TUGTUPITE: A GEMSTONE FROM GREENLAND

By Aage Jensen and Ole V. Petersen

The red variety of the mineral tugtupite, a rare silicate closely related to sodalite, has been used as a gemstone since 1965. This article presents the history of the mineral and details of its mineralogy and gemology. A recently discovered light blue variety of tugtupite is also described. Thus far, tugtupite has been found in only two localities: (1) Lovozero, Kola Peninsula, U.S.S.R., where it occurs as very small grains; and (2) Ilímaussaq, South Greenland, where it has been located at several places within the Ilímaussaq intrusion. Gem-quality tugtupite has come almost exclusively from one occurrence, a set of hydrothermal albite veins from the Kvanefjeld plateau in the northwestern corner of the Ilímaussaq intrusion.

The mineral that is now known as tugtupite was discovered in 1957 by Professor H. Sørensen in the coastal cliffs of Tugtup agtakôrfia on the north coast of the Tunugdliarfik fjord, South Greenland. It was first mentioned under the provisional name "beryllium sodalite" in the reports of the International Geological Congress, Norden (Sørensen, 1960).

Tugtup agtakôrfia lies within the geologically famous Ilímaussaq alkaline intrusion. This approximately 150-km² nepheline syenite intrusion is situated on both sides of the Tunugdliarfik fjord a few kilometers to the east of the town of Narssaq. Close to 200 different minerals have been described from this intrusion in the period from 1823 to the present.

Coinciding with the presentation of this new mineral from South Greenland, a description of an apparently identical mineral called beryllosodalite was published by Semenov and Bykova (1960). The material they described came from the Lovozero intrusion of the Kola Peninsula, U.S.S.R. At this locality, the mineral is rather rare and has never been found in masses larger than 3 mm.

Additional data were published by Sørensen (1963). He concluded that the mineral was a new species and proposed the name tugtupite, which is derived from the locality where the mineral was first found. In 1965, the Commission on New Minerals and Mineral Names of the International Mineralogical Association approved both the mineral and the name.

Danø (1966) described the crystal structure of tugtupite. A detailed description of the crystal habit, the pseudocubic penetration trillings, and the numerous localities where tugtupite had been found from the time that it was first traced at Tugtup agtakôrfia until 1971 (including the only one that has produced gem material of any significance) was presented by Sørensen et al. (1971). Another type of twin, pseudotrigonal contact trillings, was subsequently described by Petersen (1978).

The tugtupite from the type locality was described as white, but Sørensen (1960) mentions that the color changes to light pink when the mineral is exposed to strong sunshine. In 1962, pink tugtupite was found at Kangerdluarssuk, South Greenland; but it was only when a deeper red tugtupite was found at Kvanefjeld, South Greenland, in 1965 that tugtupite attained gemological interest (figure 1). Thus far, the material used in jewelry has come almost exclusively from the locality at Kvanefjeld. Cabochons of red tugtupite were introduced as a new gem material by the jewelry firm A. Dragsted of Copenhagen in 1965, and presented at the Eleventh International Gemmological Conference in Barcelona in 1966.

In the first years after its introduction tugtupite was mounted almost exclusively in gold. In recent years, however, silver mountings have also become common, as illustrated in figure 2.

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Figure 1. Red tugtupite cabochon, 2.51 ct. Photo by Mike Havstad.

Figure 2. Tugtupite mounted in silver. This cabochon measures approximately 30 × 15 mm.

MINERALOGY

Most tugtupite is massive; only a few well-developed crystals of this rare mineral have been found, growing on walls of cavities in massive tugtupite. Such crystals are short, prismatic, and transparent, they are colorless or pale pink, and they range in size from 1 × 1 × 1 mm to 3 × 2 × 2 mm. Tugtupite belongs morphologically to the crystal class $\bar{4}2m$: figure 3a shows a drawing of a slightly simplified idealized crystal; figure 3b illustrates an idealized contact trilling of tugtupite.

Optical and Physical Properties. The color of "red" tugtupite varies from light pink to dark cyclamen red (figure 4). Red tugtupite is pleochroic, showing two different hues of dark red, one with a weak bluish tint and the other with a weak orange tint.

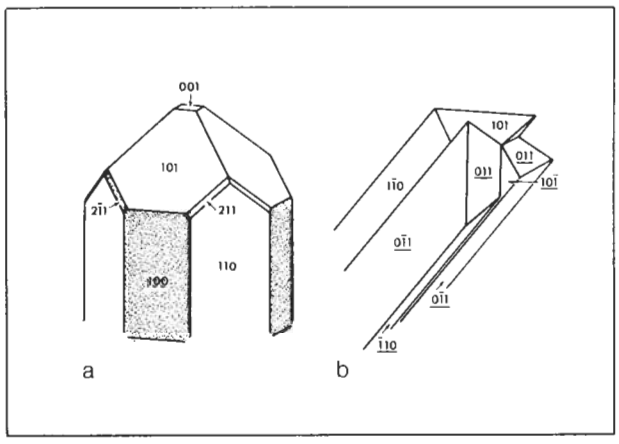
The color of red tugtupite fades when the stone is kept in darkness but is regained when the stone is exposed to sunshine; the color is quickly restored when the stone is exposed to ultraviolet radiation. Red tugtupite has been used in jewelry since 1965. Some of the early customers have returned jewelry with faded tugtupite to the firm of A. Dragsted, where the problem was solved by exposing the stone to long-wave ultraviolet radiation for 15 minutes. No customer has had this treatment performed more than once (Ove Dragsted, personal communication).

So far only the red tugtupite has been used in jewelry; the white variety has shown no potential as a gem. Recently, a light blue variety of tugtupite has been found at the Kvanefjeld plateau that might be of gemological value, but it is very scarce. To the authors' knowledge, fewer than 10 cabochons of blue tugtupite have been cut; five small cabochons (1–5 ct each) have been made in the polishing laboratory of the Institute of Mineralogy of the University of Copenhagen. Pleochroism has not been observed in the light blue material.

Tugtupite has a vitreous luster. It has a hardness of 6½ on the Mohs scale. There is a weak cleavage parallel to {101} and {110}. The fracture is uneven. Tugtupite is generally rather opaque, but small amounts of red tugtupite have proved to be transparent enough to be faceted (again, see figure 4).

Tugtupite is optically positive and is most often uniaxial, though axial angles as large as 10° have been observed.

Figure 3. Drawings of (a) an idealized crystal of tugtupite and (b) an idealized contact trilling of tugtupite.



The refractive indices of tugtupite (which were determined by means of the $\lambda - T$ variation method on pure material) are: for white tugtupite from the type locality at Tugtup agtakôrfia, $n_\epsilon = n_\gamma = 1.502 \pm 0.002$, $n_\omega = n_\alpha = n_\beta = 1.496 \pm 0.001$ (Sørensen, 1960); and for the red tugtupite from the Kvanefjeld plateau, $n_\epsilon = n_\gamma = 1.499 \pm 0.001$, $n_\omega = n_\alpha = n_\beta = 1.495 \pm 0.001$ (Sørensen et al., 1971). The values 1.495 and 1.499 are generally obtained when polished bases of cabochons are measured on the refractometer. However, faceting-quality material yields slightly lower refractive indices. Measured on the refractometer, polished bases of the light blue cabochons give $\omega = 1.495$ and $\epsilon = 1.499$.

Sørensen et al. (1971) gave the density of red tugtupite as 2.33 ± 0.01 and the calculated density as 2.35. Sixteen cabochons of red tugtupite in the possession of the Geological Museum vary in density between 2.27 and 2.44 due to porosity and the presence of minerals other than tugtupite in the cabochons. The five light blue cabochons vary in density between 2.33 and 2.36.

The fluorescence of red tugtupite has been described by Dragsted (1970) as apricot colored when the stone is exposed to long-wave ultraviolet (U.V.) radiation and salmon red when exposed to short-wave U.V. radiation. Povarennykh et al. (1971) reported that red tugtupite fluoresced yellow-orange to long-wave U.V. radiation. Having investigated most of the red tugtupite in the possession of the Geological Museum of the University of Copenhagen (more than 100 specimens in total), the present authors prefer to describe the fluorescence of red tugtupite as dark cyclamen red with short-wave U.V. radiation and varying from cinnabar red to light cyclamen red with long-wave U.V. radiation. Light blue tugtupite fluoresces light orange-yellow to long-wave U.V. radiation and light carmine red to short-wave U.V. radiation, rather similar to some of the red tugtupite exposed to long-wave U.V. radiation.

It is important to note that the exposure of light blue tugtupite to U.V. radiation must be of short duration (no more than 30 seconds), or the light blue stone will turn light red. This light red color is not stable, but on fading it leaves a reddish-blue hue that is less attractive than the original light blue of the stone. The bottom row of figure 4 shows, from left to right, two unexposed light blue tugtupites, two light blue tugtupites that were exposed to ultraviolet radiation the day before the photo was taken, and one light blue tugtupite that was exposed to ultraviolet radiation two months before the photo was taken.

Crystallography. According to Danø (1966), tugtupite belongs to the tetragonal crystal system, with space group $I\bar{4}$. The crystals display positive piezoelectric effect and lack a positive pyroelectric effect. The unit-cell parameters of tugtupite show insignificant variations. The unit-cell pa-

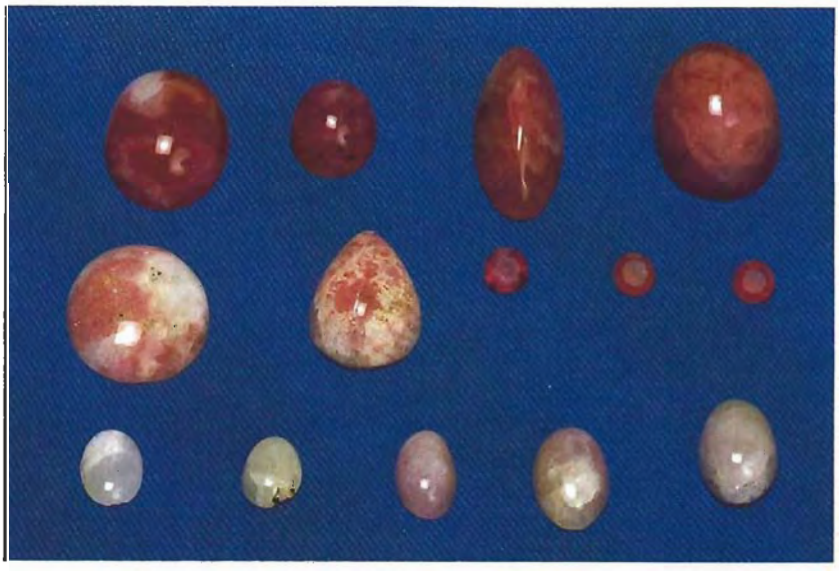


Figure 4. Upper row: four cabochons of dark red tugtupite. Middle row: two cabochons of light red tugtupite and three faceted dark red stones. Bottom row: two untreated cabochons of light blue tugtupite, two cabochons of light blue tugtupite that were exposed to ultraviolet radiation the day before the photo was taken, and one cabochon of light blue tugtupite that had been exposed to U.V. radiation two months before the photo was taken. For scale, the center stone in the bottom row measures approximately 7 mm × 10 mm.

Figure 5. View to the east from the tugtupite occurrence on the Kvanefjeld plateau.

rameters of red tugtupite from the Kvanefjeld plateau are: a = 8.637 ± 0.001 Å, c = 8.870 ± 0.002 Å (Sørenson et al., 1971).

The crystal structure of tugtupite is very closely related to that of sodalite. The formula for tugtupite is $Na_8Al_2Be_2Si_8O_{24}(Cl,S)_2$, while that of sodalite is $Na_8Al_6Si_6O_{24}Cl_2$. A comparison of the two reveals a substitution of BeSi for AlAl in the sodalite structure; this accounts satisfactorily for the lower symmetry of tugtupite.

OCCURRENCE

Since tugtupite was first discovered in 1957, in very sparse amounts, at Tugtup agtakôrfia, it has been found in a rather large number of places all over the Ilímaussaq intrusion. Thus far, though, only one site—in the northwesternmost part of the intrusion—has produced gem material of any significance.

When this gem-quality material was first discovered in 1965, access to the locality included a rough ride by car from the town of Narssaq, along the Narssaq River, to the foot of the Kvanefjeld plateau. From here, a half-hour walk, including a 300-m ascent along a well-marked path, brought one to the top of the scenic plateau in the immediate vicinity of the occurrence. Figure 5 shows the view to the east from the occurrence. In 1979 the road was extended in connection with prospecting activity in a potential uranium deposit. It now winds in narrow steep curves, close to the old path, up to less than 100 m from the top of the plateau. The entire occurrence covers an area no more than 25 × 5 m, with the tugtupite scattered in a set of highly irregular hydrothermal veins, up to 0.5 m wide, intersecting the augite syenite country rock. These veins are mainly composed of fine-grained albite; they may be zoned, with tugtupite concentrated in the central part, but tugtupite can also be found disseminated in the immediately surrounding syenite. The intense cyclamen red tugtupite occurs as angular patches up to as large as 10 cm across. Figure 6 shows the major horizontal vein as it appeared in July 1968.

Of the numerous other minerals found in the vein, the most important are aegirine, epistolite, sphalerite, pyrochlore, neptunite, and chkalovite.

Figure 6. The major vein for gem-quality tugtupite, July 1968.

Substantial amounts of tugtupite were taken from this locality in the years immediately following its discovery, and particularly large amounts of material were taken by the Geological Museum, Copenhagen, in 1969 and 1975.

THE CURRENT STATUS OF GEM TUGTUPITE

No private claims cover the occurrence of tugtupite at the Ilímaussaq intrusion. Prior to 1979, when home rule for Greenland was established, the area was under the jurisdiction of the Danish government, which held the rights to the uranium deposit inside of which tugtupite occurs. However, a special paragraph in the mining law gave residents of the area the right to use certain types of raw material, and intense juridical considerations were devoted to this subject with no definitive settlement. Today all rights, except for collecting under the auspices of the Geological Survey of Greenland for scientific purposes, belong to the community council of the town of Narssaq.

Collecting and mining of tugtupite have been carried out by anyone able to get near the occurrence. All types of mining methods have been used—picking chips with nothing but bare hands, using hammer and chisel, bringing in drilling equipment, and even dynamiting. Consequently, it is virtually impossible to estimate the amount of gem material that has been mined. Judging from the pieces of jewelry with tugtupite that can be seen in Greenland and Denmark, we are dealing with relatively large amounts.

More tugtupite, blue as well as red, occurs in the area, but right now the locality where gem-quality material has been found seems to be exhausted. However, renewed mining undoubtedly will unveil new veins with more gem tugtupite. Once the decision is made to start mining for uranium on the Kvanefjeld plateau, hitherto unseen opportunities to find new occurrences will arise.

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