NICKELIFEROUS SERPENTINE	
SiO_2	39.36
Al_2O_3	2.76
Fe_2O_3	2.77
CaO	1.32
MgO	36.71
NiO	2.57
$H_2O+120°C$	13.85
$H_2O-120°C$	1.54
Total	100.88

This chemical composition is typical of serpentine, except for the small proportion of nickel, and the optical and other physical properties are those of serpentine.

DUMORTIERITE FROM NEVADA

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INTRODUCTION

Dumortierite-sericite schist is being utilized in the production of refractories. In view of this application, the identification of dumortierite assumes added importance. A dumortierite of a Nevada schist gave such strong dispersive effects that ordinary light could not be employed in the determination of refractive index data. Since mineralogists have come to place considerable importance on refractive index determination, the difficulty encountered in the case of this mineral is worth recording. The probable source of the various colors of dumortierite is also mentioned.

OCCURRENCE

A schist occurring on the west slope of Lincoln Hill in the Rochester mining district, Nevada, appears to have been first described by Jones[1] as a result of a reconnaissance through the district in 1913. The schist is better referred to as a dumortierite-sericite schist than as a mica-tourmaline schist as first suggested by Dr. Jones on the basis of a rather hasty reconnaissance. While tourmaline was common in the veins of Lincoln Hill it was rarely found in the schist.

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[1] Geology of Rochester, Nevada: *Min. & Sci. Press*, **106,** No. 20, May 17, 1913, p. 738.

ORIGIN

This schist is referred to as a dumortieritized trachyte by Knopf[2] who presents the following statements regarding its origin: "The extensive development of dumortierite and associated minerals is clearly due to the action of boron-bearing gases, which have undoubtedly escaped from an underlying granite magma and permeated the trachytes as they traveled upward through a closely spaced network of fractures. These emanations were evidently rich in silicon, aluminum, and boron and deficient in alkalies and sulphides."

Jones states that "it is not improbable that the granodiorite that appears near . . . . to the north, underlies the area and the more intense metamorphism of the rocks and the mica-tourmaline veins of Lincoln Hill is due to its influence."

Since the material from Lincoln Hill possesses a marked schistose structure it will be referred to in this paper as a schist. The schist has since been found at several other localities near the huge mass mapped by Knopf.

A brief note recently appeared[3] reporting the purchase of an occurrence of the schist located in Limerick Canyon, not far from Lincoln Hill, by the Champion Spark Plug Company.

A news item has also recently appeared in the Reno *Evening Gazette* stating that a deposit of "dumortierite, a mineral highly useful in the manufacture of spark plugs" occurring in Gypsy Queen Canyon, 6 miles northeast of Oreana, Nevada, has been purchased by interests representing the Champion Company." This occurrence is located near the Limerick Canyon schist.

The new use for andalusite in the manufacture of spark plugs is now well-known. The use of dumortierite is a more recent development. Vernadsky[3a] found dumortierite to be converted into sillimanite at white heat. We now know that this "sillimanite" is in reality mullite. Cristobalite and perhaps an aluminum borate would be expected to accompany the mullite. It is evident from Vernadsky's work why dumortierite should have been considered of possible value in the manufacture of super-refractories.

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[2] Geology and ore deposits of the Rochester district, Nevada: *U.S.G.S. Bull.* **762,** 1924, pp. 19–20.

[3] *Eng. & Min. Jour.-Press,* **120,** No. 17, Oct. 24, 1925, p. 666.

[3a] Bull. Soc. franc. mineral., **13,** 256 (1890).

DETERMINATION OF DUMORTIERITE

The following optical data were determined for dumortierite free from alteration found in the powdered samples of the lilac colored schist from Limerick Canyon. The mineral is biaxial (−) with alpha parallel to the elongation. Birefringence amounts to .011±. An elongated cleavage fragment slightly less than .04 mm. in thickness and oriented normal to the obtuse bisectrix, exhibited the pleochroism, alpha distinct light blue and beta colorless. The dispersion of the optic axes with $\rho<\nu$ was sufficiently strong to make the accurate determination of the refractive indices impossible in white light. Dispersive effects were found over a long range of refractive index liquids using white light. With light practically equivalent to Li-light (wave length 665$\mu\mu$), alpha was determined as being closer to 1.677 than to 1.678. The variation of these two liquids was probably not greater than ±0.001. The liquids were prepared especially for this determination with the aid of the Zeiss form of the Abbé refractometer.

A search through Larsen's tables[4] supplimented by a table of new minerals described since the appearance of Larsen's tables, fails to indicate any mineral other than dumortierite with properties similar to those determined for the Nevada mineral.

A very decided test for titanium was obtained by means of the carbonate fusion method, indicating the existence of an appreciable quantity of titanium in a specimen of schist which microscopic examination showed to be dumortierite with but a trace of andalusite present. Schaller has also obtained a decided test for titanium in a dumortierite from the mass described by Knopf.[5]

The refractive indices for dumortierite found in the literature indicate that alpha is commonly as high as that determined for the Limerick Canyon mineral which contains an appreciable amount of titanium. The presence of an appreciable quantity of either TiO_2 or Ti_2O_3 in minerals is usually accompanied by an increase in the refractive indices since the specific refractive energies are high for these constituents. Thus 2% Fe_2O_3 and

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[4] The microscopic determination of the nonopaque minerals: *U.S.G.S. Bull.* **679,** 1921.

[5] *Op. cit.*, p. 19.

[6] The system Al_2O_3–SiO_2, N. L. Bowen and J. W. Greig: *Jour. Am. Ceramic Soc.*, **7,** No. 4, April 1924, p. 252.

[7] A titaniferous augite from Ice River, British Columbia: C. H. Warren and J. A. Allan: *Am. Jour. Sci.*, **43,** Jan. 1917, p. 77.

TiO_2[6] present in mullite increases the refractive index of alpha 0.6%. In the case of augite approximately 5% TiO_2[7] has been found to increase the refractive index of alpha about 1%. The above considerations appear to indicate that titanium is generally present and if this is true the various colors of dumortierite can be explained by the presence of this element.

The specimens of schist studied consist chiefly of altered, fibrous material giving aggregate polarization effects and varies from nearly opaque to nearly transparent.

The dielectric constants were determined for the Nevada dumortierite and also for typical andalusite, and cyanite.

Dumortierite	(violet)	Nevada	17
Dumortierite	(red)	Nevada	17
Andalusite	(bluish)	California	8
Andalusite	(bluish)	Tyrol	12
Cyanite	(blue)	Nevada	7–9

λ = infinite Error ± 1

It would be interesting to obtain data from other specimens since the determined values are not far apart. Dielectric constants obtained from some minerals which resemble each other very closely have been found to differ widely.

DUMORTIERITE AS A COMMERCIAL MINERAL

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Introduction

About two years ago attention was called to the rapid rise in commercial importance of andalusite, as a result of the discovery of a large deposit of it in California.[1] One might assume that the development of a mineral of such great value from the ceramic standpoint, accompanied as it was by an almost revolutionary change in the composition of certain types of porcelains, would justify a pause in the search for better material. However, as a result of the fact that modern research is continually striving for the better, we are able at this time to add another hitherto rare and practically useless mineral to the list of those of real value. The mineral referred to is dumortierite. As in the case of the California andalusite, the present deposit of dumortierite is owned and has been developed by the Champion Porcelain Company of

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[1] *Am. Mineral.*, **9**, 123–9 (1924).