



# Heliodor

## Volodarsk-Volynski

### Ukraine

By: Shannon Graewin

*“In Volodarsk Ukraine, 1500 chamber pegmatites were mined for quartz. Of these, only 2 handful carried beryl... [and] 99.99% of ones that made it to the market were all from ONE pocket”*

*-Author’s Communication with Peter Lyckberg, Nov 28<sup>th</sup>, 2014*

#### Overview

Ukraine has had a difficult and storied past. Until 1991, it virtually never had autonomous control. It was occupied by Germany in WWII and by the Russian and Soviet complex both before and after this period. Even today, its eastern peninsula Crimea, remains Russian occupied and continues to be a contentious issue in the region and world. The Volodarsk- Volynski Mine was long a Soviet and national secret and its amazing specimens were unrecognized in the West until the mid-1980s.

#### Geography



Figure 1 Zhytomir Region and Volodarsk-Volynski area



Ukraine is a large country (603,500 km<sup>2</sup>) situated between Eastern Europe and Russia, with a large coastline on the northern Black Sea and Sea of Azov. It is an important agricultural area as well as shipping area between Russia and Europe. About 77% of its population are ethnically Ukrainian, while Russians are its largest minority at 17-18%. Most ethnic Russians live in the Eastern portion of the country in the Crimean Peninsula.

Volodarsk- Volynski is a town and mining region in the northern central part of Ukraine in the Zhitomir Oblast Province near the Irscha River. It is west of the capitol Kiev, as well as southwest of Chernobyl, the site of the catastrophic nuclear meltdown on April 26<sup>th</sup>, 1986. The pegmatite region lies slightly west of the town in a north to south formation. The Volodarsk name is thought to be named for the Marxist leader and revolutionist V. Volodasky who lived from 1891-1918. The Volynski portion of the name is theorized to be an honoration of a Russian statesman Artemy Petrovich Volynski who lived from 1689-1740. Because of the Russian to English translation difficulty, many variations of spellings exist for this area. This area is known as the Volynsk Piezoquartz Deposit in Russian literature, which is particularly confusing because Volyn Oblast is a Province in the west of Ukraine and not related to these pegmatites.



**Figure 2** Aerial view of the Volodarsk-Volynski town with the pegmatite body in the lighter area running north to south

### History

Surface crystals of quartz and topaz were found sporadically in the 17<sup>th</sup> and 18<sup>th</sup> centuries by farmers tilling their fields. No one suspected that there were massive gem crystal pegmatites in the area, and instead they believed that the crystals were moved by glaciers from Scandinavia during the ice age. In 1851, Konstantin Feofilaktov described pegmatic occurrence in the area, but really it was the work and descriptions of quartz and topaz by geologist Gottfried Ossovskiy that generated mineral interest in the area. He started a personal collection of crystals that was later described by the Kreuz family and V. Vernadskiy in the early 1900s. Scientific interest grew and sporadic papers were published with increasing information on the geology of the area.

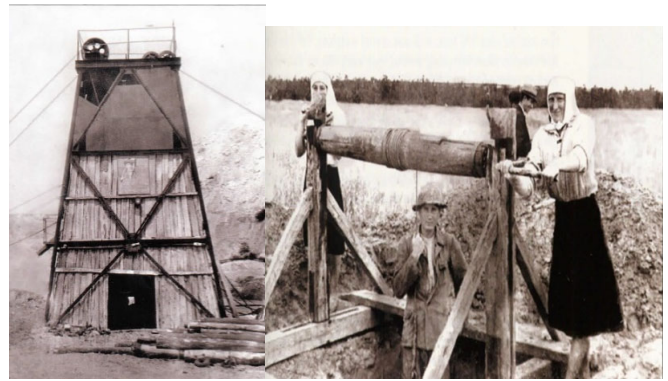
In 1931, industrial quartz mining began in the area as open pit mines and local trench diggings by farmers. 10 tons of quartz were produced in the first year of operation. In 1931 through 1933, gem quality topaz crystals were also found and sent to Europe for cutting and jewelry. In 1941, the area was occupied and controlled by the German army, who seized the quartz production for its war effort. In 1944, the area was reclaimed by the Soviet army, and mining stopped until the end of the war.



**Figure 3** Giant smoky quartz found in 1950

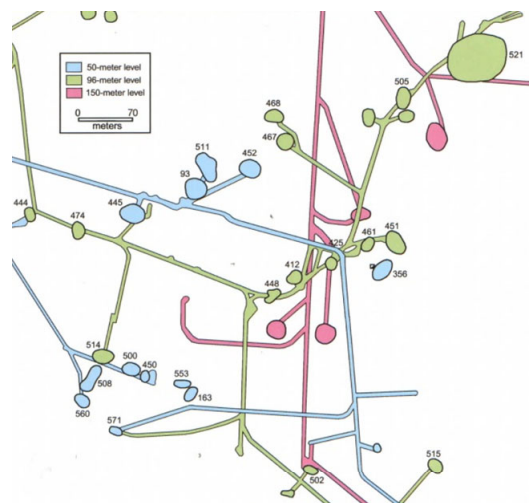
In 1945, a 10 ton quartz crystal was found. By 1946, 100 tons of quartz were mined. Mining continued until the mines were closed for quartz recovery in 1995. The mine was long held as a state secret by the Soviets, and news of these immense deposits was not really known by the western world until the 1980s. The Soviet army was interested in piezoelectric quartz for use in timekeeping (quartz timepieces), sonar, radio, lighters, and tank sightings. (Piezoelectric material accumulates electrical charge when mechanical stress is applied. It develops a

resonance from its structural vibration which can be coupled to crystal oscillators to create electrical signals with extremely precise frequencies.)



**Figure 4** Mining structures of the mid 1900s

Unlike many mines of today, which are developed rather sporadically depending on investment monies, geological areas of interest, and whim, the pegmatites of Volodarsk were mined in a systematic fashion with exploratory drilling every 50 meters, at depths of 50, 100, and 150 meters. The Soviet complex had nearly unlimited budgeting, and it is estimated that several hundred million dollars were used in the process. At its peak, the mining complex used over 1,000 miners and 60 geologists. Above ground operations incorporated approximately 10,000 personnel. Systematic mining stopped in 1995, due to extensive flooding of the tunnels and shafts. Sporadic attempts to pump water and collect specimens have occurred off and on since then.



**Figure 5** Kvarts Samotsvetny Company map showing the systematic pocket exploration of Volodarsk pegmatites

### Geology

The Volodarsk- Volynski pegmatites are related to the Proterozoic Korosten pluton which is 110 x 150 kilometers and estimated to be between 1.6 and 2.5 billion years old. The pegmatites are typically on the western portion incorporate eight major pegmatite areas. They trend north to south and are 500-1500 meters x 22 kilometers long. The pluton intrusion was a complex phenomenon with three phases and affected many different rock types. Unusual to this area, the pegmatites formed Volyn chamber pegmatites which are giant (almost cave like) chambers with growth of very large crystals.

The Volodarsk pegmatites are in the contact zone of the granite and the intruding mafic rock. They were rich with water and highly fractionated segregations merged and then cooled into crystals. They typically have one large “chamber” instead of multiple, separated pockets. The best producing areas are within 100 meters of the land surface. Therefore, much mining was done as open pit mining with subsequent underground mining done with drilled shafts and underground tunnels.



Figure 6 Pegmatite 521 where 2.5 tons of beryl was recovered



Figure 7 Vishnyakova open pit from which horizontal openings (adits) at the bottom gave access to 12 pegmatite chambers

The chamber openings are typically lenticular shapes within the granite. They are often delineated into graphic, pegmatic, and microcline feldspar zones with a single core of quartz that forms the top (superficial) portion of the chamber. Gem crystals (if formed) would be within the chamber itself, which was often filled with clay with many crystals pointing down from the roof. Typically, the sides also have crystals, but smaller than on the chamber ceiling. Crystals are also found on the floor, from pocket collapse or simply from falling.

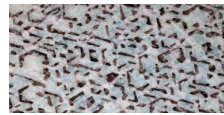


Figure 8 Graphic granite: Quartz and feldspar make writing type patterns

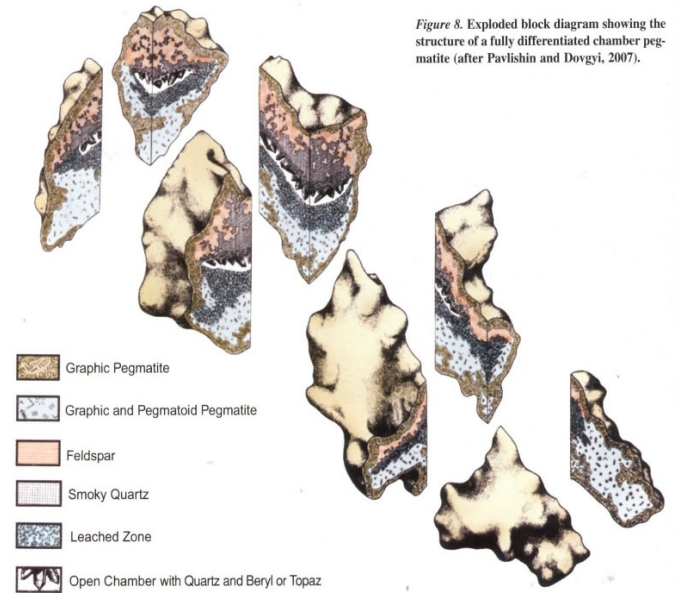


Figure 8. Exploded block diagram showing the structure of a fully differentiated chamber pegmatite (after Pavlishin and Dovgyi, 2007).

Figure 9 Chamber pegmatite anatomy

Chamber zones of Volodarsk- Volynski are typically associated with quartz crystals, perthitic microcline, platy albite, orthoclase feldspar, biotite (black mica), other micas, and kaolinite (clay, often from weathered feldspar). Under the chamber, a leached zone of a few meters is typically found. This area contains the alteration products of the pegmatite and graphic granite zones caused by complex dissolution and recrystallization and can include other mineral species. In Volodarsk, the leached areas often contained feldspar, but occasionally had fluorite, siderite, topaz, rutile, pyrite, phenakite, and topaz. Because beryl and topaz are antipodal minerals in this type of pegmatite (when one grows the other dissolves), beryl and topaz are only very rarely found together in the same chamber.

### Heliodor



Figure 10 Mineralogical Record Cover Nov- Dec 2009

The most famous mineral from the Volodarsk- Volynski region is, of course, the beryl varietal heliodor. They were unknown until the 1980s by the western world, and were originally felt to be fake specimens as they were considered too good to be true. Ukraine heliodor is typically large, gem with yellow, chartreuse, or green coloration. They are etched with various types of etching and each pocket had characteristic color and etching. They initially sold for very little money, and it really took about a year for them to sell at all.

. Most of the collectible mineral specimens of heliodor came from pegmatite 521 (1982) near shaft number 6, which produced greater than 2,500 kilograms of high quality gemmy specimens. This pegmatite was mined from 1982 on and was 60 x 50 x 70 meters (see Figure 6). It was only 23 meters deep to the land surface. Heliodors from this pocket made Ukraine world famous.



Figure 11 Peter and Paul Apostles specimen, 25 cm

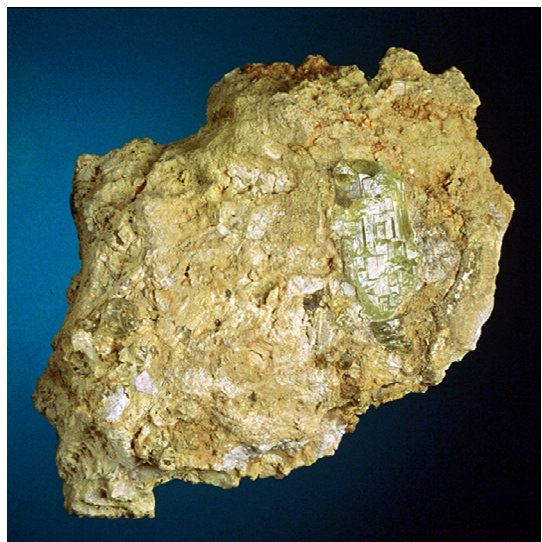


Figure 12 A rare heliodor on matrix, small cabinet size



Figure 13 A 24 cm heliodor from pegmatite 521



Figure 14 Mineralogical Record photo showing two heliodor crystals from pegmatite 521

Figure 20. A 24-cm beryl crystal from pegmatite no. 521, photographed in the back seat of a car in Volodarsk as it was being offered for sale. Konstantin Buslovich collection and photo.

Figure 21. A 1-kg beryl crystal from pegmatite no. 521, photographed in the back seat of a car in Volodarsk as it was being offered for sale. Konstantin Buslovich photo.



**Figure 15** Tomasz Praszkiel (Spirifer Minerals) holding two large heliodors



**Figure 16** The same heliodors as Figure 15 up close



**Figure 17** A 7 cm rare heliodor found and preserved on its matrix, until it was broken at its home in the museum

More sharply terminated, but less etched, the heliodor from pegmatite 576 are also highly prized. This pegmatite chamber was much smaller and the yield was much less than pegmatite 521. It was discovered in 1983 and was near shaft 6 at a depth of about 90 meters. It measured 1 x 5.5 meters and yielded 43 kg of beryl, of which only 3 kg were gem crystals. Its best crystal weighed less than 900 grams, but was cut into a 2.500 ct gemstone. Heliodor was also found pegmatite 436 near shaft 2, and pegmatite 364, which had a gushing waterfall within the chamber. It required constant pumping of water, and its miners worked in constant threat of drowning.



**Figure 18** A 14 cm heliodor from pegmatite 576. Note the sharp termination and less etching on the crystal faces



**Figure 19** Also from pegmatite 576, a 17 cm crystal from the Museum of Precious and Decorative Stones



Figure 20 A 2.7 kg gem heliodor- Chrysalis, Tom Spann photo



Figure 22 Constant pumping of water was needed in pegmatite 364 to avoid pocket flooding and risk to miners



Figure 23 Peter Lyckberg with Volodarsk topaz specimens



Figure 21 Cathedral Etchings on heliodor, Chrysalis- Doug Edmunds photo



Figure 24 Pale blue topaz, 16 cm in the Museum of Precious Stones



**Figure 25** Smoky quartz crystals (Murion: a very black smoky quartz) of enormous size next to a large feldspar specimen, both from Volodarsk



**Figure 26** Cassiterite and phenakite from Volodarsk



**Figure 27** The cabbage heliodor, Chrysalis- Doug Edmunds photo

## References

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Mindat: Volodarsk- Volynski subtopic

Wikipedia: Ukraine subtopic