[Bennett, W.A.G., 1964] Feldspar reports

Tumtum Mountain—A Potential Source of Feldspar

Introduction

Tumtum Mountain is a cone-shaped topographic feature in northeastern Clark County. It is about 35 miles north-northeast of Portland, 20 miles due east of U.S. Highway 99 at Woodland, Washington, and 6 miles northeast of Yacolt, which is, or has been, a terminus of a branch line of the Northern Pacific Railroad. It lies at the western border of the southern Cascades foot hills area, on the south side of the Lewis River drainage system, and its base is only about 600 feet above sea level. The summit of the cone rises 1,400 feet above the base on the northwest slope and 900 feet on the southeast. The width of the base is about 3/4 mile, but its area of outcrop as mapped by Mundorff is approximately a square mile, having an extension to the southwest. According to Mundorff, in his report for the U.S. Geological Survey in cooperation with the State Division of Water Resources, Tumtum is a volcanic cone built on top of glacial deposits after the glacier had melted back,also that it is practically unmarked by erosion, and that the volcanic material rose along a fault that extends from under the mountain wouthwestward for several miles; he did not, however, mention the kind of rock that composes the cone.

Subsequent to Mundorff's work, in connection with field checks for the new State geologic map, some observations were made on Tumtum by Marshall Huntting and Ted Livingston of the Division, and Howard Gower of the U.S.G.S. They noted the unusual appearance of the rock, and later petrographic examination showed a predominant feldspar composition. As a result, a decisio was made to show the cone in the category of Tertiary intrusives.

The only exposure of rock so far found to be in place is at the summit in an area some 10 to 15 feet across and rising 5 feet or so above the thin soil and forest debris. Elsewhere the cone is surrounded by talus consisting of fragments in various sizes generally from a few inches to a foot or few feet in diameter. In one place along an old road, near the base on the west side, rock is exposed intermittently for 100 feet; here, in the road cut, one has to decide whether there is an outcrop or just blocks that have rolled down slope. All of this adds to the difficulty of determining the structure and emplacement of the mass. On the southeast side of the cone the talus rests on dark-gray, flinty, porphyritic andesite.

Megascopically the rock is rather uniformly light gray to grayish white, fine grained to dense, and occasionally shows inclusions of various sizes to as much as one or two inches in diameter. These inclusions are usually dark and sometimes easily identifiable as andesite. Very rarely minute phenocrysts of hornblende or hypersthene are visible, sometimes cleavage faces of feldspar phenocrysts may be seen. The specific gravity of the rock is 2.43 as compared to 2.63 for oligoclase. This probably indicates a persistent zeolitic alteration of the groundmass, as these minerals are less dense than feldspars. When hit with a hammer the rock has a soft or punky, brick-like response, and small fragments are easily crushed to a powder. The rock will soak up and drip oil when specimens are sliced with a diamond saw lubricated with oil.

Examination of thin sections shows predominant laths of andesine forming generally 90 percent or more of the rock. These are oriented to form a trachytic texture, small crystals tending to wrap or flow around less abundant larger crystals. Magnetite, or titaniferous magnetite appears to form about 3 percent by weight. Apatite, which appears more abundant in some places than in others may form 2 percent, most of it being present in minute needles in the groundmass. The occasional phenocrysts of feldspar usually show zoning, In one instance a relatively large phenocryst 1.7 mm long was twinned but had a dusty border some .03 mm thick on the outer side of which there was further crystallization, like the interior being free of dustiness or alteration effects. In general the feldspar laths range in size between .12 and .16 mm. Some phenocrysts of feldspar are .7 to .9 mm and unusually large ones are 1 to 1.7 mm. Quartz grains are uniformly about .05 mm in diameter.

The rock from the summit shows conspicuous flow structure, which can be seen vaguely in the hand specimen megascopically. Quartz is present in considerable amount as equidimensional grains in the center of the mass. This, together with zeolitic alteration of the groundmass, perhaps indicated the passage of volatiles in greater amount in this part than elsewhere. However, the study of talus specimens picked up around the north, west, and south sides show a general uniformity in color and texture, but some variations in content of magnetite, apatite, and to some extent in alteration effects. The alteration, which is believed to be late magmatic or deuteric, is in the form of fillings between feldspars, in some places there appears to be replacement. In all cases the alteration is in minute areas (tenths or hundredths of a mm across) corresponding to the size of the feldspar crystals themselves. The alteration mineral that is wide spread in the Tumtum mass is the zeolite, chabazite, at least is the most likely mineral of the zeolite group. In crushed fragments, the index of refraction is as low as 1.486 and was at first suspected of being analcite, but this, because of low but persistent birefringence and other optical characters, suggest chabazite. Another ziolite is stilbite, which was found in a minute fracture, vug, or possibly miarolitic cavity next to a partly resorbed or absorbed inclusion. This has the characteristic sheaf, or what would be more descriptive, shingle-bale structure. Water clear rectangular plates of the mineral, like shingles piled on top of each other, form a composite wedge in their attachment to the walls of the cavity.

Various rock names might be applied to the Tumtum rock. Some geologists would call it anorthosite as a general term not specifying the kind of feldspar. But it has been the practice to restrict this term to rocks composed of labradorite or more calcic members of the plagioclase series. If the rock were essentially pure andesine, it might be called andesinite. Whatever name is applied should indicate the mode of origin. H. S. Washington, according to Johannsen, used the name oligoclasite for an oligoclase lava flow on the island of Hawaii, but he later changed it to oligoclase andesite. This rock has similarities to that described by Washington, except that the feldspar is more calcic. Perhaps leuco, quartz bearing andesite would be suitable, if the mass is a volcanic dome or leuco, micro quartz bearing diorite, if intrusive.

Feldspar-rich rocks

Material	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	Loss (Ignition)	Other	Anal
Wyoming anorthosite	27.3	49.9	2.1	0.3	13.2	0.6	3.9	0.6	1.8	0.3	U.S.
Wyoming anorthosite	29.4	51.6	1.4	-	11.9	-	4.2	-	1.1	.4	U.S.
Oligoclasite*	19.50	64.98	2.51		3.70	.50	6.09	2.01			Kold
Oligoclase	22.99	64.81			3.15		8.89	.82			Ytter
Leuco diorite** pegmatite	24.10	59.48	.66		8.21	.39	6.67	.49			(Joha nsa

* 90% oligoclase
** 93% andesine, 4% hornblende, 3% quartz

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Economic aspects

As a source of feldspar.—According to the U.S. Bureau of Mines, feldspar production has steadily increased since the 1850's to an all time high of 560,000 long tons in 1956. Ten companies produce 80 percent of the crude feldspar mined and also market most of the beneficiated and/or ground feldspar. There are many small producers of crude feldspar, and deposits are widely scattered throughout the United States, but production is centered in the southeastern, New England, and western states.

Feldspar is gound to various sizes and sold for flux and as a source of alumina in making glass, pottery, porcelain, enamel, tile, and other ceramic products. Sands are used. Pegmatites with large crystals are mined, followed by hand cobbing and hand sorting, and by mass mining methods with subsequent flotation or electrostatic concentration. Iron or iron-bearing minerals are removed by magnetic separators. Quartz and feldspar may be separated electrostatically.

The principal byproducts are quartz and mica. Nepheline syenite and aplite are the major substitutes for feldspar as a source of alkalies and alumina. Other substitutes are talc, pyrophyllite, electric-furnace slag, and lithospar.

Some feldspar is imported, but the U.S. is self sufficient in feldspar. World reserves are adequate for the foreseeable future. The outlook is for a gradual growth. The percentage of feldspar recovered by froth flotation will continue to increase.

The major problems of industry are high production costs, lack of knowledge on massive high-grade deposits, transportation costs, and competition from substitutes. The Bureau of Mines points out that the major problem for the producer is lack of a firm market, as well as the high cost of production compared to selling price of feldspar. High transportation costs constitute a problem.

It is further pointed out that the feldspar of granite may contain inclusions or disseminations of iron-bearing minerals which render the feldspar worthless for most commercial uses. Possible objectionable impurities in the Tumtum rock, as already mentioned, are magnetite and apatite, but further study should be made to determine the persistence of these.

The Bureau states that three companies are mining alaskite in North Carolina, and are recovering quartz, mica, and feldspar, the latter being soda feldspar carrying 4 to 8 percent K_2O.

As to the problem or possible problem in the use of Tumtum feldspar, the Bureau states that research by State agencies and companies throughout the country is being carried on with respect to improvements in milling techniques, such as electrostatic separation to increase the potash to soda ratio and to reduce the free quartz content.

It may be that the rock is best suited as a source of alumina. In 1947, the Bureau, in R. I. 4132, outlined a process for the sintering of anorthosite (feldspar rock) using limestone and soda ash in proper proportions. The sintered product forms a water soluble sodium aluminate and a water soluble calcium silicate. The alumina is precipitated as trihydrate, which is calcined to produce anhydrous aluminum oxide. The end liquors are treated to remove potassium sulphate and to recover soda ash for the economical operation of the process. The anhydrous aluminum oxide is then reduced electrolytically to aluminum metal.

The Bureau states in Mineral Facts and Problems, 1960, that it is "making field and laboratory investigations of ceramic raw materials, including feldspar, in the Pacific Northwest, where there is a lack of known resources." Quantitative data on world reserves of feldspar are not available, but they are enormous no doubt in sands and feldspathic rocks around the world. In Canada, there is reported over an area of 25 acres 7.6 million tons of ore containing 59.2 percent feldspar.

The writer has made a rough estimate of the volume of Tumtum, assuming an average diameter of the base of 3,400 feet and an average altitude of 1,000 feet, not considering the pore space of voids in the talus or guessing at its thickness, of some 230,000,000 short tons. The working of the deposit would seem to be accomplished with no drilling or blasting until the more solid rock is reached beneath the talus. The rock itself should be drilled with little or no difficulty, considering the remarkable softness of the material.

There is a relatively small deposit of feldspar on San Juan Island, and there are porphyritic granitic rocks in the State which might be used, but only by flotation. Tumtum is the first large deposit found in the State, if it can be used, utilizing the favorable location with respect to rail.