Charoite - A Champion among Mineralogical Discoveries in the Second Half of the 20th Century

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世上唯一被發現的查羅石礦床位於西伯利亞東部近 Chara 河附近。查羅石含40種以上稀有礦物，十多種花俏的顏色。作者檢測了多顆不同的查羅石，並對其特徵和查羅石的歷史加以描述。

The world's only deposit of charoite (the Sirenevy Kamen deposit) was found in Eastern Siberia near the River Chara. A combination of its unusual mineral colour and its flamboyant pattern makes a deep impression on the viewer. Finely laminated charoite crystals are intertwined producing the stone's flowing pattern resembling satin flower petals and intricate swirls that look like a chatoyant piece of lilac silk.

Charoite is an alkaline calcic silicate of a complex composition (crystal-chemical formula $K(Ca,Na)_2Si_4O_{10}(OH,F)H_2O$) named after the place where it was discovered, the basin of the Chara River.

The history of the discovery of charoite

Charoite-containing rocks (below referred to as - *charoitite*) were first found among metamorphic and terrigenous-carbonaceous strata of the Chara Block in 1948 (in the western part of the Aldan Shield) by V.G. Ditmar, who mistakenly called them cummingtonite schists. Cummingtonite is a magnesian amphibole and, as it was later to be proved, charoite contains almost no magnesium. Twenty years later a new generation of geologists visited the site, among them a young couple, Vera P. and Yuri G. Rogovs. Their names are closely bound up with the history of the discovery of charoite and its investigation and also of its accompanying minerals, most of which were unknown at that time. The place where charoite was first discovered is located at the boundary of the Irkutsk Oblast and Sakha Republic (Yakutia), an area of about 10 km^2.

Charoitite is formed at a contact of potassium-rich alcaline trachyte-syenite massif and carbonaceous rocks attributed by a number of researchers to carbonatite. Such places demonstrate widely manifested potassium metasomatism that has had a genetic influence upon the formation of a number of potassic-calcareous silicates – charoite, tinaksite, and canasite.

Geologically, the charoitite deposit is confined to the southern exocontact of the Murun alcaline Massif characterised by its potassium specialisation. Analogous in their composition, massifs are rather rare worldwide and are known only in Australia, the USA (California), and the island of Corsica in Europe. All the massifs of this group are characterised by their high alkaline content, which, as a rule, is significantly higher than its alumina content, with K_2O exceeding Na_2O, as well. In addition, the Murun Massif's rocks and accompanying mainly metasomatic formations located in the massif's periphery are characterised by their higher contents of Ba, Sr, Ti, Zr, and Th. This, in turn, results in the presence in their composition of a number of rare minerals most of which are also newly discovered and occur only in the charoite mineralisation zone.

Tinaksite $NaK_2Ca_2TiSi_7O_{19}(OH)$ was the first mineral discovered at the Sirenevy Kamen' deposit. It forms as randomly scattered honey-yellow crystals, sometimes grouped in radial-beam aggregates [5]. Charoite was the second. It can be considered a champion among the minerals discovered in the twentieth century, as no other mineral was found in such quantities during this period. At first, the discoverers of charoite tried to find its analogues among already known minerals. Canasite $(Ca_5Na_4K_2)_{1]}[Si_{12}O_{30}](OH,F)_4$ discovered in 1959 by M.D. Dorfman in Khibiny was the most similar, however, more detailed investigations of charoite demonstrated their differences. Only over fifteen years later, in 1977, was charoite proved to be a new mineral in its own right and Vera Rogova was credited with identifying this beautiful mineral [4].

Further investigation of charoite-bearing rocks resulted in the discovery of tokkoite $K_2Ca_4Si_7O_{17}(O,OH,F)_4$ — a silver-brown mineral named after the basin of the Tokko River [2] where it was found, frankamenite $K_3Na_3Ca_5(Si_{12}O_{30})F_3(OH)H_2O$, as well as other less rare minerals. Among the other minerals of the Sirenevy Kamen' deposit, stisiite $ThCaSi_9O_{20}$ is also worth mentioning. Due to its composition, thorium makes both the mineral itself, and its host rocks radioactive [3]. This should be taken into consideration in the production of charoite jewellery and carvings. At the very least, the mineral should be examined visually to check for the presence of short prismatic grains varying in length from 1 mm to 1-2 cm in different shades of yellow. Such isolated minerals are usually ringed with a light brown rim testifying to radioactive disintegration.

By now, the mineral composition of charoitite has been investigated sufficiently and more than 40 new and often extremely rare minerals (encountered only in two or three places globally) have been discovered at the deposit over the past 30 years.

Charoitite has dozens of fancy varieties characterised by a wide range of colour, mineral composition, and structural features that influence the rock pattern and strength [1, 6]. Macro- and microscopic investigation of the Museum Collection, about 40 charoitite-containing samples at The Museum of Minerology and Geology, enabled us to examine both their structure and decorative properties.

Thin-sections revealed the presence of charoite, aegirine, fedorite, microcline, tinaksite, carbonate, canasite, apophyllite $KCa_4[Si_4O_{]0}]_2F\text{-}8H_2O$, pectolite $NaCa_2Si_3O_8(OH)$, and single grains of ore minerals. Aegirine occurs in almost all varieties of charoitite; canasite in pale-colored samples.

Uniformly colored lilac charoite, with a compact beam and columnar structure, is the most attractive. Beam charoite (Fig.1) is composed of sheaf-like, differently oriented aggregates of 5-10 mm in size, of a deep lilac colour and with strong pearly iridescence. This variety contains fewer mineral admixtures (up to 15%) and represents high quality jewellery material.

Samples of spotty-beam charoite demonstrate the widest range of colour varieties. The deep purple and lavender background emphasises contrasting spots of black aegirine aggregates, golden or brown-yellow tinaksite, and round spots of dark green feldspar. Beam aggregates can reach up to 3 cm in diameter with spotty beam charoite up to 2-4 cm in diameter. Spotty-beam charoite is remarkable for its "landscape" varieties (Fig.2) and is used as a semi-precious stone.

Wavy-fibred charoite's pattern is formed by discontinuous sub-parallel brown-lilac fibres and cream-coloured streaks (Fig.3). Slatey charoite is characterised by a relatively monotonous violet colour and its slatey structure is due to its parallel fibres (Fig.4). Their pearly iridescence is weak. Wavy-fibred and slatey charoites are also used as semi-precious stones. The Augen variety is characterised by a micro-curly structure: long-fibred curled aggregates of charoite associated with carbonate are enveloped by grainy or short-fibred charoite (Fig.5).

By now, gem quality charoite is almost mined out at the deposit and the state enterprise "Vostokkvartzsamotsvety" (Yakutia) intends to raise about 1 billion roubles for the construction of an open-pit mine. Charoite resources are estimated at some tens of thousands of tons, with stone quality varying widely from sample to sample. Thus, for the moment, charoite remains the rarest and the most exotic gem stone on earth, and finding an analogous deposit is still unlikely, even globally.

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The Specimens shown are from the Museum Collection of the Murun Massif, Chara River, Sirenevy Kamen' deposit, Sakha Republic (Yakutia), Russia.

Fig. 1 The polished surface of a sample of a deep lilac charoite of a compact beam structure with strong pearly iridescence. (13×8 cm)

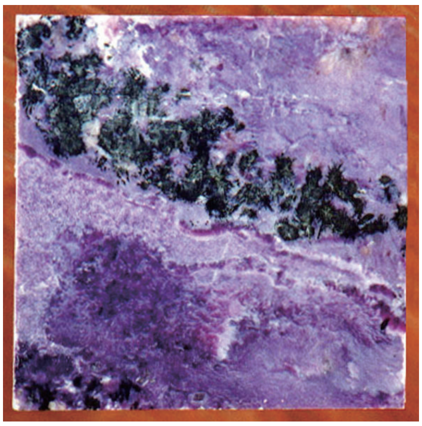

Fig. 2 Spotty-beam charoite, "landscape" variety (9×9 cm)

Fig. 3 The pattern of wavy fibred charoite (16×8 cm)

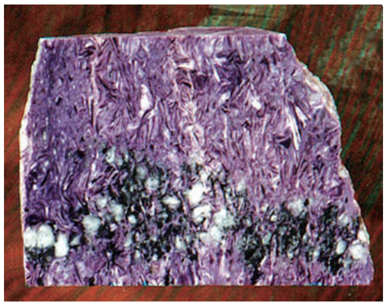

Fig. 4 Slatey charoite (11×8 cm)

Fig. 5 Augen Charoite (16×11 cm)

Fig. 6 Charoite specimens and carvings