INVESTIGATION OF A NEW OCCURRENCE OF ALURGITE FROM CALIFORNIA

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ABSTRACT

An occurrence of a purple mica is described, an analysis of the mineral presented, and the conclusion reached that it is identical with alurgite, described previously only from St. Marcel, Piedmont, Italy. It is contended that alurgite is sufficiently different in physical and optical properties to warrant retaining the name as a varietal name in the series of the mica group between muscovite and biotite.

INTRODUCTION

In the course of investigations of mineral localities of southern California, specimens of a copper- to purplish-red micaceous mineral were submitted to the writer by Mr. and Mrs. V. D. Myers of Santa Monica, California. Examination of the material shows it to be a rare variety belonging to the mica group, alurgite. As far as the writer is aware, this is the first occurrence of alurgite to be reported in North America.

PREVIOUS STUDIES OF ALURGITE

The only systematic description of alurgite was published by Penfield,[1] who investigated the properties of the rose-red mica from Piedmont, Italy, and showed it to be identical with the specimens examined and but briefly described by Breithaupt,[2] who named the mineral. Penfield's study is apparently the only systematic treatment ever published. In 1909, during a systematic study of the manganese deposits of India, Fermor[3] reported four occurrences of red and pink mica, in various associations, which he groups "provisionally" under the heading "alurgite (?)." Regarding these occurrences, he writes (p. 199):

> On comparing the pleochroism of these Indian rose and crimson micas with that of the alurgite from St. Marcel in Piedmont, it will be seen that although the pleochroism schemes are somewhat different, the colours corresponding to each elasticity axis have a general resemblance to one another. . . . It will also be noticed that the optic axial angles of the Indian micas bear a general resemblance to those of the St. Marcel mineral. . . . Hence these Indian micas can be provisionally regarded as alurgite, until they have been subjected to the test of analysis.

[1] Penfield, S. L., On some minerals from the manganese mines of St. Marcel, in Piedmont, Italy: *Am. Jour. Sci.*, **46**, (3rd Series) 288–295, 1893.

[2] Breithaupt, J. F. H., *Berg- und hüttenmännische Zeitung*, **24**, 336, 1865.

[3] Fermor, L. Leigh, The manganese-ore deposits of India: *Memoirs Geol. Soc. India*, **37**, 1–1294, 1909.

Gennaro,[4] in a brief preliminary note, records the occurrence of red mica in two localities in the Piedmont Alps. It is identified as alurgite on the basis of similarity to the St. Marcel, Piedmont, locality. Detailed petrographic descriptions of these occurrences were promised to appear in a later paper.[5]

Location and Mode of Occurrence

The alurgite is found in boulders in alluvium on the summit of the Cajon Pass, in western San Bernardino County, about twenty miles north of the city of San Bernardino, California. The first ravine west of the summit of Cajon Pass contains much of the material. The stream boulders are piedmontite-alurgite-quartz schists, and piedmontite-alurgite quartzites, scattered heterogeneously through the gravels of the desert. According to the map and sections of Noble,[6] the boulders are found in gravels of Pliocene or Pleistocene age underlying the true Pleistocene alluvial deposits. The alurgite forms major foliation planes of the schist, with alternating bands of quartz. Microscopic examination of slides of the alurgite-bearing rock shows it to contain, in addition to those constituents seen megascopically, a few small needles of apatite, magnetite, and an occasional grain of zircon.

Description of the Alurgite

The colors of alurgite given for the type locality in Piedmont are similar to those of the locality under discussion, being a copper-red to lavender-rose, with occasional shades of deeper red, or magenta. The deeper shades are due to minute included crystals of piedmontite which lie between the alurgite flakes. Nowhere were there observed the deep purple colors rarely shown at the Piedmont locality.

Other physical properties check those of the mica group. The cleavage is perfect pinacoidal, with the leaves somewhat less elastic than the commoner micas. The specific gravity, determined by F. A. Gonyer, Harvard University, is 2.914. The hardness is 2.5–3. Some specimens of alurgite show a fading of the color on weathering. In the determination of the indices of refraction, it was noted that in those flakes which have undergone considerable alteration, the values are somewhat lower than

[4] Gennaro, Virginia, Micascisti a piemontite nelle valli di Lanzo (Alpi Piemontesi), Nota preliminare, presentata dal Socio Artini: *Rendiconti della R. Accademia Nazionale dei Lincei*, Classe di Scienze fisiche, matematiche e naturali, **2**, serie 6ª, 2° sem., fasc. 11°, 1925 (Rome.)

[5] The writer has been unable to discover additional references to this locality. It is thus inferred that additional data have not as yet been published.

[6] Noble, Levi F., Excursions to the San Andreas fault and Cajon Pass: *Int. Geol. Cong. XVI, Guidebook* **15**, Southern California, 10–21, pl. 3, 1932.

for the unaltered material. Also some iron oxide seems to have been liberated during alteration, as some of the alurgite flakes are surrounded by rims of hematite.

Blowpipe analysis of the alurgite, which was separated from the piedmontite under a lens before testing, showed a strong manganese color in the sodium carbonate bead. Tests with the borax bead failed to show a strong test for manganese, but gave only a very weak color. The reaction of alurgite to sodium carbonate and not to borax was mentioned by Penfield,[7] who obtained a manganese test in borax only upon addition of much material. Furthermore, a pronounced test for iron in the borax bead was obvious, and it probably masked effectively the usual purple color of manganese.

Using oil immersion and basal sections of alurgite, the index of refraction was determined to be between 1.590 and 1.595, decidedly closer to 1.595. Larsen and Berman[8] give 1.594 for gamma and beta. The alurgite is non-pleochroic in basal sections, and slightly pleochroic in pale flesh pink and orchid tints in sections normal to the cleavage.[9] The alurgite is separated from manganophyllite, with which it might be confused, by less intense pleochroism, and lower indices of refraction. The color is pale flesh-pink in all unweathered grains; deep pink to brownish-red when alteration has set in. The optic angle is given in standard tables as from 0 to 57 degrees. The alurgite from this locality shows a pronounced biaxial figure. No determinations of 2V have been made, but from the perfect figures obtainable from almost any fresh grain, the angle can be estimated as at least 30 degrees. The optic sign is negative, as in all micas.

SUMMARY OF THE PROPERTIES OF ALURGITE FROM THE TWO LOCALITIES

	California	Italy
Color	lavender-rose	cochineal red
G.	2.914	2.835–2.849 (Penfield) 2.984–3.00 (Breithaupt)
Pleochroism	Pale flesh pink to orchid	Not marked: faint in shades of pink and red.

[7] *Op. cit.*, p. 290.

[8] Larsen, Esper S., and Berman, Harry. The Microscopic Determination of the Nonpaque Minerals: *U. S. Geol. Surv.*, Bull. **848,** 165, 1934.

[9] The material examined by the writer showed an exceedingly pale flesh-pink pleochroism. H. Stanton Hill, of Pasadena Junior college, who obtained some alurgite during the completion of a study of the Pelona[9a] schists, from a small outcrop on the Prairie Fork of the East Fork of the San Gabriel River, showed the writer a section in which the pleochroic color in sections normal to the cleavage was a distinct orchid. No orchid pleochroic colors and no pleochroic colors as intense as those from the outcrop, were observed on material from the Cajon Pass occurrence.

[9a] Hershey, Oscar H., Some crystalline rocks of southern California: *Am. Geol.*, **29,** 273–290, 1902.

Indices of Refraction	α=not determined	α=1.55
	β=1.595	β=1.594
	γ=1.595	γ=1.594 (Larsen & Berman)

Analysis of Alurgite

Only one analysis of alurgite has been published up to the present. Following is the original analysis as given by Penfield,[10] and the analysis of the material from the California locality.

	Alurgite* (Italy)	Alurgite** (California)
SiO_2	53.22	46.30
TiO_2	——	0.71
Al_2O_3	21.19	28.52
Fe_2O_3	1.22	5.32
FeO	none	none
Mn_2O_3	0.87	——
MnO	0.18	0.65
MgO	6.02	4.27
CaO	——	0.14
K_2O	11.20	9.15
Na_2O	0.34	0.61
F	——	0.67
H_2O	5.75	——
H_2O-	——	0.03
H_2O+	——	4.08
		100.45
Less O		0.28
Total	99.99	100.17

* S. F. Penfield, *Analyst.*
** F. A. Gonyer, *Analyst.*

The higher ferric iron content and absence of manganic oxide are noted in the California material in comparing the two analyses. The silica and alumina percentages seem to be insufficiently different to consider the mineral a different variety of the mica group. The SiO_2, Al_2O_3, K_2O, and MgO are present in percentages which, considering the wide variations shown within the mica group, fall well within the allowable range.

The absence of manganic oxide (Mn_2O_3) might suggest that the material was not alurgite since Penfield[11] suggests that:

> It is probable that the deep red color of the mineral is due to the presence of Mn_2O_3, for it is well known that the higher oxides of manganese have intense coloring power . . . .

The color of the alurgite from the California locality, however, is probably due to the presence of TiO_2.

[10] *Op. cit.*, 290.
[11] *Op. cit.*, 291.

Possible Identity of Alurgite and Mariposite, and Relations to Other Members of the Mica Group

In a discussion of analyses of mariposite and their relations to the analysis of alurgite from the Piedmont locality, Schaller[12] concludes that mariposite and alurgite are identical. This conclusion is not supported by the studies of Knopf[13] on the important mariposite localities of the Mother Lode belt, who points out that Schaller's

> . . . argument is not conclusive, as alurgite is a purple to cochineal-red mica. The mineral mariposite is evidently only of varietal rank; it is a green chromiferous sericite.

In discussing further the possible identity of mariposite and alurgite, Dr. Schaller says:[14]

> The names alurgite and mariposite may have some justification as varietal names but certainly not as distinct species names.

A study of the analysis of alurgite from the new California locality seems definitely to establish the fact that the use of the name "alurgite" as anything but a varietal name is incorrect. The principal oxides of the mica group make up the bulk composition of alurgite. Since the members of this group form a continuous series of constantly changing composition, of which mariposite, alurgite, etc., are simply points on the composition curve, to place alurgite as a distinct species would be definitely incorrect. The statements of Knopf[15] indicate that he misunderstood Schaller's concept of the identity of the two minerals (as did the writer prior to exchange of letters with Schaller), since Knopf recognizes mariposite as a variety of sericite and not as a separate mineral species.

The California occurrence was suspected of being identical with a purple muscovite described by Schaller and Henderson.[16] Upon analysis, however, the MgO and Fe_2O_3 content of the California occurrence showed these to be distinctly different.[17]

[12] Schaller, Waldemar T., The probable identity of mariposite and alurgite: *U. S. Geol. Surv., Bull.* **610,** 139–140, 1916.

[13] Knopf, Adolph, The mother lode system of California: *U. S. Geol. Surv., Prof. Paper* **157,** 38, 1929.

[14] Personal communication, letter dated June 6, 1938.

[15] *Op. cit.*

[16] Schaller, Waldemar T., and Henderson, Edward P., Purple muscovite from New Mexico: *Am. Mineral.,* **11,** 5–16, 1926.

[17] Dr Schaller, on the other hand, feels that the analysis of the alurgite from Cajon Pass is such that in spite of appreciable MgO and Fe_2O_3 content, it should be classed as muscovite, and not as a separate variety of the muscovite-biotite series. He says (by letter dated July 29, 1938):

"I question the correctness of calling your mica alurgite on the basis of Gonyer's analysis, although in appearance and color your mica is almost identical with the alurgite

Source of the Alurgite Boulders

Noble[18] has shown in his studies along the San Andreas fault, in the vicinity of Cajon Pass, that the so-called Cajon "amphitheater" has been produced by the degradation of streams draining the southwestern slopes of the San Bernardino-San Gabriel Mountains. The base level of these streams is essentially the San Bernardino lowland; they have extended their drainage areas at the expense of northeastward flowing streams whose base level is the Mojave desert. The latter streams have thus been beheaded. They formerly drained the then much higher San Bernardino-San Gabriel mountains, during which time they deposited huge alluvial and piedmont alluvial fans at the northeastern bases of the mountains. (See topographic maps, U. S., Cucamonga, Hesperia, San Antonio, San Bernardino quadrangles.) Many of those rocks which were the source materials for the alluvial fans of the northeastern slopes have now been eroded away. Thus, when one constructs profiles from northeast to southwest up the slopes of the alluvial fans and onto the mountain ranges, the restoration of the piedmont alluvial slopes indicates that the source of material was at least 1500 feet above the present erosional level in the general area from which the material must have come. This figure is very conservative, since no allowance is made for the increasing concavity upward of the fan slopes adjacent to the mountain ranges.

It seems, therefore, that most of the source materials of the alurgite are probably eroded away, unless, of course, the roots of the layers of the alurgite schists and quartzites are still present in the broken and contorted zones of the Pelona schists present along the San Andreas fault.[19]

Probable Wider Distribution of Alurgite Boulders

Several weeks after the samples of alurgite from the Cajon Pass locality were obtained, the writer, collecting some actinolite samples from gravels just south of the highway near Palmdale, California, along the

from Italy. There is too great a discrepancy in the percentages of SiO_2 and R_2O_3 (chiefly Al_2O_3). . . . My own feeling is that any name other than muscovite for your mica would be open to criticism."

The writer feels, however, were alurgite to be classed by a species name rather than a varietal name, that the MgO and Fe_2O_3 content is such that the alurgite should be classed as biotite and not as muscovite. A varietal name seems desirable, however, since so many of the properties of this mica are distinct from normal muscovite.

[18] *Op. cit.*

[19] As mentioned above, Hill collected specimens of alurgite identical with the Cajon Pass material from a narrow outcrop on Prairie Fork of the East Fork of the San Gabriel river. From this and other exposures now eroded away, probably came the large quantity of boulders of the Cajon Pass occurrence.

San Andreas fault, picked up two or three small boulders of schists which were apparently the same as those found to the south in Cajon Pass. These boulders, more deeply weathered than those of the first locality, contained smaller quantities of the alurgite, although it is obvious upon comparing them that they came essentially from the same source. It is, therefore, highly probable, that the distribution of alurgite is not confined to these two localities, but that this mineral will be found elsewhere, at least along the San Andreas fault.[20]

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[20] Mr. Leland H. Dykes, of Los Angeles, California, informed the writer that he had seen material identical with the Cajon Pass occurrence which was collected near Whitewater, California, by the late Gordon A. Surr, formerly of the University of California Citrus Experiment Station at Riverside, California.