BOHEMIAN GARNET—TODAY

By Jochen Schlüter and Wolfgang Weitschat

Red garnets have been mined in the Bohemian Hills of Czechoslovakia since the 16th century. These pyrope garnets reached their height of popularity in jewelry of the Victorian era. Although the deposits had been generally regarded as depleted, today a small mining operation is working on garnetiferous gravels near the village of Podsedice, northwest of Prague.

The pyropes of Czechoslovakia have been known since the Middle Ages, but they were first commercially exploited and cut locally in the 16th century. Although in recent years it was commonly assumed that the deposits had been exhausted, production does continue in a small mining operation in the Bohemian Hills, approximately 50 km northwest of Prague. The rough is sold to the Granát cooperative in the city of Turnov, where it is faceted and then set into a wide variety of jewelry pieces (figure 1).

In the world of antique jewelry, the name *pyrope garnet* immediately recalls the elaborate, glittering pieces manufactured in Bohemia (once a kingdom, now a province of Czechoslovakia) by local craftsmen and studded with small locally mined faceted pyropes. Today, only one garnet deposit is being mined, near the village of Podsedice in the Bohemian Hills, but it is producing commercial quantities of these attractive stones. The following discussion examines the history of the garnet industry in this area, the geology and current mining operation, the manufacturing of the gem-quality stones, and the properties of the Bohemian pyropes.

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HISTORY

The collecting of garnets in the area now known as Bohemia dates back at least to the Middle Ages. Then, stones were simply gathered from the surface after heavy rainfalls or, in some places, small pits were dug and the loose ground sifted and washed.

Traditionally, the stones were cut by local farmers as an occupation during the long winter. About 400 years ago, cutting centers were established in the towns of Turnov and Prague. Foreign lapidary specialists were attracted to the region by the growing industry, and in 1780 the Venetian gold- and silversmith Callegari moved to Turnov, which encouraged other craftsmen to follow. In the Turnov museum known as "Czech Paradise," examples of Callegari's art can still be seen today.

According to O'Day (1974, p. 62), Bohemian garnets appeared abundantly in Victorian jewelry

Figure 1. Today, fine jewelry continues to be made in the city of Turnov, Czechoslovakia, from pyrope garnets mined in the Bohemian Hills. Courtesy of Herrling-Schmuck, Bramsche, Germany.

of the 1880s, "when clusters of small brilliant or rose-cut stones were pavé-set in almost invisible silver settings." Bauer (1896, pp. 405–409), provided an unsurpassed (for its time) description of the pyropes, their geologic setting, mining, cutting, and distribution. His book, written when pyrope-set jewelry was near the height of fashion, gives some insight into the extent of mining and trade activity. He notes that the garnet-cutting works of Bohemia are "very old-established" and that "at the present time [ca 1896] in Bohemia there are 3,000 men engaged in garnet-cutting, some hundreds of garnet-drillers, about 500 goldsmiths and silversmiths, and some 3,500 working jewellers. The collecting of garnets employs some 350 or 400 persons, so that, including the many persons whose work is indirectly connected with the industry, there must be between 9,000 and 10,000 persons gaining their livelihood by labour connected with the working of this precious stone."

Production began to slow down after the turn of the century, as changing fashions led to a decline in the popularity of garnet jewelry and an economic depression in the 1920s affected the jewelry market as a whole (Rouse, 1986). After World War II, the new political environment in Eastern Europe led to a shift in economic interests, notably away from luxury items. Although small-scale mining continued in the years that followed, it is only with the opening of Czechoslovakia's borders to western Europe and the rest of the world that interest has been renewed in exploiting these deposits (K. Hurwit, pers. comm., 1991).

LOCATION AND ACCESS

Currently, the only locality being worked is approximately 10 km southwest of the town of Lovosice just outside the small village of Podsedice (figure 2), which is less than 50 km from the border of Czechoslovakia with Germany. The area is readily accessible by car from Prague. At the present time, a small open-pit mining operation is being conducted by the Rudné Doly cooperative. The site is located in the Bohemian Hills, south of the towns of Bilina, Teplice, and Ùstí, where in years past many sites were exploited for alluvial garnets by means of trenches and pits.

GEOLOGIC SETTING

Sediments in the basins along the southern slope of the Bohemian Hills contain garnetiferous gravels up to 6 m thick that are covered by overburdens of no more than 6 m. The gravels consist of angular

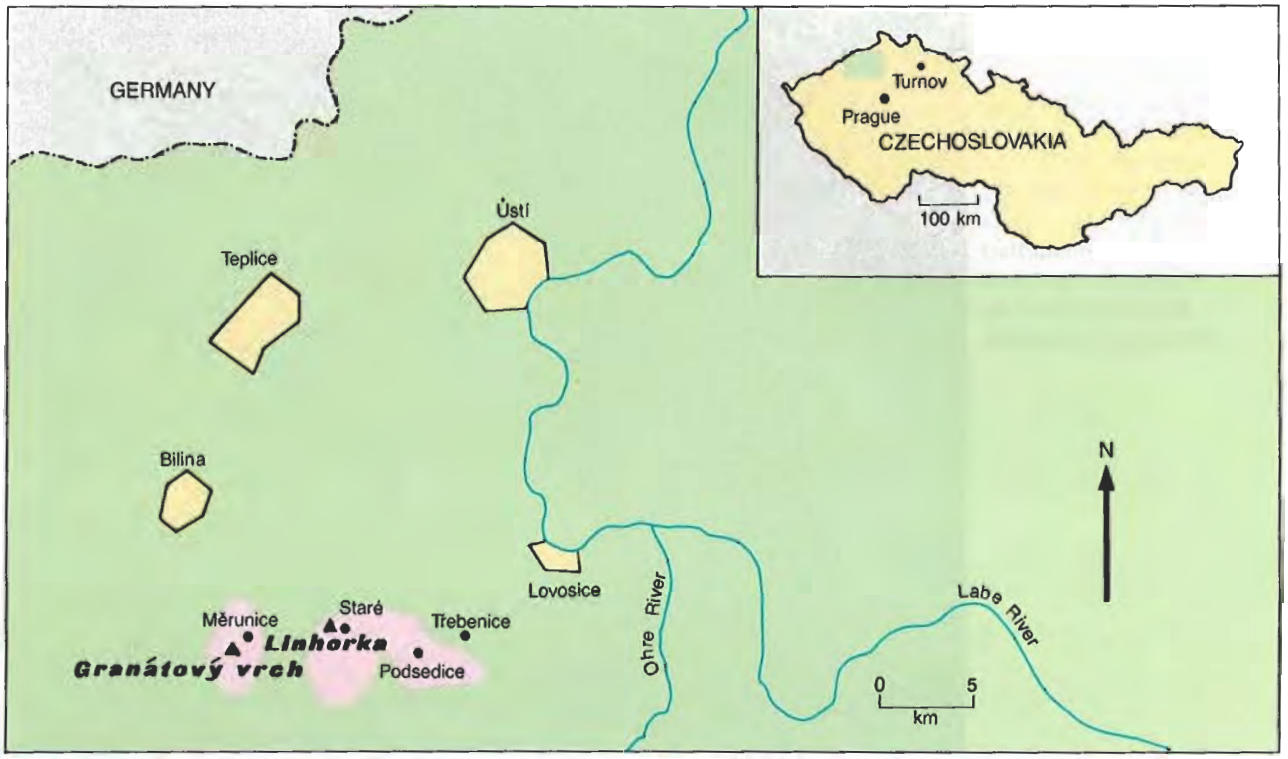


Figure 2. This map shows the main occurrences of garnetiferous gravels in the Bohemian Hills of Czechoslovakia, around the villages of Měrunice, Staré, Trebenice, and Podsedice. The peridotites in which the garnets formed, which originated in the earth's mantle, were brought to the surface by pipes such as the Linhorka and the Granátový vrch.

rock fragments of various sizes embedded in a fine clayey to sandy matrix. At Podsedice, approximately 2.5 acres of gravels are worked by open-pit mining each year. Once the gravels have been worked out, the ground is carefully restored to a state suitable for agriculture.

The sequence of events responsible for the deposition of pyrope in these young sediments is as follows. The original pyrope host rock is a serpentinized garnet peridotite (dunite/lherzolite; Fiala and Paděra, 1977) that is believed to have formed initially at a depth of at least 60 km in the earth's mantle. South of Teplice, such rocks have been emplaced in the upper crust by tectonic processes. A drill hole near Staré, for example, reached garnetiferous peridotites at depths between 209 and 436 m (Rost and Griegel, 1969). In this area, the Precambrian basement consists mainly of granulites, gneisses, and migmatites, with intercalations of such peridotitic rocks, and is covered by a 160-m-thick stratum of Cretaceous sandstones, marls, and limestones. Locally, additional sediments consist of Oligocene sands and clay, in some places covered by basaltic flows (Stutzer and Eppler, 1934).

Following Alpine orogeny during the Tertiary period, crustal stretching in the Bohemian Hills region triggered alkalic volcanism (feldspathoid and feldspathoid olivine basalts). In the Miocene (25 million years ago), molten rocks from the upper mantle erupted to the surface through fissures and cracks. In some areas, these volatile-rich melts built up high pressures before they blasted free their vents. These violent eruptions brought abundant fragments of crustal rocks to the surface. Some of these explosion pipes protrude today as volcanic necks above the surrounding Cretaceous country rocks (figure 3). The pipes at Staré and Měrunice transported fragments of peridotites, gneisses, granulites, and Cretaceous sediments upward and incorporated them into their volcanic breccias and tuffs. At the Staré pipe, called Linhorka, fragments of serpentinized garnetiferous peridotites can be found (figure 4) which are rich in gem-quality pyrope.

Since the Miocene epoch, about 400 m of rock have been eroded. Consequently, most of the volcanic rocks have been decomposed and their resistant components transported to the present alluvial gravels. The garnets occur therein as

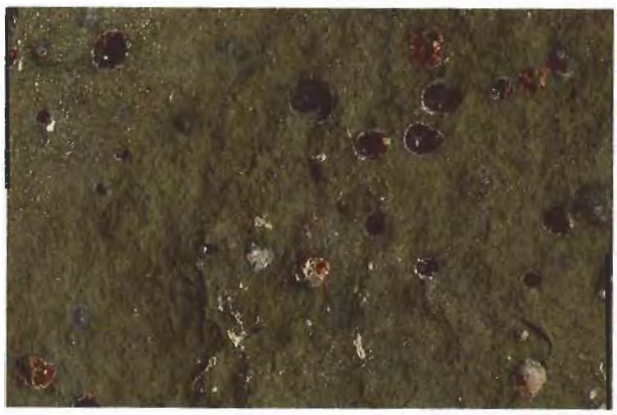
Figure 3. A power shovel is used to remove the overburden and garnetiferous gravels at Podsedice. In the background can be seen remnant pipes of Tertiary volcanism in the Bohemian Hills. Photo by J. Schlüter.

individual grains. Around Podsedice, there is an area of approximately 70 km^2 (again, see figure 2; Oehmichen, 1900) that is underlain by garnetiferous gravels of varying thickness, which, as mentioned above, are covered by recent sediments.

MINING AND RECOVERY

In the open-pit operation near Podsedice, 320 tons of gravel are mined each day with conventional power shovels (again, see figure 3) and trucked to a washing plant. The pyropes, which average 16–18 grams per ton, are separated out by a sieving process using a 1-cm mesh. Because of their high specific gravity, the garnets are then easily recovered by density separation (figure 5). Some 45 kg of pyrope concentrates (figure 6) are produced daily, from which about 5 kg of cutting-grade pyrope in sizes over 3 mm are picked out by hand by female workers (figure 7). This selected material is sold to the cooperative society called Granát, in the town of Turnov, where the stones are faceted.

Figure 4. This serpentinized garnet peridotite from the Linhorka pipe near Staré contains several small gem-quality pyropes. Photo by U. Mahn.



Cutting losses amount to about 10% by volume, with the result that 4.5 kg of faceted stones are made available to the numerous Granát jewelers each day. The stones are still set using traditional techniques, with the aim of producing mountings studded by numerous closely set faceted gems which emphasize the beauty of the pyropes and relegate the metal of the setting to a minor role (again, see figure 1). Over time, jewelry makers in Turnov have developed about 20,000 different models of garnet jewelry that can be manufactured on demand.

This jewelry is exported through the Czech foreign trade company known as Artia, which is headquartered in Prague, or through Herrling-Schmuck, which is located in Bramsche, Germany. If mining continues at its present pace, it is estimated by leaders of the Rudné Doly cooperative that the Podsedice deposits have sufficient reserves to continue for more than 15 years (J. Hlavsa, pers. comm., 1989). Other garnet-bearing

Figure 5. Density separation is used to concentrate the pyropes in this jig at Podsedice. Photo by J. Schlüter.

alluvials elsewhere in the Bohemian Hills are currently being explored.

DESCRIPTION OF THE GARNETS

The classic Bohemian garnet is the Mg-Al-rich member of the garnet group known as pyrope, in which minor substitutions of iron and especially chromium are responsible for the characteristic "fire-red" hue. Specimens of the finest color contain between 1.5 and 2.5 wt.% chromium as Cr_2O_3. In general, the crystals occur as rounded grains (figure 8) up to 5 mm in diameter, with larger sizes being very rare. Most of the cut stones are very small, around 0.10 ct.

Six representative samples were selected for study. Refractive indices, as obtained with a refractometer and sodium light source, ranged from 1.748 to 1.750. Three of the six samples displayed anomalous birefringence when immersed in methylene iodide and viewed between crossed polarizing filters. All appeared red when viewed through a Chelsea filter and were inert to both long- and short-wave ultraviolet radiation. Density determinations were considered unreliable due to the small size of the stones. The optical spectra, as seen with a prism hand spectroscope, were typical for chrome-bearing pyrope, with chromium lines in the red and a broad region of absorption in the yellow.

Figure 6. In this garnet concentrate from the Podsedice deposit, red pyropes (up to 5 mm) are easily seen among the other mafic minerals and rock fragments. Photo by J. Schlüter.

M. Bauer (1896) stated that "the Bohemian garnet is generally without exception of ideal purity; it is the only gemstone deposit where all stones are equally free of inclusions and impurities." Nevertheless, J. Bauer (1966) has described three morphologic types of zircon inclusions (up to 0.57 mm) as well as chrome-diopside inclusions. The changes in volume that zircons undergo due to metamictization cause internal stress which results in both anomalous birefringence and distinct cracks around the inclusions. In accord with J. Bauer's observations, our six study samples contained small colorless inclusions (probably zircon), as well as larger ones surrounded by stress cracks. These inclusions are reminiscent of the zircon inclusions typically found in Sri Lanka rubies. Generally, however, Bohemian garnets are rela-

Figure 7. At Podsedice, a worker in the Rudné Doly cooperative carefully selects gem-quality stones from the pyrope concentrate. When the mine is in operation, approximately 5 kg of cutting-grade pyrope are produced daily. Photo by J. Schlüter.

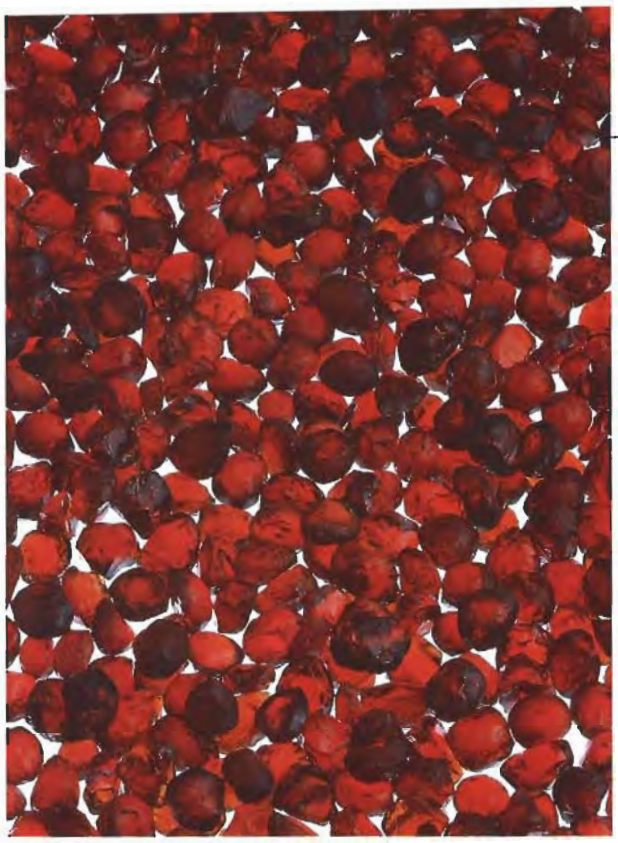


Figure 8. These rounded garnet crystals, which average approximately 0.25 ct (2.5 mm in diameter), are typical of the pyropes currently being mined in Bohemia. Photo by Shane F. McClure.

tively free of microscopic features, including growth zoning and healing planes (feathers).

Chemical data were obtained for the same six stones by electron microprobe analysis. The results revealed a limited range of compositional variability. Data for two representative samples are provided in table 1; the chemical compositions of the Bohemian garnets appear to be comparable to those of chrome-bearing pyropes from other localities.

CONCLUSION

Pyrope garnets are still being mined from the historic Bohemian Hills region, now part of Czechoslovakia, although currently from a single alluvial deposit. Nevertheless, production is sufficient to support a local cutting and jewelry-manufacturing operation that exports finished pieces worldwide. If production continues at its present pace, the Podsedice deposit should be able to provide garnets for more than 15 years.

Other localities are currently being explored in the Bohemian Hills. With the opening of trade barriers throughout Europe, increased demand for all types of jewelry may anticipate the discovery—or rediscovery—of other commercially viable deposits of this historically renowned gemstone.

TABLE 1. Representative microprobe[a] chemical analyses for two samples of pyrope garnet recently mined in the Bohemian region of Czechoslovakia.

Oxide (wt%)	Sample 1		Sample 2	
	Core	Rim	Core	Rim
SiO_2	41.46	41.02	41.06	41.13
Al_2O_3	21.51	21.47	21.39	21.53
FeO[b]	9.17	9.20	9.10	9.21
MgO	21.29	21.28	20.82	20.93
MnO	0.32	0.31	0.31	0.34
CaO	4.45	4.46	4.48	4.45
TiO_2	0.70	0.67	0.55	0.56
Cr_2O_3	1.66	1.62	1.76	1.75
V_2O_3	0.09	0.03	0.05	0.08
Total	100.65	100.06	99.52	99.98

[a]*Operating conditions and details of analyses available on request to the authors.*
[b]*Total iron as FeO.*

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