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# MINERALS OF THE KOLA PENINSULA

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Since 1920 the Mineralogical Museum of the Academy of Sciences of the USSR, and the Research Institute of the North have been jointly investigating two massives of alkaline rocks in the central part of the Kola Peninsula, lying between 67°35′ and 67°55′ north latitude. The districts are known as Hibina- (or Umptek), and Lujavr-Toundra (or Lujavr-urt).

The total area of the massives is 1600 square kilometers; a barren, badly dissected country, 1200 meters above sea level, covered with forests and swamps (*taiga*), and free from snow only during the two or three months of polar summer.

In the course of six years work, the various parties of the "Expeditions" (varying in personnel from two to eleven men) have covered about 3000 kilometers and collected over five tons of scientific material. The rare and interesting minerals found represent approximately one hundred and fifty different localities. The conditions under which the work was carried on were exceedingly trying owing to the bitter cold (snow fell as early as August 9), the swarms of insects and the absence of roads or even pathways, not to mention lack of habitations. The principal bases were the railway stations of Hibina, Imandra, and Belaya.

Hibina-Toundra and Lujavr-urt occupy first rank among mineral localities, not only for the beauty of the specimens, but also for the peculiarity of the minerals, the abundance of rare combinations, and their interesting genetic relationships. The rich mineralogical material collected is now exhibited in all its splendor in the Mineralogical Museum of the Academy of Sciences.

Our experience has been that every new journey to this field develops new mineralogical discoveries since a large number of gorges and portions of plateaus have not yet been visited. The study of this material is still being pursued by numerous workers

in the Mineralogical Museum; new facts are being discovered, so that our knowledge of these massives is far from being complete.[1]

## GEOLOGY

The massives of Hibina-Toundra and Lujavr-urt consist of nephelinitic rocks. The western massive—Hibina-Toundra—is composed of a variety of light-colored nephelite syenites bordered by zones of sedimentary rocks and gneisses, which are metamorphosed at the contact. These rocks are cut by segregation veins.

A deep meridian lake separates this massive from the eastern one—Lujavr-urt—composed of schistose lujavrite (variety of nephelite syenite). From orographic and petrographic standpoints both massives have the shape of a horse shoe, opening to the east, and consisting of concentric ridges of mountains, cut through by snow obstructed passes.

The mineral localities follow the same concentric zones, and are peculiar to definite types of syenites. In Lujavr-urt the zone of pegmatite veins containing rare minerals is to be found at a height of 600 to 700 meters, with an extension of 50 kilometers.

## HIBINA MINERAL ASSEMBLAGES

Twenty-seven typical mineralogical segregations are distinguishable in both massives. These are shown in Table I.

The contact minerals of the Hibina massive (Group B) are found in a zone around the whole massive, and appear also at times in the highest central points. The margin of the massive consists of rocks of the type of umptekite, lying near the contact, and by coarse-grained hibinite. The hibinite passes into lamellar nephelite syenites (including minerals of Group R).

The minerals of the magmatic phase (Group A) are limited by a deep furrow separating the outer zones from the central part of the massive. The central part is crossed by veins of Group O; while the line of the valley of Koukiswumchorr is bordered by veins of Group P. The middle and inner slope of the massive is occupied by Group G.

[1] About fifty papers have been published in various journals on special investigations of the Expeditions. The general summary appears in three volumes: the first, with a map of Lujavr-urt and the routes appeared in 1925. The second volume, to appear in 1926, will contain the geological and petrographical results, with a description of the localities. The third volume will describe the mineralogy and geochemistry of the massives.

TABLE I. GENETIC TYPES OF HIBINA-AND LUJAVR-TOUNDRA.

| According to W. Brögger | Temperature | Phases of Process | Characteristics | I Zr, and Rare earths Predominate; Lamprophyllite Group | II Ti Predominates Astrophyllite Group | III Ti Predominates Sphene-Ilmenite Group | IV Rare earths, Zr, and Ti absent. Feldspar-Zeolite Group | V Endocontact Group B | VI Lujavr-urt Group L |
|---|---|---|---|---|---|---|---|---|---|
| First: Magmatic Phase | Near 1000° | A Magmatic | Amazonite, with large masses of black Aegirine I, and Arfvedsonite. Aegirine II | 1. Rinkolite a. With Aegirine b. With Aegirine and Eudialyte. 2. Aenigmatite, Mesodialyte. a. With rare Lamprophyllite. | R b. Reaction rim of Astrophyllite. | 9. Brown Sphene. | 13. Hornblende-Amazonite 14. Aegirine-Amazonite 15. Sodalite-Arfvedsonite. 16. Feldspar-Aegirine a. elaeolite absent b. with elaeolite | 20. Loparite-Eudialyte or Eucolite 16c. Fedspar with Aegirine, and Ramsayite. 16d. Feldspar with Aegirine and Loparite. | 21a. Aegirine-Eucolite-Ramsayite, with Lamprophyllite-Murmanite (and Sodalite). |
| | | B Epimagmatic, Pegmatitic. Sphene, Astrophyllite, and Apatite | 3. Lamprophyllite-Mesodialyte, with (Aegirine II). | J 4. Astrophyllite a. With Aegirine and Mesodialyte b. With Hornblende 5. Eucolite, with Albite, Aegirine, and Hastingsite 6. Feldspar-Astrophyllite | | 10. Yellow Sphene. 11. Eucolite a. With Sphene b. With Ilmenite 12. Pectolite-Astrophyllite. | W | 22. Feldspar-Quartz | 21b. Lamprophyllite-Murmanite 27. Schizolite-Ussingite |
| | | | | | | 17a. Apatite with Sphene A | 17b. Apatite with Magnetite or Biotite | | |
| Second: Pneumatolitic Phase | 500° | C Pneumatolytic | Yellow-Brown Feldspar, and dark minerals | Feldspar Veins (with Fluorite) (Largely Albite) a. With Zircon, and some Arfvedsonite | | O b. With Ilmenite, local Arfvedsonite (Zircon). | c. With Biotite | 25. Albite with Biotite and Zircon 23. Corundum-Pyrrhotite (with Anatase) 24a. Albite-Analcite with Neptunite and Elpidite. | 24a. Analcite (Sodalite), Aegirine with Neptunite. |
| Third: Hydrothermal phase | 350° | D Hydrothermal | Natrolite (red) Aegirine III | | | | 18. Chalcedony (Calcite II) | | |
| | 200° | | Natrolite: white, and reddish. Zeolites. | 8. Natrolitic veins and masses a. With Zircon | b. With Astrophyllite. | P c. With Ilmenite | 8d. Analcite e. With Aegirine f. With Hydrargyllite. | 24. Natrolite-Neptunite (with Aegirine | 24b. Natrolite-Neptunite (with Aegirine). |
| Fourth: Fluocarbonate phase | 100° | | Yellow flint. | | | | 19. Flint Calcite III | | |

GENETIC HISTORY. The regular distribution of genetic types is connected with the mode of origin and method of cooling of these magmatic masses. As yet the studies have not been completed, and one must construct hypotheses for the explanation of the observed correlations.

Careful study of the course of the geological processes of Hibina-Toundra show two very marked periods in the history of the mineralogical events. The first period separates the magmatic and pegmatitic stages, which in all cases was marked by the formation of immense radiated masses of aegirite of the second generation. At this time the earlier formed magmatic minerals became unstable: aenigmatite was replaced by astrophyllite, elatolite was removed, the stream of volatile elements increased, and the formation of minerals of lower specific gravity began.

This was due not so much to the variation of temperature as to the unexpected lowering of pressure. This type of phenomena was especially characteristic of the central zone of Hibina, where we undoubtedly have to deal with the region in which the formation of the minerals proceeded under decreased pressure.

The second period in the geochemical history of the massive was determined by the liquation of the steam (about 300–400°C). From then on appeared the typical hydrothermal veins (zeolites).

It is more difficult to trace the genetic processes in Lujavr-urt, as this Toundra has not been sufficiently studied. Nevertheless, one is attracted by the great resemblance of the lujavritic pegmatities with the contact zones of Hibina-Toundra.

## MINERALS PRESENT

About ninety minerals have been found in the nepheline syenites and their endocontact zones. These are listed below. Those identified only under the microscope are placed in parentheses, while the more interesting ones are given in italics.

SULFIDES (6): chalcopyrite, galena, molybdenite, pyrite, pyrrhotite, sphalerite.
HALOIDS (2): fluorite, yttrocerite.
CARBONATES (4): calcite, *calcioancylite*, *elatolite*, malachite.
PHOSPHATES (1): cerium apatite.
OXIDES (15): agate, (anatase), chalcedony, (corundum), flint, (hydrargyllite), ice, ilmenite, limonite, manganese oxides, quartz, (quartzite), (rutile), (spinel), zircon.
SILICATES (45): actinolite, aegirite, (aegirite-augite), (albite), analcite, (andalusite), (andesine), anomite, anorthoclase, arfvedsonite, barkevikite, biotite, cancrinite, cataforite, chabazite, chlorite, chrysocolla, (diopside), epidote, epistilbite(?),

(garnet), *hackmanite*, hastingsite, heulandite, hornblende, hydronephelite, kaolinite, mesolite, microcline, natrolite, nephelite, nosean(?), olivine, orthoclase, *pectolite*, pyroxene-titaniferous, *schizolite*, (serpentine), (sillimanite), sodalite, *taeniolite*, thomsonite, *ussingite*, (wollastonite), *yuksporite*.

ZIRCONO-TITANO-SILICATES (15): Eudialyte group: *aenigmatite*, *astrophyllite*, eucolite, eudialyte, låvenite, *lamprophyllite*, *lovchorrite*, mangan-neptunite, mesodialyte, *murmanite*, *ramsayite*, *rinkolite*, rosenbuschite, *titano-elpidite*, wöhlerite.

TITANATES AND TANTALATES (4): *loparite*, perovskite(?), (pyrochlorite ?), sphene.

## DESCRIPTIONS

AENIGMATITE. This is very common in several types of segregation veins, forming large irregular crystals weighing several kilograms. It is accompanied by aegirite, microcline, nephelite, and eudialyte. Astrophyllite and aegirite when bordering this mineral, sometimes replace it entirely, forming a variety of reaction-rim called *coronite*.

ASTROPHYLLITE. Likewise very common in large golden-yellow plates, or fine filiform and fibrous masses, associated in the latter form with pectolite, sphene, and natrolite. Masses weighing ten kilograms were found.

CALCIO-ANCYLITE. This mineral is similar to ancylite from Narsarsuk, Greenland, in its crystallographic and physical properties. It occurs in small yellow, tinged with gray or brown, crystals, coating the cavities of an unidentified mineral, associated with zircon, natrolite, ilmenite, acicular aegirite, and occasionally with small quantities of yttrocerite.

CERIUM-APATITE. Green apatite is rather common in nephelite syenite veins in masses of probably commercial importance. It contains about 3.18% of the rare earths of the cerium group. It occurs associated with magnetite, nephelite, biotite, aegirite, sphene, and microcline.

ELATOLITE. Under this name, A. E. Fersman has described traces of a mineral filling cavities about 8 cm. in length with an arborescent crystalline skeleton. Crystallographic examination indicates an origin from primary calcium carbonate stable at a temperature above 1000°C, and disappearing entirely at a decreased pressure.

EUDIALYTE GROUP. In variety of color and abundance of crystal forms, the members of the eudialyte group have proved exceedingly interesting. It is found sometimes in large masses. There are many types, from violet-red eudialyte to the brown eucolite.

The change of color follows the increase in specific gravity, increase of rare earth content, and gradual change of optical sign (+ to −), with the intervening pseudo-isotropic variety called mesodialyte.

HACKMANNITE. Common in Lujavr-urt, associated with sodalite. It has a violet-red tinge on a fresh fracture, which rapidly disappears after a few minutes exposure in the open air.

LAMPROPHYLLITE GROUP. Lamprophyllite is one of the most remarkable of the Hibina and Lujavr-urt minerals. It occurs in poorly developed crystals up to 20 cm. in length, or in stellate groups, with a perfect cleavage, and a semimetallic luster. Its exterior resemblance to astrophyllite is very striking so that it is very difficult to distinguish them without testing. It occurs associated with eudialyte, aegirite, and rinkolite. The mutual replacement of zirconium by titanium, and CaO by SrO and BaO is characteristic, with corresponding variations in optical properties.

LOPARITE. It is a black mineral, with a metallic luster, forming pseudocubic penetration twins. The principal forms are (100) and (111). It occurs in umptekite along the line of contact, associated with eudialyte, aegirite, ramsayite, and sphene.

MANGAN-NEPTUNITE. This mineral was found locally in the contact zone of the Hibina massive, in dark red, almost black crystals, associated with fibrous aegirite, natrolite, and analcite. It occurs also in the pegmatites in the lujavrite of Lujavr-urt, associated with aegirite, natrolite, eucolite, and ramsayite.

MURMANITE. This is a violet, scaly mineral with a perfect micaceous cleavage, and a semimetallic luster, occurring both in Hibina-Toundra (rare), and in Lujavr-urt (in beautiful plates of considerable size).

PECTOLITE. It occurs in large masses in gneissic pegmatites or nephelite syenites. Numerous analyses show it to possess a variable composition. It is accompanied by sphene, fibrous astrophyllite, aegirite, biotite, natrolite, and more rarely by grains of fluorite, galena, and sphalerite.

RAMSAYITE. It differs from lorenzenite in the absence of zirconium. It occurs as large, dark brown, well developed orthorhombic crystals up to 3 cm. in length. It is associated with feldspar, nephelite, aegirite, and eucolite. It has been prepared artificially.

RINKOLITE. It is very common in the Hibina-Toundra, forming elongated and lamellar crystals of yellowish-green color, which may attain a length of 20 cm. At one locality, large brown, colloidal masses weighing hundreds of kilograms were found (*lovchorrite*). It is related to mosandrite and rinkite, resembling the latter in paragenesis and exterior appearance.

SCHIZOLITE. This mineral is very rare, and occurs only in ussingite in single crystals.

TAENIOLITE. It occurs in laminae resembling the mineral from Narsarsuk, Greenland, and was found in the valley of Mannepahk in Hibina-Toundra, in the contact zone.

TITANO-ELPIDITE. It occurs in small quantities in the contact zone associated with albite and the oxides of manganese. It differs from elpidite from Narsarsuk, Greenland, in having titanium prevailing over zirconium, with corresponding differences in optical properties.

USSINGITE. It was found in a boulder in Lujavr-urt with aegirite and schizolite. Its composition and properties are identical with the mineral from Kangerdluarsuk, Greenland.

YUKSPORITE. It is a pink lamellar, or scaly mineral, which appears to be a member of the pectolite group, but contains more sodium. It is found intergrown with sphene, and accompanying pectolite, astrophyllite, biotite, and aegirite.

## GEOCHEMISTRY

From the geochemical standpoint the massives are of great interest because of their characteristic elements. The table below lists these in order of decreasing importance. The prevailing elements which determine the type of geochemical province are printed in heavy type:

(I) O, F, **Na**, Mg, Al, Si, P, Cl, K, Ca, **Ti**, Mn, Fe, **Zr**, Ce group.
(II) H, C, S, Cu, Mo, Pb, Zn, Sr, Ba
(III) V, Y, Nb, Hf, Ta, Th, Li (Au?)

The elements of the middle atomic weight strikingly predominate, and the absence of light volatile metalloids and heavy metals is also marked. Even numbered elements, especially those of the fourth periodic group, prevail. Compared with other great alkaline regions the following features are noteworthy: the predominance of titanium over zirconium (as it is in Greenland and

the Langesundfiord); and the prominence of phosphorus, the cerium group of rare earths, strontium and barium.

While the geochemistry and mineralogy of the contact zones resemble the assemblages of Narsarsuk, Greenland, the central part of Hibina-Toundra more nearly approaches the dikes of alkaline rocks in that country. The minerals of Lujavr-urt, however, somewhat resemble those of Pilandsberg in South Africa. Without analogy, and quite exceptional, are the ramsayite pegmatites of Lujavr-urt, in which are to be found assemblages of rare beauty consisting of hackmannite, elatolite, lamprophyllite, ramsayite, eucolite, and murmanite—six of the characteristic minerals of the Kola Peninsula.

Tables II and III summarize some of the more important chemical analyses, physical and optical properties of a number of the minerals of this region.

TABLE II. SELECTED ANALYSES OF SOME OF THE MINERALS FROM HIBINA-AND LUJAVR-TOUNDRA

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | ..... | 59.17 | 46.57 | 48.05 | 55.44 | 27.66 | 42.02 | 52.68 |
| $TiO_2$ | ..... | ..... | 1.01 | 3.13 | 5.28 | 20.83 | 8.34. | 18.21 |
| $ZrO_2$ | ..... | ..... | 14.49 | 8.97 | ..... | 12.40 | ..... | ..... |
| $Ce_2O_3$ | 47.27 | ..... | ..... | 2.54 | ..... | 0.50 | ..... | ..... |
| $Yt_2O_3$ | 0.74 | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| $Al_2O_3$ | ..... | 17.67 | ..... | ..... | ..... | 0.52 | tr | ..... |
| $Fe_2O_3$ | ..... | ..... | ..... | ..... | 0.44 | 2.89 | 9.72 | ..... |
| FeO | ..... | ..... | 7.25 | 6.15 | ..... | ..... | 29.23 | 5.16 |
| MgO | ..... | ..... | 0.05 | 1.67 | 0.43 | 0.20 | 1.40 | 0.12 |
| CaO | 4.36 | ..... | 12.26 | 10.33 | 18.81 | 1.81 | 0.53 | 0.43 |
| SrO | 12.11 | ..... | ..... | ..... | ..... | 8.40 | ..... | ..... |
| BaO | 1.59 | ..... | ..... | ..... | ..... | 6.75 | ..... | ..... |
| MnO | ..... | ..... | 1.20 | 2.91 | 0.45 | 1.99 | 3.22 | 9.95 |
| $Na_2O$ | ..... | 19.66 | 13.82 | 12.43 | 10.76 | 14.00 | 4.74 | 9.16 |
| $K_2O$ | ..... | ..... | 0.48 | 0.89 | 2.52 | 1.42 | 0.43 | 4.94 |
| $CO_2$ | 28.38 | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Cl | ..... | ..... | 1.21 | 1.32 | ..... | ..... | ..... | ..... |
| F | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| $H_2O$ | 5.55 | 3.80 | 0.91 | 0.50 | 5.61 | 0.67 | 0.47 | ..... |
| Total | 100.00 | 100.30 | 99.25 | 98.89 | 99.74 | 100.04 | 100.10 | 100.65 |

TABLE II—continued

| | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 34.06 | 29.13 | 27.58 | 27.61 | 0.47 | 40.26 | 49.39 | 30.76 |
| $TiO_2$ | 46.26 | 37.33 | 11.15 | 12.71 | 50.24 | 1.92 | 1.91 | 40.34 |
| $ZrO_2$ | ..... | 2.00 | 0.35 | 0.20 | 0.04 | 12.72 | ..... | ..... |
| $Ce_2O_3$ | 0.32 | ..... | 18.02 | 8.79* | 33.17 | ..... | ..... | 0.17 |
| $Yt_2O_3$ | | ..... | ..... | 1.36† | 1.54 | ..... | ..... | |
| $Al_2O_3$ | 0.90 | ..... | 1.47 | 0.13 | ..... | ..... | 21.83 | |
| $Fe_2O_3$ | ..... | ..... | 0.99 | ..... | ..... | 26.43 | 3.37 | 0.10 |
| FeO | 1.03 | 1.84 | ..... | ..... | ..... | ..... | .... | 0.02 |
| MgO | tr | 0.75 | tr | 0.80 | ..... | 2.42 | tr | 0.72 |
| CaO | 0.35 | 2.10 | 24.70 | 27.26 | 5.08 | 1.68 | 4.46 | 27.50 |
| SrO | ..... | ..... | 3.30 | 3.56 | ..... | ..... | ..... | ..... |
| BaO | ..... | ..... | tr | ..... | ..... | ..... | ..... | ..... |
| MnO | 0.02 | 2.92 | tr | 0.53 | ..... | 8.28 | 1.76 | 0.20 |
| $Na_2O$ | 16.20 | 14.94 | 6.73 | 7.18 | 8.60 | ..... | 10.60 | 0.83 |
| $K_2O$ | 0.28 | ..... | 0.16 | 0.28 | 0.43 | ..... | 1.21 | 0.11 |
| $CO_2$ | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Cl | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| F | ..... | ..... | 5.99 | 6.38 | ..... | ..... | .... | ..... |
| $H_2O$ | 0.33 | 8.92 | 1.75 | 0.51 | ..... | ..... | 6.16 | ..... |
| Total | 99.75 | 99.93 | 102.19 | 102.68 | 99.57 | 93.71 | 100.69 | 100.75 |

*$CeO_2$=8.79; $ThO_2$=0.23

†$(Di, La)_2O_3$=5.15

(1) Calcio-ancylite, analyzed by G. P. Chernik; (2) Ussingite, anal. by N. P. Vrevskaja; (3) Eudialyte, anal. by G. P. Chernik; (4) Eucolite, anal. by I. Starynkevich; (5) Yuksporite, anal. by N. P. Vrevskaja; (6) Lamprophyllite, anal. by K. Beloglasov; (7) Aenigmatite, anal. by I. Starynkevich; (8) Neptunite, anal. by L. M. Kourbatov; (9) Ramsayite, anal. by K. Beloglasov; (10) Murmanite, anal. by I. D. Starynkevich; (11) Rinkolite, anal. by K. A. Nenadkevich; (12) Lovchorrite, anal. by I. D. Starynkevich; (13) Loparite, anal. by I. Knipovich; (14) Astrophyllite, anal. by K. Beloglasov, incomplete; (15) Ranite, anal. by N. P. Vrevskaja, a mixture of pectolite and "spreustein"; (16) Sphene, anal. by V. A. Smirnov.

TABLE III. PROPERTIES OF SOME OF THE MINERALS OF THE KOLA PENNINSULA

| NAME OF SPECIES | SYSTEM | OCCURRENCE | H | SP. GR. | COLOR | STREAK | ELONGATION | $n_g$ | $n_m$ | $n_p$ | $n_g - n_p$ | SIGN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Calcio-ancylite | Rhombic | Indistinct crystals | 4 | 3.82 | Brownish yellow | White | | | | | | |
| Ussingite | | Fine grained | 6–7 | | Violet | White | | | | | | |
| Pectolite | Monoclinic | Radiated | 5 | | Grayish white | White | + | 1.643 | 1.642 | 1.6098 | 0.0332 | + |
| Yuksporite | | Platy, Fibrous | 5 | | Pink, Red | White | − | | | | 0.0166 | + |
| Titano-elpidite | Rhombic | Xls. elong. ‖ to $C$ | 6.5 | 2.55 | Brown Pink | Brownish | | 1.698 | 1.686 | 1.681 | 0.017 | + |
| Lamprophyllite | Rhombic ? | " | 2–3 | 3.35 | Yellow | Yellowish | + | | 1.75 | | 0.0326 to 0.040 | + |
| Rinkolite | Monoclinic | " | 5 | 3.40 | Brown Green Yellow | Light yellow | − | 1.651 1.681 | 1.645 1.667 | 1.643 1.662 | 0.008 to 0.019 | + |
| Lovchorrite | | Amorphous | 5 | 3.32 | Brown Yellow | " | | | 1.653 | | | |
| Manganneptunite | Monoclinic | Crystals | 5 | 3.20 | Red | Orange-red | + | | 1.73 | | | |
| Ramsayite | Rhombic | Xls. elong. ‖ to $C$. | 6–6.5 | 3.44 | Brown, Red | Pale yellow | + | | | >1.83 | nearly 0.091 | − |
| Loparite | Pseudocubic | Twins | 5.5 | 4.77 | Black | Red-brown | | | | | | |
| Murmanite | ? | Tabularmasses | 2–3 | | Violet | Pale violet | | | 1.735 | | | |

TABLE III. (Continued)

| NAME OF SPECIES | AXIAL ANGLE | DISPERSION | OPTICAL ORIENTATION | PLEOCHROISM | COMPOSITION | REMARKS |
|---|---|---|---|---|---|---|
| Calcio-ancylite | | | | | Carbonate of cerium and the alkaline earths | Near ancylite from Greenland with Sr partly replaced by Ca and Ba. |
| Ussingite | | | | | Hydrous aluminum, sodium silicate | Similar to material from Greenland. |
| Pectolite | 53° | | $n_g = b$; $n_p$ nearly $\|\|$ to $C$ | | (Ca, Na, $H_2$) $SiO_3$ | |
| Yuksporite | Variable 46°—75.5° | | Plane of optic axes in elong. | $n_p$ = yellowish pink; $n_m$ and $n_g$ = pink. yellow | Near pectolite but more Na and K. | Fine fibrous structure makes optical determinations difficult. |
| Titanoelpidite | | $\rho > \upsilon$ | $n_g = a$; $n_p = b$ | $n_m$ = yellow; $n_p$ = uncolored | Hydrous titano-zirconosilicate of sodium | Differs from Elpidite in having more $TiO_2$ than $ZrO_2$. |
| Lamprophyllite | 40° | | | $n_g > n_m > n_p$ | Titano-silicate of cerium, sodium and the alkaline earths | Named and described by Ramsay. |
| Rinkolite | 45°–88° | $\rho > \upsilon$ | $n_p \wedge c$ 1.5–3.5°; $n_m = b$. | $n_g > n_m > n_p$ | Titano-Silicate of cerium, calcium, strontium and sodium. | Belongs to Mosandrite-Rinkite group. |
| Lovchorrite | | | | | " | Partly isotropic, partly anisotropic. |
| Manganneptunite | | | $n_g \wedge c = 20°$; $n_m = b$ | $n_g > n_m > n_p$ = orange yellow | $R_2^{I}R^{II}Si_4O_{12}$ | High content of manganese. |
| Ramsayite | 49.9° | $\rho > \upsilon$ | $n_p = a$; $n_g = c$ | $n_g$ = pale yellow; $n_m = n_p$ = pale orange | $Na_2O \cdot 2TiO_2 \cdot 2SiO_2$ | Belongs to Lorenzenite group. |
| Loparite | | | | | Titanate of cerium, calcium and sodium. | Belongs to Perovskite group. |
| Murmanite | Biaxial | | $n_p \perp$ to cleav. | | Titano-zicono-silicate of sodium, iron, manganese and calcium. | Study of the mineral not complete. |