TABLE MOUNTAIN, OREGON

NEPHELINE SYENITE PROSPECT

GEOLOGIC FIELD RECONNASAINCE AND SAMPLING PROGRAM

by

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PREFACE

The varied applications of nepheline syenite have put the commodity in a prime market position around the world. The Table Mountain nepheline syenite prospect is strategically located near the seaport of Newport, Oregon, and it has excellent access by ground and rail transportation. The estimated reserves at Table Mountain are in the neighborhood of 700 million tons, exploitable by open pit means. The size and the strategic location of the nepheline syenite at Table Mountain justify further research as to the removal of its iron content. The application of biomimic technologies may provide an avenue in this issue.

Nepheline Syenites are igneous intrusive rocks. They are light-colored, medium- to coarse-grained holocrystalline, deficient in silica, feldspathic, largely made up of nepheline, sodium feldspar (albite), and alkali feldspar (orthoclase, microcline), additional trace minerals and rare earth elements (REEs) but no quartz. Silica undersaturated magmas crystallize nepheline instead of albite. These unique rocks set the stage for a wide variety of applications.

Commercially viable syenites are typically high in alumina (>23%), low in silica (<60%), low in iron (<2% Fe_2O_3), and high in alkalis ($Na_2O+K_2O>15\%$). Nevertheless, some deposits containing 2 to 5% iron can be used for the manufacture of colored glass and still have application in some ceramics. The syenite at Table Mountain contains alumina 18 to 19%, Silica 58%, iron 5 to 6% and alkalis (Na_2O+K_2O) 12.43%. Syenites are found all over the world but only a few are sufficiently low in iron, or have iron in a form than could be inexpensively removed, for use in clear glass or ceramic applications.

There are 11 major commercial nepheline deposits in the world, most notably in Russia, Canada and Norway. Some are exploited underground and others by open pit means. The production capacity ranges from 35,000 to 1,500,000 ton per year. Perhaps the most important nepheline producer in the world is Unimin Corporation.

There are about 28 additional known deposits, of which 4 have minor production, 2 are proposed for exploitation, 2 are under development, 2 have been examined, 1 is under preliminary testing, 3 have been delineated, 4 are undergoing exploration, 1 is underdevelopment and 9 have no formal or extensive studies known. The nepheline syenite at Table Mountain is classified in the last 9 with no formal or extensive studies known.

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NEPHELINE SYENITE PROSPECT

1. INTRODUCTION.

A reconnaissance-sampling program of the nepheline syenite at Table Mountain, Oregon, was conducted by Ricardo Villasenor (geologist), on October/November, 2007. Laboratory analyses of 17 samples were obtained to determine the chemical composition of the deposit. The reported nepheline values were marginal but somewhat promising considering the sizeable reserves. These reserves are estimated to be 700 metric tons, an economically feasible extraction through open pit means.

- The iron content obtained in the lab results is high (5-6%), restricting the straight use of the ore in high quality ceramics.
- Beneficiation testing by the Bureau of Mines (1962) apparently failed to remove the iron content, however no details are known regarding the testing.
- However, the application of a new biological agent technology reportedly can remove the iron content.
- It is recommended that cathodoluminescence research be conducted on selected samples to verify which host mineral(s) contain the iron fraction. The results will serve as a foundation for any future beneficiation tests.[1]
- The location of the deposit plus its accessibility and excellent infrastructure justify the preliminary investment in market research and economic viability of a variety of potential products that do not require the removal of the iron content.

2. GENERAL INFORMATION.

Mr. Ricardo Villasenor, Geologist, was commissioned to conduct a preliminary geologic reconnaissance of the nepheline syenite prospect at Table Mountain, near Newport, Oregon. The nepheline syenite occurrence consists of a thick tabular body of rock (an intrusive sill) extending over 1 square mile with a depth of over 300 ft. The potential tonnage in this deposit is estimated to be 700 million tons of recoverable nepheline syenite. The prospect is well situated for potential markets due to its accessibility by ground and maritime transportation near Newport, Oregon. Specific market and application research is necessary to determine the immediately exploitable economic uses of the resource. Even though, the reported nepheline values obtained in this initial sampling were marginal, and the iron content in them was high, the tonnage potential and the location of the resource justify further beneficiation ore testing. The mineral mining claims in the area are registered under the name of Mr. Barry Murray, and purportedly in good standing.

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[1] cathodoluminescence is an inexpensive petrographic research on polished thin sections; approximately $500 per sample.

2.1 Location and Infrastructure of the Table Mountain Prospect. The claims are found 15 miles (direct) from Newport/Toledo, or 12 miles NW (direct) from Waldport, on the scenic Oregon Coast, which is itself 135 miles SW from Portland, Oregon. The coordinates of the apex at Table Mountain are 44° 28.52'N, 123° 50.20'W or 44° 28' 31"N, 123° 50' 12"W or UTM 10 433550E 4924821N.

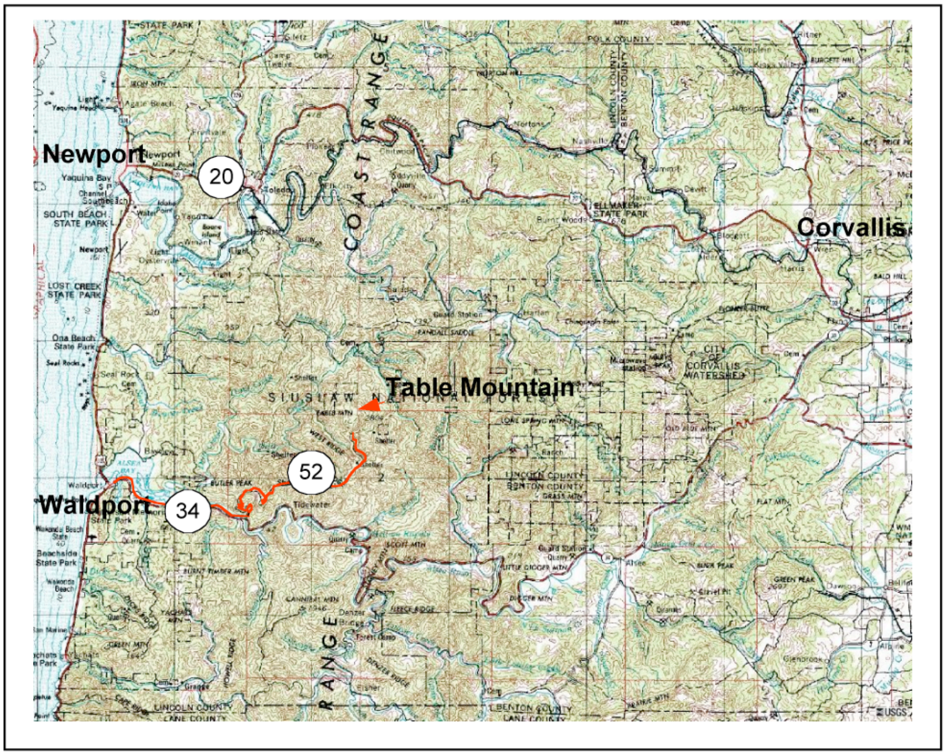

FIGURE 2. LOCATION MAP (OREGON)

2.2 Access.

By road Table Mountain is situated 25 miles from either point, Newport/Toledo or Waldport, Oregon, with the best all weather route being a paved highway from Waldport for 20 miles, and U.S. Forest Service road for 8 miles, of which the last three miles are gravel. From Oregon Highway 34, turn north on FS 52, which is blacktopped for the first 5 miles. Turn north again at the junction of 5200, and continue on for 3 miles on gravel (crushed nepheline syenite) to the claim boundary.

2.3 Infrastructure.

Table Mountain is easily accessible by ground, water, and rail transportation.

2.3.1 Roads.

Roads are accessible year round and are well maintained using nepheline syenite gravel as road base.

2.3.2 Rail.

The paper mill in Toledo maintains constant access to the rail network. There is a railhead and sea-going barge loading facility at Toledo, only 15 miles away, which could be accessed via a private logging road. Portland & Western Railroad (P&W), a wholly owned subsidiary of Genesee & Wyoming Inc., operates a 520-mile regional system consisting of rail transportation service to the Portland metropolitan area, the Willamette Valley, coastal Toledo, and the deep-water Port of Astoria. The "Toledo Line" runs from Toledo to Albany, Oregon serving a large Georgia Pacific kraft paper mill.

2.3.3 Barge.

A barge port is also accessible at Toledo, approximately 10 miles up river from the seaport of Newport.

2.3.4 Sea Port.

The Port, based in Yaquina Bay, was constructed as a deep-water port to provide shipping services to local, regional and international vessels and to service one of the largest commercial fishing fleets on the Oregon coast. Currently, the Port is restricted in providing shipping services due to failing terminal infrastructure; however, redevelopment of the terminal is set to begin in 2007 and be completed in 2009.

2.3.5 Electricity.

Table Mountain hosts a microwave repeater station. An electric line runs underground on the north side of the area.

2.3.6 Water.

There is a natural water spring located on the SW flank of the mountain at approximately 2280 ft a.s.l. at the following coordinates: Long. N44 27.968 / Lat. W123 50.821. The spring was roughly estimated to produce 15 gal/min in late October/early November.

3. OBJECTIVES OF THE SURVEY.

The main objectives of this study were to obtain a preliminary general view of the mineral resource at Table Mountain, Oregon. These objectives included:

- A general reconnaissance of distribution and potential of the nepheline syenite by a field inspection.
- Collecting field samples at the Table Mountain.
- Chemical analysis of samples in a laboratory to determine their nepheline, iron and other elements.
- Estimate the potential reserves of the deposit.
- Explore the future steps to determine the economic viability and applications of the resource.
- Obtain background and historical information on the prospect.
- Discuss possible approaches for ore beneficiation methods.
- Determine a research strategic plan.
- Develop a report.

4. BACKGROUND INFORMATION.

Two official reports have been published on Table Mountain: Bulletin 81 and USGS Professional Paper 840. Unofficially, there have been some unconfirmed studies done by Hecla Mining Inc. and by a metallurgist regarding the iron removal and ore beneficiation applying biological technology.

4.1 Bulletin 81.

The Oregon Department of Geology and Industrial Minerals, , published *Environmental Geology of Lincoln County*, *Bulletin 81* (1973) [1]. This article mentions some of the potential commercial applications of the resource at Table Mountain. A beneficiation testing of the ore performed by the Bureau of Mines was also mentioned in this article. This beneficiation test failed to remove the iron content, which would the application of the nepheline syenite at Table Mountain from being used in clear glass and some ceramics. No detail information has been found in regards to this beneficiation testing.

4.2 USGS. Professional Paper 840.

The second publication was issued by The US Department of the Interior, Geological Survey Professional Paper 840, "Description and Analyses of Eight New USGS Rock Standards [2], which described the nepheline syenite mineral deposit at Table Mountain in general terms.

4.3 Biological Ore Beneficiation Technology.

This is a beneficiation technology using microorganisms to process the ore for the removal of its iron content. No tangible information has been seen by Ricardo Villasenor or by the claim owner regarding this testing but it has been expressed that it was successfully applied on the syenite at Table Mountain. Current investigation is taking place with respect to the application of the technology.

4.4 Hecla Mining, Inc. James G. Clark (petrologist) from Applied Petrographics, Inc. in Oregon, pointed out to Mr. Villasenor that during the 90's Hecla had done some studies at Table Mountain. The nature of these studies is unknown at this point.

5. MINING CLAIMS.

A composite of thirty five (1-35) nepheline mining claims, ORMC 151343, ORMC 151374, at Suislaw National Forest, Lincoln County, Oregon, cover the greater portion of the nepheline syenite mineral resource. The surrounding forestlands belong to USFS property and Georgia Pacific holdings. A portion of the deposit is on section (36), which is set aside as State of Oregon School Lands, and as such is not open to mineral entry and no additional mining claims can be filed in the area (see Figure 5.0).

5.1 Certificate of Location.

Currently registered on file at the Lincoln County Courthouse in Book 320, Pages 0463 to 0495. The Oregon Office of the Bureau of Land Management also has claim documents on file.

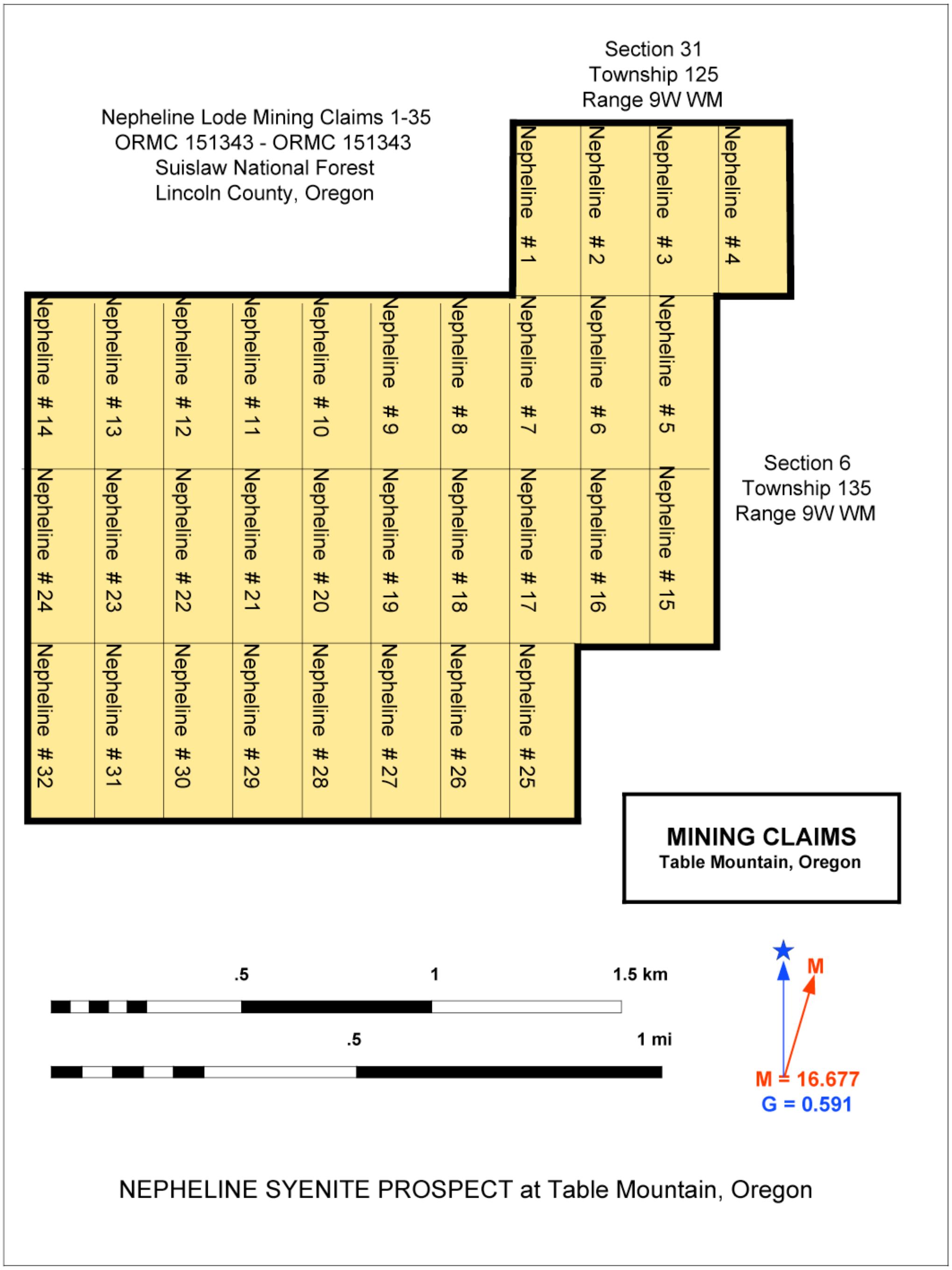

Figure 5. Mining Claims

5.2 Claim Stakes.

The claim pattern was laid out to accommodate the future patent process, once the claims are put into production. This is a procedure where the land is purchased in fee simple from the government.

5.3 Mining Claims and Surrounding Land.

The forestlands adjacent to the claims are USFS property and Georgia Pacific holdings. A portion of the deposit is on a section (36), which is set aside as State of Oregon School Lands, and as such is not open to mineral entry and no additional mining claims can be filed in the area (see Figure 5.0).

6. METHODOLOGY.

6.1 Geologic Mapping.

The geology map was copied and modified from the one published in the USGS, Professional Paper 840 by P.D. Snavely, Jr., and H.C. Wagner, 1959. The map exhibits two geologic units, which have not been determined as the original map has not been available. A new topographic map and cross sections were constructed based on this geological map.

6.2 Tonnage (Reserve) Estimates.

The volumetric calculation for the tonnage potential in the prospect was estimated from the geologic outcrop in combination with the topographic map.

6.3 Topographic Map.

The topographic map was reconstructed from the published USGS maps.

6.4 Rock Sampling.

Seventeen (17) field samples of nepheline syenite at Table Mountain were collected in the field. Fifteen (#1-15) of these samples were surface samples of weathered rock and two (A and B) were bulk samples with somewhat less weathered surfaces. The rock exhibits a tenacious strength that makes it very difficult to chip, and therefore true representative samples were difficult to collect by means of regular hammer and chisel. The samples were wrapped in aluminum foil, which is NOT a recommended practice because the metal can contaminate the sample. The samples sent to the lab for analysis were scrubbed with a plastic brush, and rinsed to remove and aluminum residue. The samples were then reduced in size and sent to the lab in plastic bags. The consistency of the aluminum values reported in the analysis indicates that there was no contamination from the aluminum foil.

6.5 Chemical Analysis and Laboratory Techniques.

The laboratory work was all performed by Stan Mertzman, Professor of Geosciences, Franklin & Marshall College[2]. The samples were analyzed using major element chemical analysis process, *Loss on Ignition* determination (LOI), and the Fe+2 titration. The total amount of iron present in each sample was determined by X-ray fluorescence (XRF). The nepheline content was estimated by *Normative Mineral Calculation*. In addition, the allocation of the iron content was determined by the reconstructing the theoretical mineral composition.

7. GEOLOGY.

Regionally, the Table Mountain area is surrounded by sandstone and siltstone sedimentary beds of the Tyee Formation (middle Eocene). The plutonic sill that underlies Table Mountain, which consists a peralkaline nepheline syenite composition[3], locally intruded these sediments. The sill exhibits a tabular shape that extends over 1.5 mi^2, ranging in thickness from 250 to 400ft and gently dipping 6° in a S65°W direction. A few remnants of sediments overlay the nepheline syenite. A north-south fault intersects the sill body with a transverse movement.

There is very little overburden covering the nepheline syenite making it amenable to open pit mining. Most of the area is heavily wooded with commercial conifers. Additional dike intrusions of nepheline syenite, shonkinite[4], and camptonite[5] (***) compositions crop out in the area. These intrusions are thought to be the arteries of the sill at Table Mountain. A nepheline syenite dike at Indian Creek, Mapleton quadrangle (approximately 18 miles south of Table Mountain), has a potassium-argon age of 33.6 m.y. (determined by R.W. Kisler, U.S. Geol. Survey). The fresh nepheline syenite presents a somewhat homogeneous appearance but locally it ranges in color from gray to light gray to greenish. It is a fine-grained holocrystalline rock (phonolite-like) with a trachytic texture characteristic of plutonic flowage. The rock is extremely tenacious and resists breakage when struck with a sledgehammer, making fresh rock chips difficult to obtain. On the surface, the nepheline syenite is weathered, exhibiting a pitted surface due to the leaching nepheline and analcime.

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[2] Stan Mertzman, Professor of Geosciences,Department of Earth and Environment, Franklin & Marshall College,Lancaster, PA 17604-3003,USA

[3] Nepheline Syenite is a light-colored, medium to coarse-grained holocrystalline, silica-deficient, feldspathic, plutonic igneous rock largely made up of nepheline, sodium feldspar (albite) and alkali feldspar (orthoclase, microcline), but no quartz

[4] Shonkinite is an uncommon type of intrusive igneous rock found in Montana, Ontario, Canada, and the southeast Indonesian island Timor. The dominant materials that comprise the dark-colored rock are orthoclase feldspar and augite. Other minerals include olivine, biotite, and nepheline, with little plagioclase feldspar and no quartz. Shonkinite is closely related to several other relatively rare types of rock, such as theralite, essexite, and teschenite.

[5] Camptonite, sannaite, and monchiquite, are types of the rock in which the predominant mafic minerals are amphibole, augite, olivine, and biotite. Camptonite is distinguished form these closely related rocks, however, by the fact that it contains a greater amount of feldspar than feldspathoid minerals and more plagioclase than orthoclase feldspar.

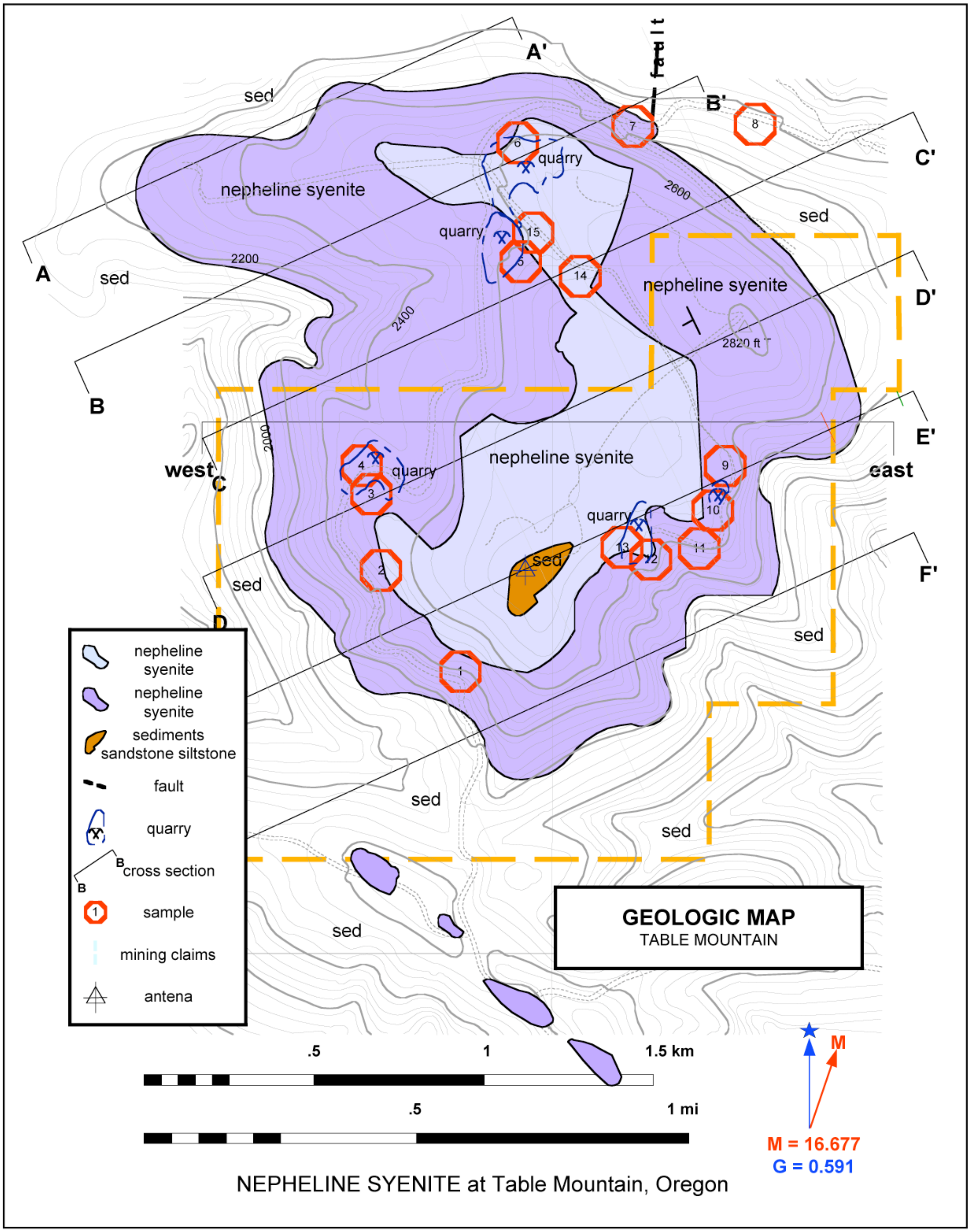


Figure 7. Geologic Map

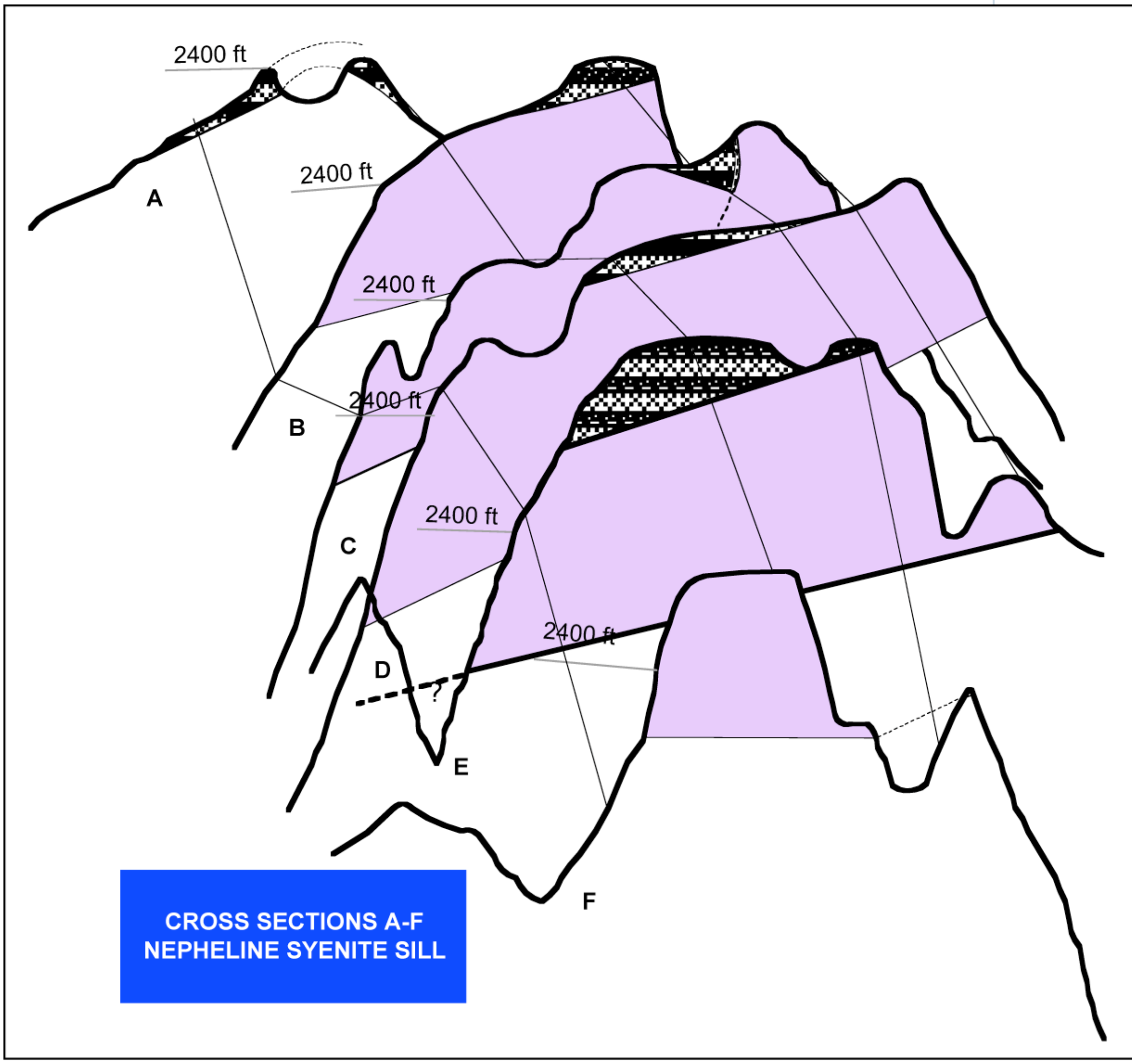
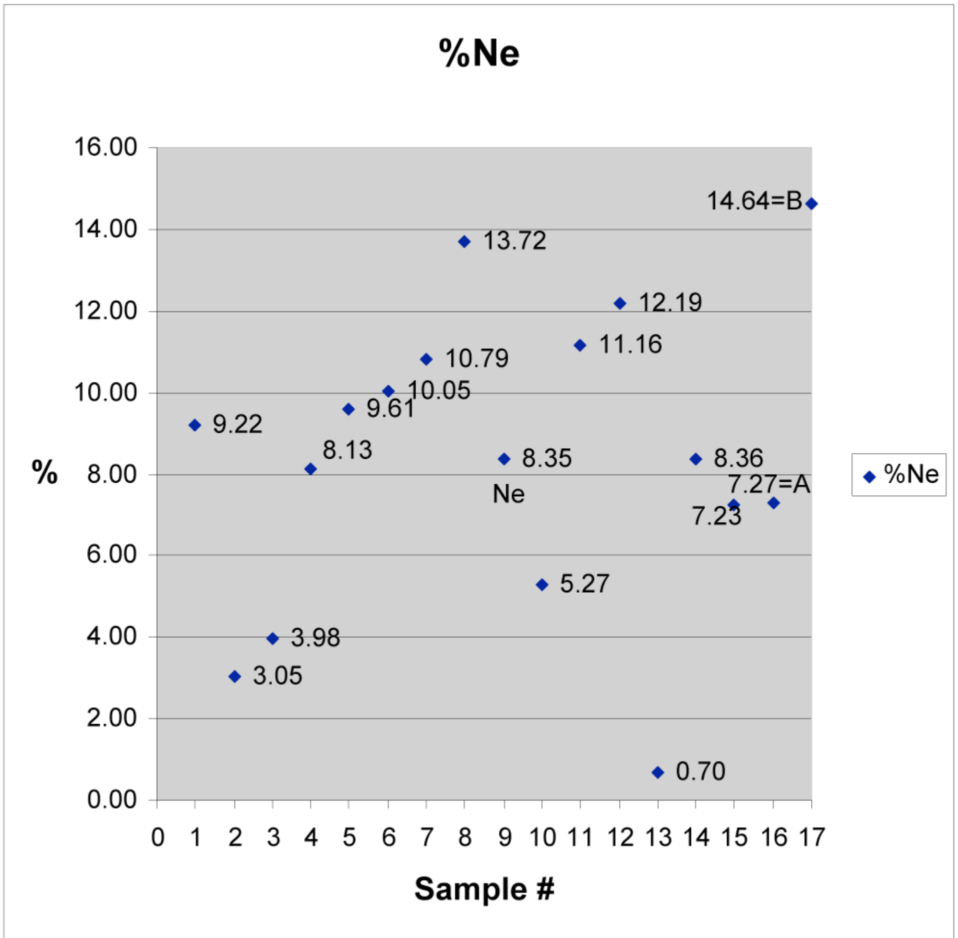


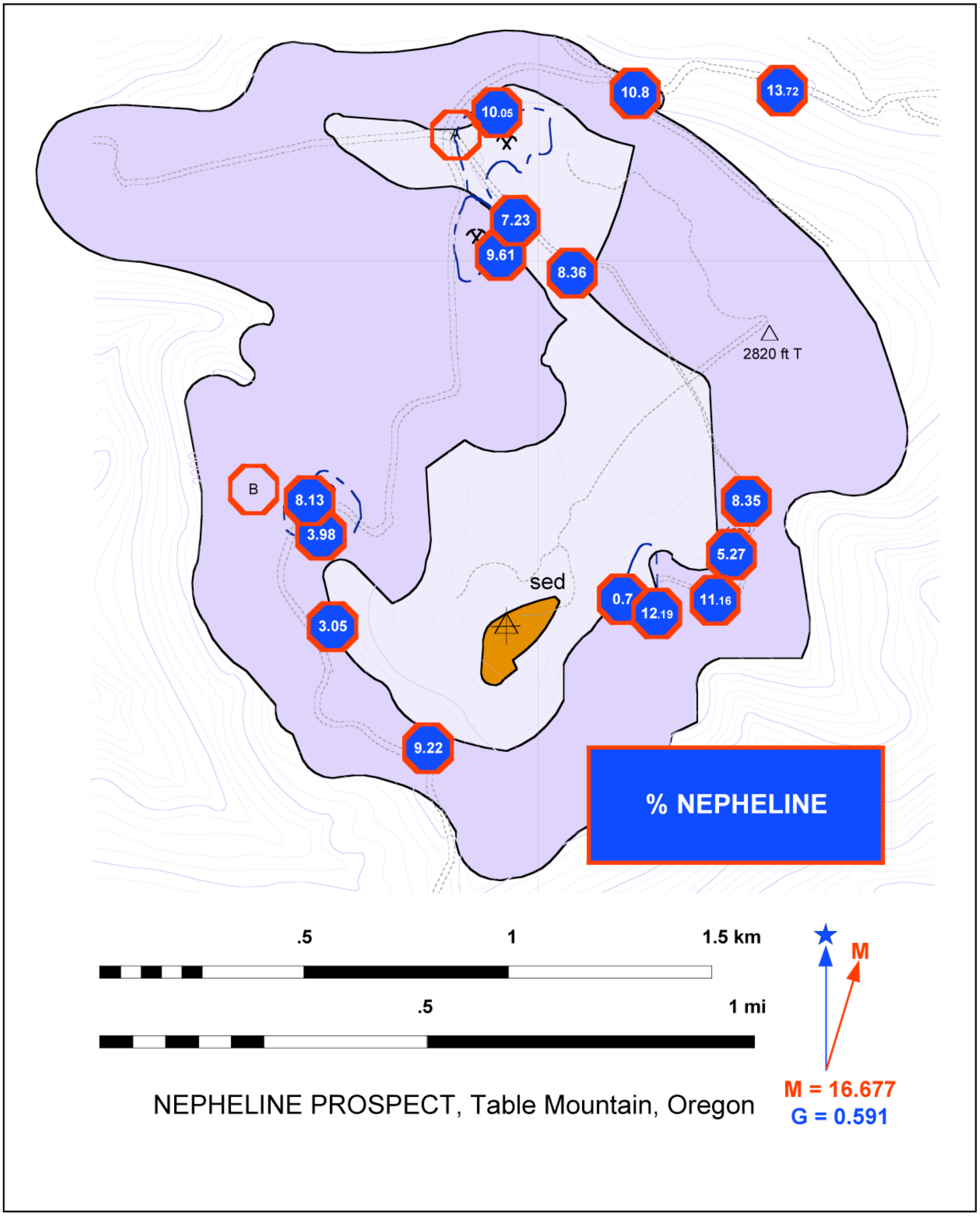
Photo of the SW quarry (open pit) showing the upper part of the nepheline syenite sill at Table Mountain, Oregon.



Graph 7.1 Nepheline Values at Table Mountain

7.1 Distribution of Nepheline (ne) Values.

Nepheline values reported in the 17 samples from Table Mountain range from 0.7% to 14.64%. with a median value of 8% to 12%. The *Loss on Ignition* (LOI) portion indicates that surface weathering has leached some of the nepheline content. Values are expected to be higher on fresh rock samples. No pattern emerged from the distribution of ne-values in the field. Sample #13 (ne 0.7%) was collected from a rock joint at the SE quarry. Its low value is attributed to excessive weathering. Bulk samples A and B were collected at the North quarry and SW quarry respectively. These samples came from the large quarried blocks that are less exposed to weather.



10.05
10.8
13.72
7.23
9.61
8.36
2820 ft T
B
8.13
3.98
8.35
5.27
sed
0.7
12.19
11.16
3.05
9.22
% NEPHELINE
.5
1
1.5 km
.5
1 mi
M
M = 16.677
G = 0.591
NEPHELINE PROSPECT, Table Mountain, Oregon

Figure 7.1

8. MINERALOGY.

The nepheline syenite at Table Mountain is light to medium gray with a glassy luster, holocrystalline, very fine to fine with a pronounced trachytic texture. It is an igneous plutonic sill, tabular in shape, which intruded sedimentary rocks. The ne-syenite fine texture indicates a fast cooling process making it resemble a volcanic rock (phonolite) but still presents an aphanitic grain or crystalline structure.

8.1 General Mineral Composition. In general, the nepheline syenite is composed of alkali feldspar Ab_{90}-Or_{10} 75-80%, nepheline 5% to 14%, analcime 5%, aegirine 10%, Riebeckite-arfvedsonite 3%, olivine <1%, biotite <0.5%, opaque minerals plus apatite <0.5%. The alkali feldspar Ab_{90}-Or_{10} constitutes 75-80% of the nepheline syenite with a sub parallel alignment of laths (trachytic texture). Nepheline occurs as euhedral and subhedral crystals and as anhedral small grains interstitial to feldspar. Analcime occurs in association with nepheline. The mafic minerals surround the nepheline and analcime crystals and are found intergrown with alkali feldspar[1]

8.2 Mineral Composition for Three Samples and Weather Alteration. In the process of determining the distribution of the iron content in the rock, the following mineral assemblage was found for 3 samples.

Sample		NS-13	NS-10	Bulk B
Mineral Composition	**or**	22.28	24.94	25
	ab	60.13	54.76	45.44
	an	2.98	3.52	
	ne	0.8	5.36	14.74
	c	1.54	0.53	
	di			3.68
	wo			
	ol	0.37	1.19	1.27
	ac			5.64
	mt	5.47	5	1.87
	Il	0.25	0.27	0.3
	hem	0.27		
	ap	0.44	0.44	0.42
	zr	0.24	0.24	0.24

TABLE 8.2 Mineral Composition of Three Samples

Table 8.2 Mineral composition and comparative Ne% for three samples with low, mid, and high Loss On Ignition (LOI) values.

[1] Descriptions and analysis of eight new USGS rock standards. Nepheline Syenite, STM-1, from Table Mountain, Oregon. By P.D. Snavely, Jr., N.S. MacLeod, F.J. Flanagan, Sol Berman, H.G. Neiman, and Harry Bastron.

Weathering exposure causes the leaching of nepheline out of the rock. Loss On Ignition (LOI) values are an indication of the weathering effect on a sample: the fresher the rock the lower the LOI value. The chart above shows three selected samples, for the high, medium and low LOI values, to demonstrate this inverse relation contrasting the ne values. Most Altered (NS-13) / High LOI-----in the mid-stream (NS-10)-----Least altered (Bulk B)/ low LOI.
Source: Dr. Stan Mertzman from the laboratory at Franklin & Marshall College.

9. LABORATORY AND CHEMICAL ANALYSIS.

Prof. Stan Mertzman at the Franklin and Marshall College performed the chemical analysis via XRF for 17 samples. The nepheline values were derived by normative mineral calculation. Loss on Ignition (LOI) was also performed along with Fe+2 titration. The results are included in the Appendix.

9.1 Nepheline Content.

Nepheline values reported in the 17 samples from Table Mountain ranged from 0.7% to 14.64% with median values between 8% and 12% (see Graph 9.1).

9.1.1 Weather effects on nepheline content.

A portion of the nepheline and analcime content in the rock samples was lost due to weather exposure. The *Loss on Ignition* (LOI) indirectly reflects the degree of weathering, the higher the value of LOI, the higher the weather exposure and alteration. The lab made no attempt to compensate for the lost nepheline values in the report. Chart 9.1.1 exhibits the *inversely proportional* values of LOI vs. nepheline content on the 17 samples collected at Table Mountain.

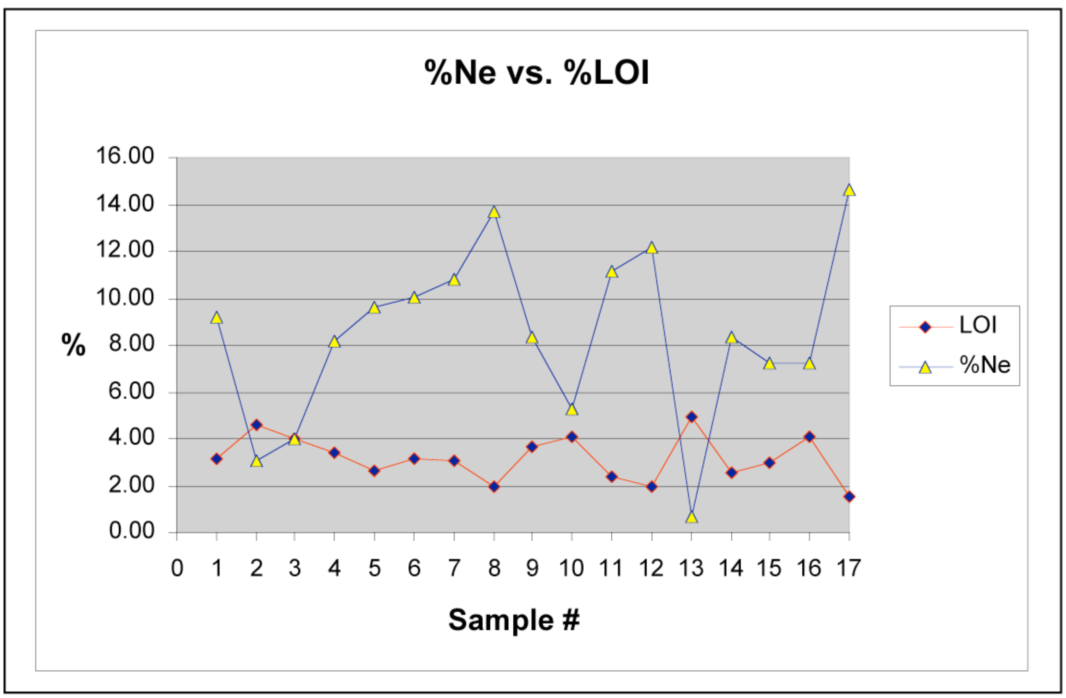


Chart 9.1.1 ***Inversely Proportional*** **Values of LOI vs. Nepheline Content**

9.2 Iron Content.

The total iron content present in these samples, reported as F_2O_3T in Appendix 1, is consistent. It ranges between 5.34%-5.96%. However in the actual rock samples iron exists both as Fe+2 as well as Fe+3. A titration analysis was performed at the lab to distinguish between these two types of atoms. The laboratory results for the current 17 samples (see Appendix 1) range between F_2O_3 2.86-4.45%, FeO 1.33-2.37%, with a total of F_2O_3T between 5.34%-5.96%. Commercially, deposits containing 2% to 5% F_2O_3 can be used in the manufacture of colored glass and some ceramics. Only a few deposits in the world are sufficiently low in iron, or have iron in a form that could be inexpensively removed, for use in clear glass or ceramic manufacture. Magnetic separation, however, after drying and crushing can sometimes reduce the dark iron mineral content, especially in those cases where the syenite rock exhibits large grained crystalline texture. The nepheline syenite at Table Mountain consists of a medium to fine grained texture. , Such a texture generates a higher milling cost to achieve smaller particles to free the iron. It is believed that most of iron is hosted in non-magnetic minerals.[2]

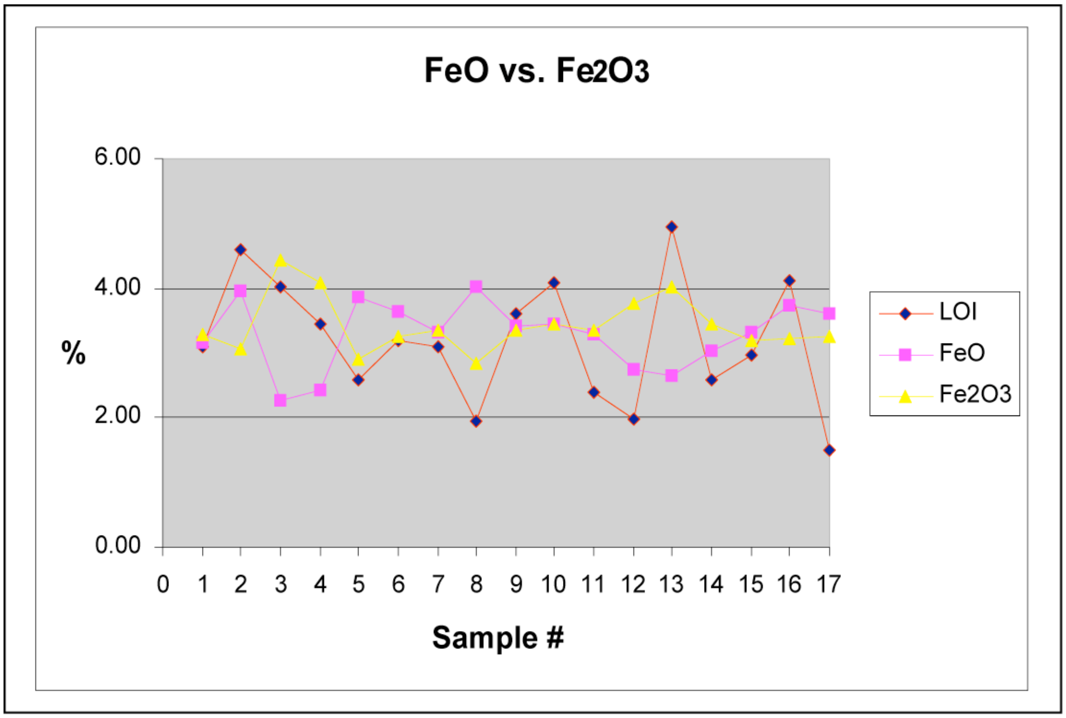


Chart 9.2.1 ***Inversely Proportional*** **Values of LOI vs. Nepheline Content**

9.2.1 Weather effects on iron content.

In the case of the Table Mountain's ore, the iron mineral content (FeO) is suspected to be only fractionally in the form of magnetite, which is a residual mineral caused by the

[2] A good feldspar-nepheline concentrate should be less than <0.4% Fe_2O_3. In nepheline syenites minor amounts of iron are observed in the alkali feldspar (Platt 1996). Iron concentrations are frequently higher in sanadine than orthoclase and microcline, which typically contain <0.2% Fe. The iron content in the rock is related to magma temperature. Secondary magmatic intrusions, which have not been detected at Table Mountain, seem to play a role in reducing the iron content in nepheline syenites.

weathering and oxidizing process of acmite and dark iron minerals. This fraction could be extracted from the ore by magnetic means when the rock is milled to the proper size. The bulk of the iron content (Fe_2O_3) however, seems to be tied up in sodium iron pyroxene, a nonmagnetic mineral known as aegirine.[3] (See Chart 9.2.1).

9.3 Aluminum Content.

The Al_2O_3 content in the nepheline syenite at Table Mountain is very consistent. It ranges from 18.25% to 19.35%, values primarily in the 18.5% to 19% range. Further technical and economic studies are necessary to determine the viability of the prospect for aluminum recovery[4]

9.4 Calcium Content.

The CaO values range from 0.85% to 1.28%. These values are low enough for ceramic applications.

9.5 Niobium and Zircon Content. .

In ppm, Nb between 266.7 - 300.0 while Zr ranges between 1210 -1294. These two elements are very refractory and have a high melting point: Nb (2477^{0}C, 4491^{0}F) and Zr (1855 ^{0}C, 3371 ^{0}F). At this point it is not known how these two elements might impact the formation of ceramic material. The zirconium, due to its high specific gravity may be removed by gravity means.

9.6 Rare Earths (REE).

Lanthanum and cerium are present in elevated concentrations. They are likely contained in the mineral apatite given the P2O5 content of syenites. As a reference, lanthanum in the form of La_2O_3, improves the alkali resistance of glass. Cerium compounds are also used in the manufacture of glass, both as a component and as a decolorizer. In glass cerium (IV) oxide allows selective absorption of ultraviolet light.

9.7 Transition Metals.

Transition metals except for zinc have very low concentrations reflecting the very low magnesium concentration of these rocks and the relative moderate iron content.

9.8 Alkaline earth metals.

Strontium, barium and the alkali metal, rubidium, are likely to be distributed in both the minerals apatite and orthoclase/microcline feldspar.

9.9 Alkalis (Na_2O+K_2O).

Most commercial nepheline syenites contain more than 15% alkalis (Na_2O+K_2O). The ne-syenite at table mountain has an average alkalis value of 12.52%.

[3] also known as acmite, NaFeSi2O6.
[4] The largest nepheline syenite deposit in the world is in the Kola Peninsula in Russia and it is for alumina with REE's as a byproduct.

10. NEPHELINE SYENITE ORE APPLICATION.

- **Flux agent**. Nepheline syenites are used as a flux in Glass Making, ceramics and flatware with advantages over feldspar as they lower the melting temperature. The high iron content produces a dirty-brown discoloration in glass. Beneficiation tests by the Bureau of mines (Harris, 1962) reportedly did not remove the iron contained in a sample from Table Mountain. Nevertheless, the details of this information are not available and further laboratory testing is necessary to investigate the possibility of the iron content removal with standard metallurgical as well as biological means applying Biological technology. The laboratory results in the current 17 samples range between F_2O_3 2.86-4.45%, FeO 1.33-2.37%, with a total of F_2O_3T between 5.34%-5.96%. Commercially, deposits containing 2% to 5% F_2O_3 can be used in the manufacture of colored glass and some ceramics. The fines are used as a colorizing and fluxing agent in the manufacture of brick and as compaction fill.

- **Roofing-granule**. Weather-resistant application. The nepheline syenite's high strength and resistance to erosion allows its use in roofing. Its neutral gray color, UV attenuation, blocking of sunlight and anti-weathering protect and prevent deterioration of the asphalt in the roof shingles.

- **Abrasives**. Its lack of quartz, and relative hardness enables nepheline syenites to be used as a silica free abrasive. This is advantageous since it presents no harm to the lungs, as do silica-based abrasives.

- **Jettystone.** The nepheline syenite at Table Mountain was used in the construction of the jetty at Yaquina Bay in Newport seaport. The wide jointing in some areas at Table Mountain allows for the production of large size stones with minimal excess. For jettystone, 2.56 density is required. Classification by weight is as follows: select class A minimum weight 27.8 tons; class A, minimum 15.2 tons; class B minimum 7.6 ton, and class C, minimum 0.23 tons.

- **Dimension stone.** The Nepheline Syenite at Table Mountain presents excellent characteristics for dimension stone applications. The physical characteristics of strength, tenacity (toughness), hardness, nonfriability and resistance to environmental damage make the stone an excellent candidate for ornamental use.

A “star” drill hole through a block of nepheline syenite at Table Mountain illustrates the ability to sharply cut the stone.

The deposit presents wide fracturing (see photo on title page) so that the stone can be quarried in blocks by means of controlled blasting in combination with diamond-impregnated wire cutting saws. In addition, cutting the stone with an oxy-acetylene torch may prove to be advantageous due to the fluxing qualities naturally intrinsic in the rock.

- **Pigments and fillers.** Because nepheline syenite has high brightness, inertness, and easy wetting and dispersion in parent formulations, it is highly useful in pigments and fillers.

- **Aluminum Ore.** Pikalyovo Alumina Refinery in Russia is the only production facility in the world, which uses wastes from processing apatite and nepheline ores (nepheline concentrate) as a raw material. The refinery was commissioned in 1959, and its main product is alumina, with by-products of nepheline slurry, cement, gallium and soda products. It employs 3,217 people. In 2006, the refinery produced 0.3 mln tones of alumina, showing an 11.7% increase compared to output in 2005. The refinery deploys unique technology for processing nepheline concentrate into alumina, which was designed by specialists of the Russian National Aluminum & Magnesium Institute (VAMI). It enables the production facility to process between 4 and 4.1 tones of nepheline and 7.5 tones of limestone into 1 ton of alumina, 0.8 tones of soda, 0.3 tones of potash and 10 tones of cement.

- **Other potential Applications** include fertilizer**,** refractory cement, paper production, riprap, rock wool, Portland cement and road surfacing materials such as asphalt and concrete aggregate.

A P P E N D I X

Analytical result on 17 samples collected in the field at Table Mountain, Oregon. Nepheline Prospect.

Note: Samples #1-15 are hand samples while A and B are Bulk samples. Professor, Stan Mertzman at Franklin and Marshall College, performed the chemical analyses.

Assay Results. Part I

Specimen	NS-1	NS-2	NS-3	NS-4	NS-5	NS-6	NS-7
SiO2	58.66	57.97	58.43	58.25	59.36	58.38	58.51
TiO2	0.16	0.19	0.14	0.14	0.16	0.14	0.14
Al2O3	18.56	18.83	18.75	18.76	18.46	18.89	18.57
Fe2O3	3.28	3.07	4.45	4.07	2.91	3.25	3.34
FeO	1.85	2.33	1.33	1.42	2.27	2.14	1.95
MnO	0.24	0.23	0.25	0.25	0.24	0.25	0.24
MgO	0.30	0.23	0.20	0.19	0.19	0.22	0.19
CaO	1.17	1.00	0.96	0.99	1.28	1.24	1.05
Na2O	8.23	7.30	7.64	8.24	8.46	8.36	8.62
K2O	4.33	4.18	4.10	4.09	4.19	4.17	4.17
P2O5	0.18	0.23	0.19	0.18	0.19	0.18	0.19
LOI	3.11	4.61	4.02	3.44	2.60	3.18	3.09
Total	**100.07**	**100.17**	**100.46**	**100.02**	**100.31**	**100.40**	**100.06**
Fe2O3T	5.34	5.66	5.93	5.65	5.43	5.58	5.51
%Ne	**9.22**	**3.05**	**3.98**	**8.13**	**9.61**	**10.05**	**10.79**
Rb	129.4	120.0	111.3	110.0	121.4	122.8	118.0
Sr	711	718	672	692	893	803	782
Y	55.3	42.6	43.9	48.0	45.6	46.5	49.0
Zr	1210	1230	1287	1258	1243	1269	1258
V	8	10	7	5	5	12	8
Ni	<1	<1	<1	<1	<1	<1	<1
Cr	<1	<1	<1	<1	<1	<1	<1
Nb	273.9	268.6	292.1	285.1	273.9	286.0	284.1

Ga	34.6	33.3	34.0	34.4	33.7	34.7	34.2
Cu	<2	<2	<2	<2	<2	<2	<2
Zn	248	244	264	260	250	257	272
Co	<1	<1	<1	<1	<1	<1	<1
Ba	667	739	702	666	626	611	642
La	139	119	128	132	117	125	127
Ce	237	241	261	255	233	245	247
U	8.3	9.6	10.3	9.0	8.9	9.7	9.5
Th	32.7	31.3	33.3	33.9	32.1	32.6	33.0
Sc	1	2	2	<1	2	1	<1
Pb	15	9	11	30	9	11	12

Assay Results. Part II

Specimen	NS-8	NS-9	NS-10	NS-11	NS-12	NS-13	NS-14
SiO2	58.95	58.13	58.05	58.84	59.12	57.62	58.93
TiO2	0.14	0.16	0.14	0.15	0.14	0.13	0.13
Al2O3	18.57	18.97	18.96	18.53	18.42	18.69	18.25
Fe2O3	2.86	3.36	3.45	3.35	3.76	4.04	3.46
FeO	2.37	2.00	2.02	1.94	1.62	1.56	1.79
MnO	0.24	0.24	0.26	0.24	0.24	0.25	0.24
MgO	0.18	0.19	0.19	0.20	0.21	0.21	0.20
CaO	0.94	0.99	0.96	1.10	1.19	0.85	1.15
Na2O	9.17	8.12	7.64	8.79	8.99	7.28	8.28
K2O	4.31	4.20	4.22	4.11	4.27	3.77	4.24
P2O5	0.18	0.19	0.19	0.18	0.17	0.19	0.17
LOI	1.94	3.62	4.10	2.40	1.99	4.96	2.58
Total	**99.85**	**100.17**	**100.18**	**99.83**	**100.12**	**99.55**	**99.42**
Fe2O3T	5.49	5.58	5.69	5.51	5.56	5.77	5.45
%Ne	**13.72**	**8.35**	**5.27**	**11.16**	**12.19**	**0.70**	**8.36**
Rb	129.0	125.0	127.5	122.3	121.6	104.4	119.0
Sr	654	792	737	819	828	671	901

Y	45.8	52.6	53	47.6	45.2	48.3	45.8
Zr	1294	1241	1288	1275	1232	1279	1242
V	10	4	6	10	7	9	7
Ni	<1	<1	<1	<1	<1	<1	<1
Cr	<1	<1	<1	<1	<1	<1	<1
Nb	290.7	275.0	287.5	284.0	275.8	300.0	283.3
Ga	34.7	35.3	34.3	33.9	33.7	33.9	33.9
Cu	<2	<2	<2	<2	<2	<2	<2
Zn	257	251	260	255	253	260	256
Co	<1	<1	<1	<1	<1	<1	<1
Ba	621	655	663	638	640	704	631
La	120	150	141	124	121	141	125
Ce	239	256	285	245	240	271	252
U	9.7	8.9	8.5	9.2	8.3	9	9
Th	34.6	32.9	34.5	32.6	31.8	35.1	32.2
Sc	<1	<1	<1	2	1	<1	<1
Pb	13	11	12.2	11.3	8.1	13	11.7

Assay Results. Part III

Specimen	NS-15	Bulk A	Bulk B		Duplicate NS-2
SiO2	59.10	57.43	58.89		57.66
TiO2	0.15	0.16	0.16		0.19
Al2O3	18.48	19.35	18.70		18.72
Fe2O3	3.19	3.22	3.24		3.29
FeO	1.96	2.19	2.12		2.19
MnO	0.24	0.24	0.24		0.23
MgO	0.21	0.24	0.23		0.23
CaO	1.07	1.00	1.09		0.98
Na2O	8.09	7.89	9.34		7.25

K2O	4.24	4.07	4.23	4.13
P2O5	0.18	0.20	0.18	0.22
LOI	2.97	4.11	1.51	4.59
Total	**99.88**	**100.10**	**99.93**	**99.68**
Fe2O3T	5.37	5.65	5.60	5.72
%Ne	**7.23**	**7.27**	**14.64**	**2.71**
Rb	123.9	124.1	126.5	111.9
Sr	786	810	749	715
Y	56.8	58.1	45.4	42.9
Zr	1239	1257	1253	1229
V	6	7	6	9
Ni	<1	<1	<1	<1
Cr	<1	<1	<1	<1
Nb	278.6	282.6	277.6	266.7
Ga	34.3	36.1	34.4	34.7
Cu	<2	<2	<2	<2
Zn	253	248	254	241
Co	<1	<1	<1	<1
Ba	652	634	590	728
La	142	142	117	117
Ce	248	239	231	238
U	10	9	9.2	9.4
Th	34.1	32.1	31.5	31.1
Sc	<1	1	<1	2
Pb	11	11	40	10

(End of the report)