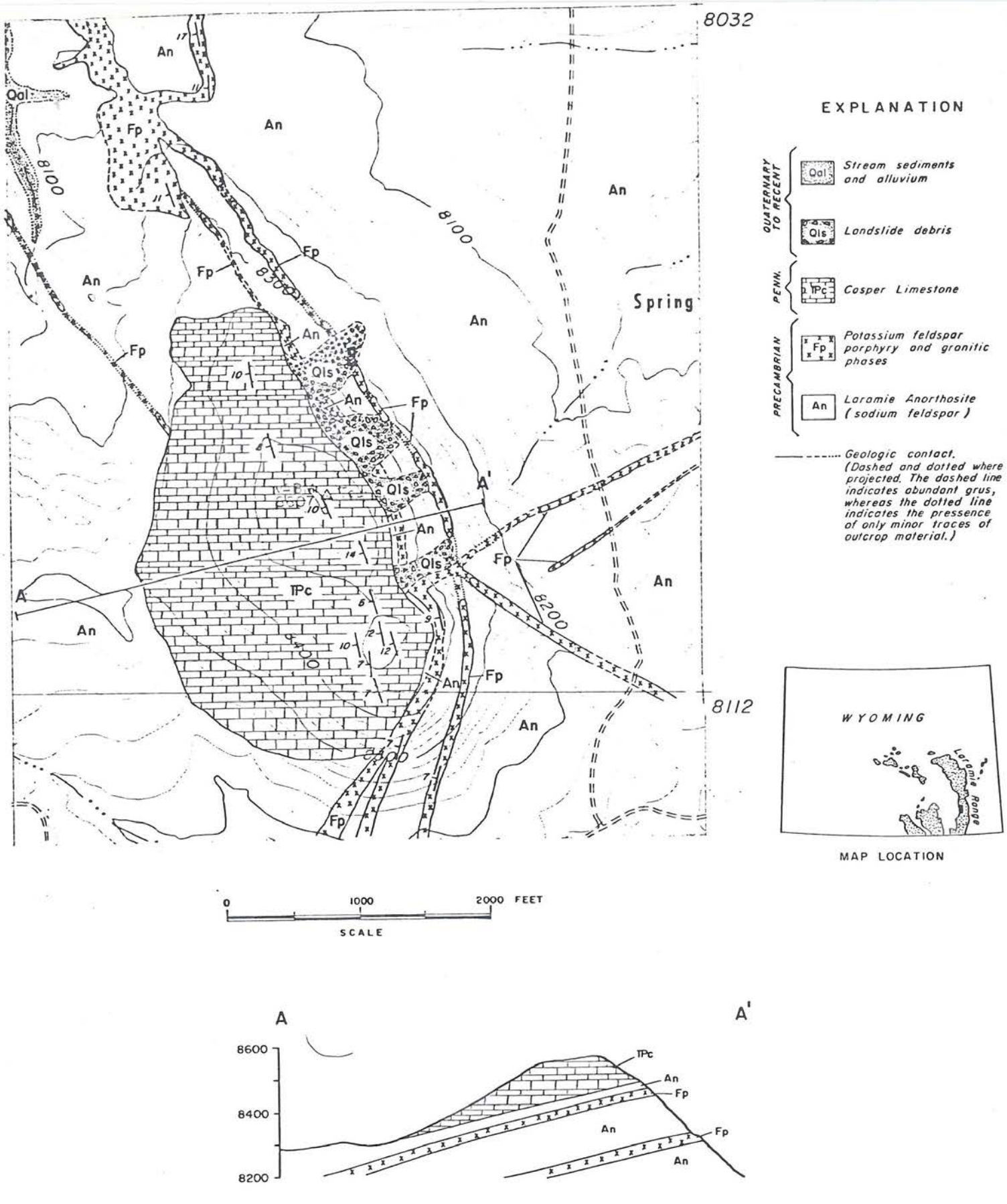
LEGEND

◇ section Corner
o Claim Corner
△ L.S. Location Site
▭ Ex. Exploratory Drill Holes
Scale 1inch = 1000 Feet

PLATT
MINING CLAIMS
LOCATED in Sec. 8, T18N, R72W

January 12, 1966 Ellwood A. Bass
Rev. August 27, 1979 P.E. & L.S. 422
for Scale

(Figure 1)



PRELIMINARY GEOLOGICAL MAP OF THE TWIN BUTTES FELDSPAR PROPERTY, BALDY MTN. QUADRANGLE, ALBANY COUNTY, (T. 18 N., R. 72 W.)

Geology by W. Don Hausel, 1981

(Figure 3)

in composition to the Sherman Granite batholith. Apparently the granitic rocks were intruded along the same passageways as were the feldspar porphyry sills and dikes.

In hand specimen, samples of the red feldspar porphyry rock consist of 80 to 90 percent orthoclase (potash) feldspar phenocrysts set in a finer grained matrix of minor mafic minerals (5 to 10%) and quartz (less than 5%). The mafic minerals (amphibole) show some alteration to chlorite and epidote. Localized stains of hematite and limonite suggest the presence of accessory magnetite and possible ilmenite (less than 1% of the rock).

It is estimated by Shutt (1970) that approximately 10.6 million tons of this rock underlies the property. This rock according to Shutt should yield at least 9 million tons of potash feldspar.

Anorthosite (sodium feldspar)

The entire Twin Buttes property is underlain by anorthosite; a rock that is enriched in andesine (soda) feldspar (Exhibits C1 and C2). The depth that the anorthosite obtains under the property is not known, but it should be considerable in that the Twin Buttes' anorthosite is part of an extensive batholith.

During field examination, two anorthosite types were recognized. Much of Baldy Mountain is underlain by fairly pure gray to black anorthosite containing better than 90% sodium feldspar (andesine plagioclase) by volume, with less than 10% mafics (pyroxene) and accessory ilmenite. In many grab samples, the mafic and accessory minerals comprised less than 2% of the total volume of the rock.

In the flat area of the eastern edge of the Twin Buttes property, the anorthosite is more noritic in composition, and commonly contains about 10% or greater mafic minerals. The composition of the feldspar ranges from andesine to labradorite and are therefore slightly more enriched in CaO than are the feldspars of the more pure anorthosite found on Baldy Mountain (i.e. the labradorite feldspar chemically contains greater $CaO:Na_2O$ ratios than the andesine feldspar). These two phases of anorthosite were not differentiated during mapping.

An analysis of the heavy minerals contained in the anorthosite is presented in Exhibit D, and the iron-bearing heavy minerals in Exhibit E. Floatation tests are summarized in Exhibit F. The more important iron-bearing heavy minerals are ilmenite, and this should be expected in that ilmenite is common throughout the Laramie anorthosite complex. In places, such as in the Iron Mountain District several miles west of Baldy Mountain, rich pods and lenses of titaniferous ilmenite were found in minable tonnages in the anorthosite (Hagner, 1968).

Shutt (1970) estimates that the tonnage of exposed anorthosite at Baldy Mountain is 19.8 million tons containing 17.8 million tons of andesine (soda feldspar).

Summary

The Baldy Mountain area, in section 8, T. 18 N., R. 72 W., contains large

resources of flagstone, limestone, potash and soda feldspar. These resources are extensive and could supply a good-sized operation with minable ore for more than a decade. Essentially all of the materials necessary to support a glass industry are found in southeastern Wyoming (Hausel, 1981) which should make the Twin Buttes property all the more attractive to industry.

Market conditions were not examined for this report, but are briefly discussed by Shutt (1970).

GEOLOGY

Casper Formation

The limestones of the Casper Formation are marine in nature, formed during Pennsylvanian-Permian time by a sea transgressing from the northeast. Transgressive and regressive cycles were most likely influenced by subsidence and uplift of areas to the south and west, i.e., the Ancestral Rockies. The regressions are reflected in the distribution and amount of the sands, silts and clays derived from the emerging highlands.

After the deposition of the sands, silts and clays and at the beginning of a transgression, terrigenous material continued to be fed to the encroaching sea in decreasing amounts as the subsidence continued, hence the basal contact of each limestone is gradational

When the areas to the south and west began to rise again, aoelian deposits of silt and clay were incorporated into the upper part of the calcareous ooze, forming in places a red marker bed.

It appears that Baldy Mountain itself is a block faulted downward from the main rim of the Casper Formation. However, the structure of this area is not of prime importance, but rather the lithologic nature of the sedimentary sequences.

ESTIMATED QUANTITY AND QUALITY

The following quantities were based on 1) limestone with calcium carbonate content greater than 50% (estimated average about 80%), 2) a minimum thickness of 15' for the limestone. The figure of 15' total thickness was arrived at by using the the cross-sections and from the known geology of the area, extrapolating the thickness of the bottom limestone. A quantity figure of 60,000+ cubic yards is not to be construed as a maximum figure, but rather a minimum estimate due to the relatively shallow penetration due to the afore-mentioned problem with the drill.

FUTURE INVESTIGATIONS

It is believed that if development of this area is to be undertaken, a complex of holes to a depth of not less than 150' should be considered. Coring would be of inestimable value in the development of a quarry and would facilitate reserve estimates.

cc: Michael Bintner
File

REFERENCES CITED

Hagner, A.F., 1951, Anorthosite of the Laramie Range, Albany County, Wyoming, as a possible source of alumina: Geological Survey of Wyoming Bull. 43, 15 p.

Hagner, A.F., 1968, The titaniferous magnetite deposit at Iron Mountain, Wyoming, in Ridge, J.D., (ed.), Ore deposits of the United States, 1933-1967 (Araton-Sales Volume) AIME, N.Y., vol.1, p.665-680.

Harrer, C.M., 1954, Wyoming anorthosite and related resources as a basis for an alumina industry: U.S. Bureau of Mines Preliminary Report no. 92, 30 p.

Hausel, W.D., 1981, Economic mineral deposits of Wyoming - a review: Wyoming Geological Association Guidebook, Sept., in press.

Osterwald, F.W., Osterwald, D.B., Long, J.S., Jr., and Wilson, W.H., 1966, Mineral resources of Wyoming: Geological Survey of Wyoming Bull. 50, 287 p. (Revised by W.H. Wilson).

Shutt, T.C., 1970, Preliminary report on feldspar occurrence on Twin Buttes Corporation property: Unpublished Report, 5 p.

JIM ELLIOTT
Consultant
Geology – Engineering Geology
912 Downey Street
Laramie, Wyoming 82070
Phone (307) 742-3516

July 2, 1978

M E M O R A N D U M

TO: Twin Buttes Company

FROM: Jim Elliott, Geologist

SUBJ: Limestone investigation, portion of Baldy Mountain, Section 8, T16N R72W.

GENERAL

This investigation was commissioned by Mr. Donald Bird and Mr. Michael Bintner in later April 1978 to determine quality and quantity of limestone beneath 2½ acres on top of Baldy Mountain and to ascertain if further investigation on the lower slopes of the mountain could be justified. Drilling was accomplished June 1-3, 1978 using a crawler-type compressed air drill with samples being taken at 2' intervals. Due to a malfunction in the drill, which could not readily be alleviated, it was not possible to penetrate deeper than 12'. Included with this report are cross-sections of the area, along with a map of hole placement and chemical analyses of some of the samples taken. Also included are cards with actual mounted samples.

(Exhibit A)

WYOMING ANALYTICAL LABORATORIES, INC.
Box 638 • 605 South Adams (307) 742-7995 LARAMIE, WYOMING 82070

REPORT OF ANALYSIS

Request No. 22 Lab No. 127 -152 Date June 19, 1978

Material Rock

Submitted by Twin Buttes Co.

Address 1515 Park
Laramie, Wyoming 82070

Lab. No.	Sample No.	Depth	%Ca	%$CaCO_3$	Lab.#	Sample No.	Depth	%Ca	%$CaCO_3$
127	1-1	2 to 4'	32.9	82.2	144	6-4	10-12'	32.0	80.1
128	1-2	4 to 6'	32.5	81.2	145	7-2	2 to 4'	37.0	92.6
129	1-4	8-10'	8.75	21.9	146	7-3	4 to 6'	36.6	91.5
130	1-5	10-12'	0.3	0.8	147	7-5a	6 to 8'	19.2	48.1
131	2-4	8-10'	20.0	50.1	148	7-5b	8-10'	6.8	17.0
132	3-1	2 to 4'	29.0	72.4	149	7-6	10-12'	14.1	35.2
133	3-2	4 to 6'	20.9	52.2	150	8-1	2 to 4'	28.7	71.9
134	3-3	6 to 8'	12.9	32.4	151	8-2	4 to 6'	18.6	46.5
135	3-4	8-10'	14.4	36.1	152	8-5	10-12'	38.5	96.3
136	3-5	10-12'	25.0	62.4					
137	4-4	10-12'	32.9	82.2					
138	5-1	2 to 4'	26.2	65.4					
139	5-2	4 to 6'	16.8	42.0					
140	5-3	6 to 8'	2.2	5.5					
141	5-4	8-10'	13.8	34.5					
142	5-5	10-12'	33.0	82.4					
143	6-3	8-10'	29.4	73.5					

Analyzed by Jane V. Thomas

Signed

Arbor-Rock Company

P.O. Box 31559
Denver, Colorado 80041
303 364-1290

October 2, 1978

Mr. Mike Bintner
1515 Park Avenue
Laramie, Wyoming

Dear Mr. Bintner:

The Flagstone samples received by this office recently are interesting. The crystal-like composition on one side is quite unique and had there been more space between the fissures, small stalagmites may have been developed.

This is not a common flagstone.

Because of the distinguishing features this stone could be promoted in the home and commercial building business.

Yours truly,

Thomas C. Brown

(Exhibit B)

NATURAL RESOURCES RESEARCH INSTITUTE
P. O. BOX 3038, UNIVERSITY STATION
LARAMIE, WYOMING 82071

REPORT OF ANALYSIS OR TEST

Sample No. 4609 Date April 21, 1977

Lab. No. 22035 Material rock

Submitted by Mike Bintner Date Rec'd April 11, 1977

Address Twin Buttes Corp. 1515 Park, Laramie, Wyo. 82070 Analyzed for see below

	original ore	crushed ore 60-140			
Al_2O_3	20.9	27.5			
SiO_2	63.0	56.2			
Fe_2O_3	1.7	1.8			
CaO	7.3	8.4			
MgO	0.5	.6			
Na_2O	4.1	5.1			
K_2O	0.5	.12			
TiO_2	0.28	.05			
Cu	0.11				
specific gravity		2.72			

Analyzed by Jane V. Thomas Analysis Completed April 21, 1977

Signed Jane V. Thomas Analysis Reported April 21, 1977

(Exhibit C-1)

THE UNIVERSITY OF WYOMING
COLLEGE OF ENGINEERING

NATURAL RESOURCES RESEARCH INSTITUTE
P. O. BOX 3038, UNIVERSITY STATION
LARAMIE, WYOMING 82071

REPORT OF ANALYSIS OR TEST

Sample No. 4598 Date November 4, 1976

Lab. No. 21953 Material rock

Submitted by Mike Bintner Date Rec'd November 3, 1976

Address Twin Buttes Corp.
1515 Park
Laramie, WY 82070 Analyzed for Alumina, Iron

	Al_2O_3	Fe_2O_3			
	28.8%	2.1%			

Analyzed by JVT Analysis Completed November 4, 1976

Signed Dan V. Thomas Analysis Reported November 4, 1976

(Exhibit C-2)

COLLEGE OF ENGINEERING

NATURAL RESOURCES RESEARCH INSTITUTE
P. O. BOX 3038, UNIVERSITY STATION
LARAMIE, WYOMING 82071

REPORT OF ANALYSIS OR TEST

Sample No. 4609 Date May 26, 1977

Lab. No. 22035 Material Anorthosite

Submitted by Mike Bintner Date Rec'd April 11, 1977
Twin Buttes Corporation

Address 1515 Park Ave. Analyzed for Heavy Minerals in
60 x 140 mesh product

Laramie, WY 82070

Float on 2.95	851.2 gr	97.01			
Sink in 2.95	26.2 gr	2.99	say 3.0%		
	877.4 gr	100.00			

The sample treated was not free of fines, which migrated so slowly in the heavy liquid that the sink product, as filtered, carried an appreciable quantity of this material. Hence the 3.0% figure is an upper limit.

X-ray spectrography of the sink fraction showed the major heavy metal to be iron which is probably present in the range of several tens of percent, say 30-[illegible]. The next most prominent metals were chromium, manganese and vanadium with very minor amounts of copper and zinc.

X-ray diffraction was difficult to interpret and merely suggested the presence of olivines altering to chlorite. Cordierite appears to be present. Under the microscope, there is a considerable fraction of magnetic material, only a small portion of which is transparent. In the rest of the heavy sample the major dark mineral grains, amounting to over three-fourths of the sample, are variably altered with high index of refraction - 1.65 and even greater than 1.74 again suggestive of olivine or other ferromagnesian minerals primarily. There does not appear to be any prominent cleavage apparent.

Analyzed by WED Analysis Completed May 26, 1977

Signed Walter E. Dunn Analysis Reported May 26, 1977

(Exhibit D)

HAZEN RESEARCH, INC.

4601 INDIANA STREET
GOLDEN, COLORADO • 80401
TELEPHONE 303/279-4501

September 22, 1977

Mr. LaVerne W. Bintner
3700 South Roslyn Way
Denver, CO 80237

Re: HRI Project 4314
Removal of Impurities from Feldspar Ore

Dear Mr. Bintner:

A mineralogical examination of your feldspar ore was made in order to determine the mode of occurrence of the iron. This examination was made upon your request following our meeting in August in which the results of screening and flotation tests were reviewed as per my August 19, 1977, letter.

As you may recall, the results given in the August 19, 1977, letter indicated that a feldspar concentrate produced by flotation would be expected to contain approximately 0.6% Fe_2O_3. The purpose of the present mineralogical examination was to determine how this iron was occurring in the concentrate.

For the mineralogical examination a portion of the first cleaner concentrate from flotation test A-4 was examined under the microscope. It was found that there were three types of iron occurrences: (1) as relatively coarse grained attached particles of ilmenite, (2) as surface coatings of hematite and limonite, and (3) as very small lamella of tentatively identified ilmenite occurring as oriented inclusions within the feldspar crystals. It is believed that the majority of the iron occurs as these lamella and due to their fineness, their liberation, and removal would require extremely fine grinding.

The first two forms of iron are potentially removable. To determine to what extent they could be removed, a sample of the

(Exhibit E)

concentrate was leached in a 1:1 HCl acid solution at 75°C for one hour. The results of this test gave a "clean" feldspar concentrate containing 0.337% Fe_2O_3. This is a 43.6% reduction in the iron based on a feed of 0.598% Fe_2O_3. We believe this to be indicative of the practical minimum level of iron that could be attained.

This practical iron limit was further substantiated by hand picking under the microscope crystals of feldspar which had clean surfaces and contained only the lamella of ilmenite. An assay of this hand-picked fraction gave an iron level of 0.387% Fe_2O_3.

During the foregoing examinations, it was noted that the feldspar crystals that were abundant in the ilmenite lamella were slightly magnetic. Therefore, a high intensity magnetic separation was made on the plus 48-mesh fraction of the concentrate sample. The magnetic separation resulted in three products: (1) a strongly magnetic product containing feldspar crystals that contained large amounts of the ilmenite lamella, (2) a weakly magnetic fraction in which the feldspar crystals contained a lesser amount of ilmenite lamella, and (3) a nonmagnetic fraction which contained relatively clean feldspar crystals having a low level of ilmenite lamella. The weight distribution and assays of the three products are given below. Please bear in mind that this separation was done only on plus 48-mesh material and a similar separation on the entire concentrate may give somewhat different results.

Table 1

Results of Magnetic Separation on Plus 48-mesh Material 1/

Fraction	% Wt	Iron Level % Fe_2O_3
Strongly magnetic	26.8	0.615
Weakly magnetic	48.5	0.302
Nonmagnetic	24.7	0.292

1/ First cleaner concentrate, flotation test A-4.

An acid leach of the nonmagnetic fraction in 1:1 HCl at 80°C for one hour gave a product assaying 0.236% Fe_2O_3. This is a 19.2% reduction in the iron level. This would appear to be the absolute minimum level of iron that could be achieved; however, it would probably not be practical to obtain.

I hope the foregoing information will prove helpful. It is extremely valuable since it identifies the mode of occurrence for the iron and defines the limit to which the iron can be removed. If you should have any questions, please feel free to contact us.

Sincerely,

J. C. Gathje

J. C. Gathje
Project Engineer

JCG:mk

HAZEN RESEARCH, INC.

4601 INDIANA STREET
GOLDEN, COLORADO • 80401
TELEPHONE 303/279-4501

August 19, 1977

Mr. LaVerne W. Bintner
3700 South Roslyn Way
Denver, Colorado 80237

Re: HRI Project 4314
Removal of Impurities from Feldspar Ore

Dear Mr. Bintner:

The purpose of this letter is to summarize the results of the work to date.

Four flotation tests have been run on the ore. A metallurgical balance has been made on only three. A metallurgical balance on the fourth test is not planned at this time. A screen analysis of the ore and an analyses of the fractions are also attached.

Results of the flotation tests are tabulated in Table 2, and screen analysis is given in Table 3. As you review the flotation data please keep in mind that the conditions have not been optimized. These results are only indicative of the ore's amenability to treatment.

The results of the flotation tests show the lowest iron for Test A-4 with a level of 0.598% Fe_2O_3 in the feldspar concentrate. This accounted for a rejection of approximately 90% of the total iron in the ore feed. The flowsheet for Test A-4 is similar to those used commercially to treat feldspar ores. It should, therefore, be the most indicative of what to expect from the ore.

The results of the screen analysis and fraction assays of Table 3 indicate that there may be a locking problem with the iron. This point should be investigated further by mineralogical examination to best determine the iron's mode of occurrence and its size.

(Exhibit F)

Should you have any questions regarding the enclosed data, please feel free to contact me. Mr. Carrasco and I are looking forward to meeting with you on Tuesday, August 23, 1977.

Best regards.

Yours very truly,

HAZEN RESEARCH, INC.

J. C. Gathje
Project Engineer

JCG:mgp
Enclosures

Table 1

Analysis of Ore
HRI 11802

Analysis			
Fe_2O_3 %	Mn %	Al_2O_3 %	V_2O_5 %
2.25	0.025	26.0	<0.01

Note: Fluorescent X-ray spectrographic analysis of ore is attached with letter.

Table 2

Summary of Flotation Tests

Test No.	Feed Size Tyler Mesh	Feldspar Concentrate Assays						
		Weight % of Feed	Fe_2O_3 %	Mn %	Al_2O_3 %	V_2O_5 %	SiO_2 %	Na_2O %
A-1	-200	57.60	0.768	0.008	25.0	<0.01	-1/	-1/
A-3	35 x 150	85.91	1.45	0.015	26.6	0.01	-1/	-1/
A-4	35 x 400	48.52	0.598	0.004	26.5	-1/	45.0	4.59

1/ Not assayed.

Table 3

Size Analysis and Chemical Analysis of Size Fractions
HRI 11802

Feed Size Tyler Mesh	Weight %	Assay				Distribution			
		Fe_2O_3 %	Al_2O_3 %	Mn %	V_2O_5 %	Fe_2O_3 %	Al_2O_3 %	Mn %	V_2O_5 %
20 x 60	71.71	1.82	26.0	0.017	<0.01	62.3	72.6	50.0	-
60 x 150	14.48	2.17	25.0	0.023	<0.01	15.0	14.1	13.6	-
150 x 200	3.50	2.30	24.0	0.030	<0.01	3.9	3.3	4.3	-
-200	10.31	3.82	25.0	0.076	<0.01	18.8	10.0	32.1	-
Calculated head	100.00	2.09	25.7	0.024	-	100.0	100.0	100.0	-
Assay head	-	2.25	26.0	0.025	<0.01	-	-	-	-

Table 4

Screen Analysis of Feldspar Cleaner 1 Concentrate from Flotation Test A-4

Feed Size Tyler Mesh	Weight %	Cumulative % Retained
0 x 48	3.19	3.19
48 x 65	16.01	19.20
65 x 100	25.88	45.08
100 x 150	20.98	66.06
-150	33.94	100.00
Total	100.00	

FLUO RESCENT
X RAY
SPEC TROGRAPHIC
Analytical Laboratory

718 Sherman Street (rear)
Denver, Colorado 80203
Phone (303) 837-1396
Merlyn L. Salmon, Manager

XXXX QUALITATIVE
XXXX SEMI-QUANTITATIVE
____ QUANTITATIVE

ANALYTICAL REPORT

Job Number 21780
Page 1 of 9 Pages
Date 5 Aug 1977

TO: Hazen Research, Inc

NOTE: The values below are estimated percentages in the metal equivalent of the indicated elements. No check was made for elements with atomic numbers less than 22 (below Titanium).

SAMPLE: HRI 11802

Copper	0.010	Iron	1.5	Lanthanum	
Silver		Cobalt		Cerium	
Gold		Nickel	0.005	Praseodymium	
Zinc	0.013	Cesium		Neodymium	
Cadmium		Rubidium	0.004	Samarium	
Mercury		Barium	0.072	Europium	
Gallium		Strontium	0.090	Gadolinium	
Indium		Titanium	0.13	Terbium	
Thallium		Zirconium	0.024	Dysprosium	
Germanium		Hafnium		Holmium	
Tin		Thorium		Erbium	
Lead	0.012	Vanadium		Thulium	
Arsenic	0.005	Columbium		Ytterbium	
Antimony		Tantalum		Lutetium	
Bismuth		Chromium	0.005	Yttrium	0.005
Selenium		Molybdenum			
Tellurium		Tungsten			
Bromine		Uranium			
Iodine		Manganese	0.037		

By Merlyn L. Salmon

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Attachment to Letter
Mr. LaVerne W. Bintner -6- August 19, 1977

FLUO RESCENT
X RAY
SPEC TROGRAPHIC
Analytical Laboratory

718 Sherman Street (rear)
Denver, Colorado 80203
Phone (303) 837-1396
Merlyn L. Salmon, Manager

XXXX QUALITATIVE
XXXX SEMI-QUANTITATIVE
_____ QUANTITATIVE

ANALYTICAL REPORT

Job Number 21780
Pages 2 of 9 Pages
Date 5 Aug 1977

TO: Hazen Research, Inc

SAMPLE: Test A-1, Feldspar concentrate

NOTE: The values below are estimated percentages for the metal equivalent of the indicated elements. No check was made for elements with atomic numbers less than 22 (below titanium).

Copper	0.005	Iron	0.52	Lanthanum	
Silver		Cobalt		Cerium	
Gold		Nickel	0.004	Praseodymium	
Zinc	0.003	Cesium		Neodymium	
Cadmium		Rubidium		Samarium	
Mercury		Barium	0.049	Europium	
Gallium		Strontium	0.094	Gadolinium	
Indium		Titanium	0.032	Terbium	
Thallium		Zirconium	0.025	Dysprosium	
Germanium		Hafnium		Holmium	
Tin		Thorium		Erbium	
Lead	0.009	Vanadium	0.007	Thulium	
Arsenic		Columbium		Ytterbium	
Antimony		Tantalum		Lutetium	
Bismuth		Chromium		Yttrium	0.001
Selenium		Molybdenum			
Tellurium		Tungsten			
Bromine		Uranium			
Iodine		Manganese	0.018		

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ANALYTICAL REPORT

Job Number 21780
Page 3 of 9 Pages
Date 5 Aug 1977

TO: Hazen Research, Inc

SAMPLE: Test A-1, Heavy minerals concentrate

NOTE: The values below are estimated percentages for the metal equivalent of the indicated elements. No check was made for elements with atomic numbers less than 22 (below titanium).

Copper	0.014	Iron	2.8	Lanthanum	
Silver		Cobalt		Cerium	
Gold		Nickel	0.004	Praseodymium	
Zinc	0.009	Cesium		Neodymium	
Cadmium		Rubidium		Samarium	
Mercury		Barium	0.074	Europium	
Gallium		Strontium	0.080	Gadolinium	
Indium		Titanium	0.50	Terbium	
Thallium		Zirconium	0.024	Dysprosium	
Germanium		Hafnium		Holmium	
Tin		Thorium		Erbium	
Lead	0.016	Vanadium	0.022	Thulium	
Arsenic		Columbium		Ytterbium	
Antimony		Tantalum		Lutetium	
Bismuth		Chromium		Yttrium	0.004
Selenium		Molybdenum			
Tellurium		Tungsten			
Bromine		Uranium	0.003		
Iodine		Manganese	0.058		

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Page 4 of 9 Pages
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NOTE: The values below are estimated percentages for the metal equivalent of the indicated elements. No check was made for elements with atomic numbers lower than 22 (below titanium).

SAMPLE: Test A-1, Slimes

Copper	0.022	Iron	2.4	Lanthanum	
Silver		Cobalt		Cerium	
Gold		Nickel	0.009	Praseodymium	
Zinc	0.011	Cesium		Neodymium	
Cadmium		Rubidium		Samarium	
Mercury		Barium	0.080	Europium	
Gallium		Strontium	0.087	Gadolinium	
Indium		Titanium	0.13	Terbium	
Thallium		Zirconium	0.016	Dysprosium	
Germanium		Hafnium		Holmium	
Tin		Thorium		Erbium	
Lead		Vanadium	0.008	Thulium	
Arsenic		Columbium		Ytterbium	
Antimony		Tantalum		Lutetium	
Bismuth		Chromium	0.007	Yttrium	
Selenium		Molybdenum			
Tellurium		Tungsten			
Bromine		Uranium	0.009		
Iodine		Manganese	0.038		

By Merlyn L. Salmon

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Page 5 of 9 Pages
Date 5 Aug 1977

TO: Hazen Research, Inc

NOTE: The values below are estimated percentages for the metal equivalent of the indicated elements. No check was made for elements with atomic numbers less than 22 (below titanium).

SAMPLE: Test A-3, Feldspar concentrate

Copper	0.008	Iron	0.80	Lanthanum	
Silver		Cobalt		Cerium	
Gold		Nickel	0.005	Praseodymium	
Zinc	0.004	Cesium		Neodymium	
Cadmium		Rubidium		Samarium	
Mercury		Barium	0.070	Europium	
Gallium		Strontium	0.078	Gadolinium	
Indium		Titanium	0.065	Terbium	
Thallium		Zirconium	0.020	Dysprosium	
Germanium		Hafnium		Holmium	
Tin		Thorium		Erbium	
Lead		Vanadium	0.023	Thulium	
Arsenic		Columbium		Ytterbium	
Antimony		Tantalum		Lutetium	
Bismuth		Chromium	0.002	Yttrium	0.001
Selenium		Molybdenum			
Tellurium		Tungsten			
Bromine		Uranium			
Iodine		Manganese	0.015		

By Merlyn L. Salmon

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ANALYTICAL REPORT

Job Number 21780
Page 6 of 9 Pages
Date 5 Aug 1977

TO: Hazen Research, Inc

NOTE: The values below are estimated percentages for the metal equivalent of the indicated elements. No check was made for elements with atomic numbers less than 22 (below titanium).

SAMPLE: Test A-3, Heavy minerals concentrate

Copper	0.007	Iron	3.8	Lanthanum	
Silver		Cobalt		Cerium	
Gold		Nickel	0.011	Praseodymium	
Zinc	0.008	Cesium		Neodymium	
Cadmium		Rubidium	0.005	Samarium	
Mercury		Barium	0.14	Europium	
Gallium		Strontium	0.083	Gadolinium	
Indium		Titanium	0.81	Terbium	
Thallium		Zirconium	0.026	Dysprosium	
Germanium		Hafnium		Holmium	
Tin		Thorium		Erbium	
Lead	0.010	Vanadium	0.032	Thulium	
Arsenic		Columbium	0.002	Ytterbium	
Antimony		Tantalum		Lutetium	
Bismuth		Chromium	0.005	Yttrium	0.002
Selenium		Molybdenum			
Tellurium		Tungsten			
Bromine		Uranium	0.009		
Iodine		Manganese	0.069		

By Merlyn L. Salmon

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HRI FLOTATION TEST

TITLE: Twin Buttes Mining Corporation

OBJECTIVE: Initial flotation test using minus 200-mesh ore.

REMARKS:

SAMPLE: HRI 11802, minus 200-mesh, 1,000 g

WATER: Deionized MACHINE: Agitair, LA-500

TEST NO.: A-1

PROJECT: 4314

DATE: July 14, 1977

PAGE: 1 of 1

BY: JCG

TEST CONDITIONS

OPERATION		Deslime 1/	Cond	Heavy Ro Float	Cond	Mica Ro Float
CELL		1000	1000	1000	1000	1000
TIME, MINUTES		-	2	2	2	5
pH		-	2.30	2.30	2.20	2.25
TEMPERATURE, °C		-	20	20	20	20
SOLIDS, %		-	≈ 50	-	-	-
REAGENTS, lb/TON	AP 801R	-	0.40	-	-	-
	AP 825	-	0.40	-	-	-
	H_2SO_4	-	4.40	-	2.00	2.00
	Hoechst 1940	-	-	-	-	-
	AP 815	-	-	-	-	0.18
						0.28

1/ Used Daxad 30 for dispersion

TEST PRODUCT	DRY WEIGHT g	WEIGHT %	ASSAYS, % Fe_2O_3	Al_2O_3	Mn	V_2O_5	UNITS	DISTRIBUTION, % Fe_2O_3	Al_2O_3	Mn
Head (assay)	-	-	2.25	26.0	0.025	<0.01		-	-	-
Feldspar conc	572.81	57.60	0.768	25.0	0.008	<0.01		20.5	57.6	20.6
Heavy min. conc	246.71	24.81	4.96	24.0	0.050	0.02		57.0	23.8	55.6
Slimes	174.87	17.59	2.76	26.5	0.030	<0.01		22.5	18.6	23.8
Head (calc)	994.39	100.00	2.16	25.0	0.022	-		100.0	100.0	100.0

hri

HRI FLOTATION TEST

TITLE: Twin Buttes Mining Corporation

OBJECTIVE: Flotation of 35 x 150-mesh ore

REMARKS:

SAMPLE: HRI 11802, 35 x 150-mesh

WATER: Deionized MACHINE: Agitair, LA-500

TEST NO.: A-3

PROJECT: 4314

DATE: July 15, 1977

PAGE: 1 of 1

BY: ICG

TEST CONDITIONS

OPERATION	Cond	Mica Float	Dewater	Cond	No.1 Heavy Float	Cond	No.2 Heavy Float
CELL	1000	1000	-	1000	1000	1000	1000
TIME, MINUTES	2	2	-	3	2	3	3
pH	2.8	3.0	-	2.40	2.60	2.60	2.80
TEMPERATURE, °C	20	20	-	20	20	20	20
SOLIDS, %	-	-	-	-	-	-	-
REAGENTS lb/TON: H_2SO_4	2.22	-	-	3.32	-	-	-
Armac T	0.66	-	-	-	-	-	-
DF-250	0.14	0.071	-	-	-	0.071	0.177
AP 801R	-	-	-	1.66	-	-	-
AP 825	-	-	-	1.11	-	-	-
AP 845	-	-	-	-	-	0.65	-

TEST PRODUCT	DRY WEIGHT g	WEIGHT %	ASSAYS, % Fe_2O_3	ASSAYS, % Al_2O_3	ASSAYS, % Mn	ASSAYS, % V_2O_5	UNITS				DISTRIBUTION, % Fe_2O_3	DISTRIBUTION, % Al_2O_3	DISTRIBUTION, % Mn	DISTRIBUTION, % V_2O_5
Head (assay)	-	-	2.25	26.0	0.025	<0.01					-	-	-	
Feldspar conc	309.99	85.91	1.45	26.6	0.015	<0.01					61.7	87.6	61.1	
Heavy min. conc	50.83	14.09	5.49	23.0	0.058	0.03					38.3	12.4	38.9	
Head (calc)	350.82	100.00	2.02	26.1	0.021	-					100.0	100.0	100.0	

HRI FLOTATION TEST

TITLE: Twin Suttes Mining Corporation

OBJECTIVE: Production of clean feldspar concentrate.

REMARKS: Use of mica float followed by iron float and then a feldspar float.

SAMPLE: HRI 11802, minus 6-mesh, 1,000 g

WATER: Deionized MACHINE: Agitair, LA-500

TEST NO.: A-4

PROJECT: 4314

DATE: August 4, 1977

PAGE: 1 of 2

BY: JCG

TEST CONDITIONS

OPERATION	Grind 1/	Deslime	Cond	Mica Float	Dewater	Cond	Heavy Float	Dewater	Cond	Feld-spar Float	Dewater	Cond	Feld-spar Float
CELL	Rod (G)	400-mesh	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
TIME, MINUTES	5 and 4	-	16	5	-	10	7	-	5	3	-	5	1-1/2
pH	-	-	2.25	3.05	-	1.75	1.95	-	2.00	2.40	-	2.3	2.45
TEMPERATURE, °C	-	-	-	-	-	-	-	-	-	-	-	-	-
SOLIDS, %	50	-	-	-	-	-	-	-	-	-	-	-	-
REAGENTS, lb/TON													
H_2SO_4	-	-	2.83	-	-	4.05	2.02	-	-	-	-	-	-
Armac T	-	-	0.28	-	-	-	-	-	0.81	-	-	0.81	-
Fuel Oil 2	-	-	0.275	-	-	-	-	-	-	-	-	0.14	-
DF-250	-	-	0.323	-	-	-	0.259	-	-	0.13	-	-	-
Morco M-70	-	-	-	-	-	3.04	1.01	-	-	-	-	-	-
HF	-	-	-	-	-	-	-	-	8.50	-	-	8.10	-

1/ Stage ground and sized to 35 x 400.

TEST PRODUCT	DRY WEIGHT g	WEIGHT %	ASSAYS, % Fe_2O_3	Mn	Na_2O	SiO_2	UNITS				DISTRIBUTION, % Fe_2O_3	Na_2O		
Head (assay)	-	-	-	-	-	-					-	-		
Feld. clnr 1 conc	479.19	48.52	0.598	0.004	4.59	45.0					9.9	≈64.8		
Feld. clnr 1 tails	31.01	3.14	1.50	-	4.27	-					1.6	≈ 3.9		
Feld. ro tails	268.96	27.23	3.75	-	3.95	-					34.9	≈31.3		
Iron conc	84.78	8.58	10.86	-	-	-					31.9	-		
Mica conc	12.49	1.27	5.45	-	-	-					2.4	-		
Slimes	111.23	11.26	5.00	-	-	-					19.3	-		
Head (calc)	987.66	100.00	2.92	-	≈4.4	-								
Feld. ro conc	-	-	-	-	-	-								

hri

HRI FLOTATION TEST

TITLE: Twin Buttes Mining Corporation

OBJECTIVE:

REMARKS:

SAMPLE: HRI 11802, minus 6-mesh, 1,000 g

WATER: Deionized MACHINE: Agitair, LA-500

TEST NO.: A-4

PROJECT: 4314

DATE: August 4, 1977

PAGE: 2 of 2

BY: JCG

TEST CONDITIONS — Feldspar

OPERATION	Cond	Cleaner 1
CELL	1000	1000
TIME, MINUTES	5	2
pH	2.35	2.60
TEMPERATURE, °C	-	-
SOLIDS, %	-	-
REAGENTS, lb/TON: Armac T	-	-
Fuel oil 2	-	-
HF	2.16	-

TEST PRODUCT	DRY WEIGHT g	WEIGHT %	ASSAYS, %				UNITS				DISTRIBUTION, %			

hri

Flowsheet for Flotation Test A-4

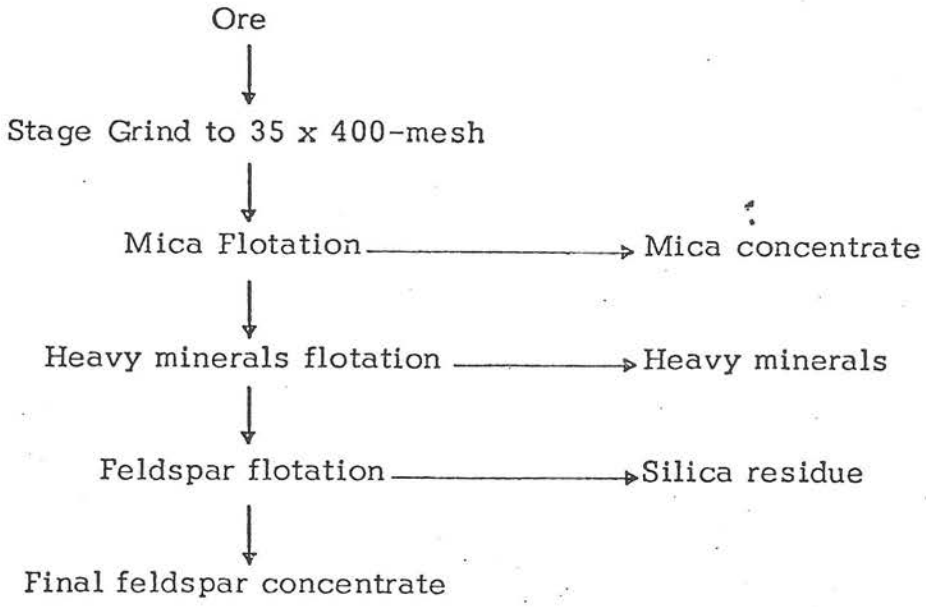

Figure 1

36 f.