

A Status Report On Gemstones From Afghanistan

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Although Afghanistan has historically been well known for its lapis lazuli deposits, significant amounts of fine emerald, tourmaline, kunzite, and some rubies are now emerging from that embattled nation. Emeralds come primarily from the Panjsher Valley, northeast of Kabul. Large amounts of green, blue, and pink tourmaline, as well as considerable quantities of kunzite and some aquamarine, have been taken from the pegmatites of the Nuristan region, east of Panjsher. Smaller quantities of fine ruby have been found in the Sorobi region, between Jalalabad and Kabul. The occurrence, mining, and distribution of these gem materials are summarized, as are their gemological properties. Lesser amounts of garnet, amethyst, spinel, and morganite have also been located. The prospects for future production of emeralds and pegmatite gems, in particular, are excellent.

Although the political situation in Afghanistan continues to be very unstable, Afghan miners remove many thousands of carats of fine gems each year from that country. In addition to the historically famous deposits of lapis lazuli, significant quantities of emerald, tourmaline, and kunzite, among other gem materials, have emerged from the Hindu Kush region of Afghanistan within the last few years. Small amounts of fine ruby are also being mined. Most of these gem materials are of very high quality. While much has been written about the lapis lazuli from Sar-e-Sang (e.g., Wyart et al., 1981), relatively little has been published about these other gems. To help fill some of the gaps in our knowledge of this area, this article presents a current status report on several Afghan gem materials - emerald, tourmaline, kunzite, and ruby - including the locations of the mines, mining methods, gemological properties, and some production figures.

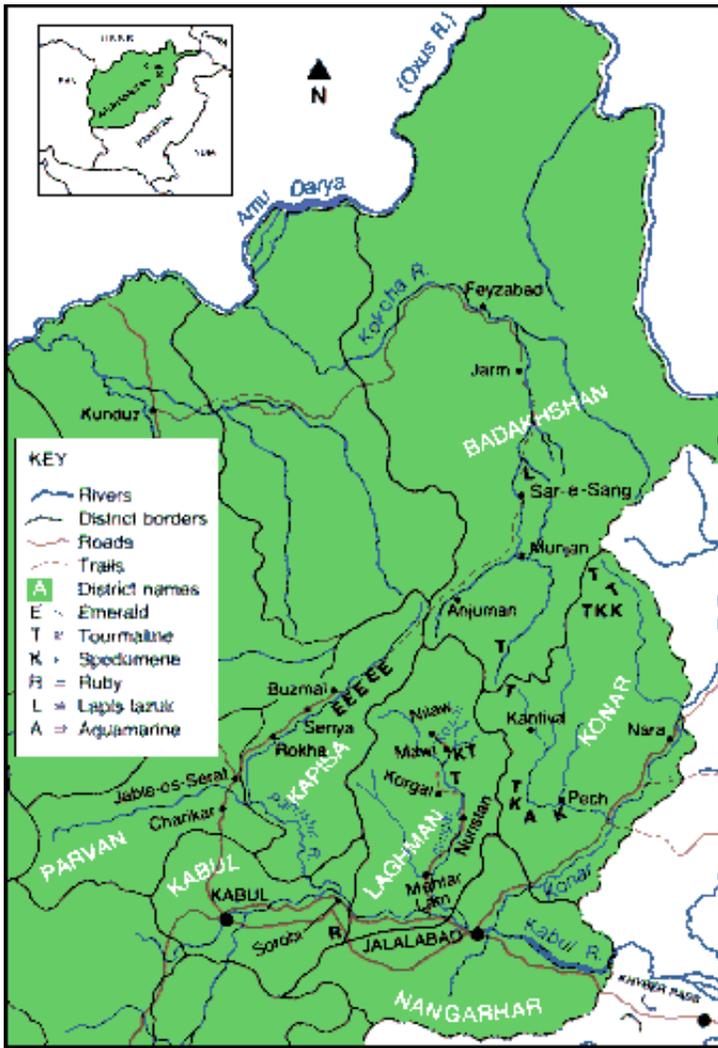


Figure 1. The north eastern provinces of Afghanistan - bordered by the USSR, China, and Pakistan (see inset) - encompass one of the most important gem - producing regions in the world today. Some of the principal localities for emerald, tourmaline, spodumene (kunzite), ruby, lapis lazuli, and aquamarine are labeled E, T, K, R, L, and A, respectively, on the map.

THE HINDU KUSH GEM-PRODUCING AREAS

The mines that have recently produced gem material are for the most part in the northeastern portion of the country, north and east of Kabul, the capital of Afghanistan (figure 1). Emeralds have been found primarily in the Panjsher Valley.* Pegmatite gems - tourmaline, kunzite, and aquamarine - have been found in the Nuristan region, crossing the provinces of Laghman and Konar. Rubies have been found in the southern portion of the Sorobi district, in Kabul province.

*Note in figure 1 that Panjsher Valley has been placed in Kapisa Province, on the basis of the Rand-McNally (1982) and other recent maps used as references to develop this one. However, many geologic sources refer to Panjsher Valley as being in Parvan Province. Note also that the spellings for Afghan place names used in this article are those adopted by Rand-McNally (1982). We have chosen this source for the sake of consistency, although these names, too, often vary greatly from one reference to another.

The topography of the region is dominated by the towering Hindu Kush mountain range. These mountains form the western end of the Himalayas, which stretch eastward across northern Pakistan and India. The Hindu Kush range is one of the most rugged areas of the world, with mountains reaching up to 6,000 m (19,500 ft.) separated by narrow, steep river valleys. The road network is limited, and many areas in this part of Afghanistan are inaccessible except by foot. This, combined with a climate that ranges from extremely cold winters to hot, dry summers, contributes to the inhospitability of the region.

Despite their remoteness, both the Hindu Kush range and the adjacent Karakoram range in neighboring Pakistan have been the sites of spectacular finds of gemstones during the last 15 years. In addition to earlier descriptions of Panjsher emeralds (Neilson and Cannon, 1977) and of pegmatite gemstones from Nuristan (Bariand and Poullen, 1978), important discoveries of tourmaline, beryl, corundum, and other gemstones have been made in Pakistan in the Gilgit area (Kazni et al., 1985), in the Swat and Hunza valleys northeast of Peshawar (Gübelin, 1982), and in Kashmir (Atkinson and Kothavala, 1983). These areas of Afghanistan and Pakistan are located in one of the most geologically dynamic regions of the world - at the juncture along which the Indo-Pakistan and Asian crustal plates collided to give rise to the Himalayas. The geology of this region is quite complex, and it has been investigated in detail only recently (for further information, see Weippert et al., 1970; Lapparent, 1972; Fuchs et al., 1974; and Wolfart and Wittekindt, 1980). These investigations indicate that the Hindu Kush area represents the western end of a succession of important gem-producing regions that stretch all along the Himalayas through Afghanistan, Pakistan, India, Nepal, and into Burma. Rossovskiy and Konovalenko (1976) have suggested that these separate regions are in fact part of a much larger "South Asian" gem pegmatite belt whose formation can be linked to the sequence of orogenic events that resulted in the formation of the Himalaya range.

The formidable Hindu Kush mountains provide a harsh environment for gem mining, and many remote gem localities are inaccessible except by many miles of travel by foot. The Hindu Kush range forms the western end of the Himalayas and stretches from central Afghanistan to the northern tip of Pakistan. The severe climate in these mountain regions further restricts gem mining.

Although gem beryl was found during the archeological excavation of an ancient Greek city in northwestern Badakhshan, organized mining of beryl, tourmaline, kunzite, and ruby in Afghanistan dates only from the early 1970s (Dunn, 1974; Bariand and Poullen, 1978). Ostensibly the mines are under government jurisdiction, but most active mining and selling is done by independent miners, usually local tribesmen. Because of the volatility of the current political situation in Afghanistan, the gem-mining areas around Kabul and Jalalabad are virtually inaccessible to foreign gem buyers. Once mined, the uncut crystals of emerald, tourmaline, spodumene, etc., are smuggled across the border into Pakistan, primarily into tribal Agency areas such as Bajaur (surrounding Peshawar), where most of the trade in Afghan gems is conducted. To enter Afghanistan, or even to travel along the frontier Agency areas of northern Pakistan, one must have special permission from both the government and the local tribal leaders. Such passes are nearly impossible to obtain, and even then there is no guarantee of safety.

This report describes some of the gem materials currently originating in Afghanistan. It is based largely on the author's many years of experience dealing with Afghan gemstones, his previous travels within the country to purchase gemstones, and his recent (September 1985) discussions in Pakistan with several prominent Afghan miners.



Figure 2. This parcel of 87 Afghan emeralds weighs a total of 140.9 ct and displays the range of colors found in the Panjsher material. Stones courtesy of Gem Industries, Inc. Photo by G. W. Bowersox.

THE PANJSHER EMERALDS

Several thousand carats of fine-quality emeralds, some of which are very similar in color and quality to those from the famous Mute mine of Colombia, have emerged from Afghanistan in recent years. The emerald-mining area of the Panjsher Valley is located approximately 110 (air) km (70 mi.) northeast of Kabul (again, see figure 1). The Panjsher River, a tributary of the Kabul River, bisects a portion of the Hindu Kush mountain range. The emerald-mining district lies along the southern slopes of the Hindu Kush, south of the Panjsher River. It currently encompasses six active mines - Darkhenj, Mikenj, Butak, Buzmal, Bakhi, and Darun (Neilson and Gannon, 1977).

Access, Geology, and Mining. Although travel in this area is extremely dangerous at the present time, access to Panjsher from Kabul is fairly straightforward. Travel north by field vehicle 58 km to Charikar. From Charikar, travel 14 km north to Jable-os-Seraj, then 35 km northeast along the north side of the Panjsher River to Rokha, then another 29 km to Senya, and - for the last 19 km - by a poor dirt road to where it ends at the village of Buzmal (Neilson and Gannon, 1977). The Panjsher Valley is densely populated. The emeralds occur at an elevation of 3,000-4,000 m, requiring that the miners walk several hours up the rough slopes (30°-40° angle) as there are no horse or mule trails.

The Panjsher emerald locality has been actively mined only during the last 10 years, with the greatest activity since the early 1980s, although the deposit reportedly was found by Russian geologists in 1970 (Bariand and Poullen, 1978). Within this district, the emeralds occur along small replacement or fracture-filling veins. According to Neilson and Gannon (1977), the veins cut through host rocks consisting of metamorphosed limestones, calcareous slates, phyllites, and micaceous schists of Silurian-Devonian age (400 million years). The veins themselves consist mainly of quartz and albite, and are apparently related in origin to a local igneous intrusive rock described as a quartz-feldspar porphyry. When followed in an exposure, these veins vary in thickness up to 15 cm. Emerald mineralization along and within the veins is distributed sporadically, but is often associated with pyrite, which the miners use as an indication of the emerald. The emerald is believed to be of hydrothermal origin, and apparently resulted from a chemical reaction between solutions traveling along the veins and the enclosing host rocks. According to Mr. Hail Mohamuddin, one of the discoverers of the Buzmal mine, approximately 1,000 workers are mining emeralds throughout the valley; 100 men regularly work Buzmal.

Dynamite is used first to identify where in the host rock the emerald crystals are most likely to be found. The bombings that frequently occur in this area occasionally perform the same function. Using picks and shovels, the miners dig in pits as shallow as one meter and as deep as several meters to extract the individual crystals or specimens. In spite of the extreme weather conditions, the mines are worked virtually all year, the political situation permitting.

Description of the Material. In general, the Panjsher emeralds are a rich dark green (figure 2). The finest stones are similar in color to the fine emeralds found at the Mute mine in Colombia. The local miners claim that the Panjsher emeralds of the best color and quality come from the Mikenj and Darkhenj mines.



Figure 3. Haji Mohamuddin (left) and Fazal Uddin (right), owners of the Buzmal emerald mine, display the largest specimen (190.5 ct) from a 374.5-ct parcel of 10 Buzmal emerald crystals that they brought from the Panjsher Valley to Pakistan. Photo by G. W. Bowersox.

Gem-quality crystals over 10 ct are common. In fact, a lot of 10 crystals weighing a total of 374.5 ct was recently recovered from the Buzmal mine. The largest of these crystals weighed 190.5 ct (figure 3). Overall, the Panjsher material is larger and cleaner than emeralds found in the Swat (see Gübelin, 1982) and Gilgit regions of Pakistan.

Gemological Properties. A study of the few crystals and cut stones made available for this purpose showed the physical and optical properties to be quite normal for emerald: refractive indices, 1.578 and 1.585 (± 0.005); S.G., 2.71 (± 0.02); inert to ultraviolet radiation; and a typical spectrum with sharp lines at 682, 679, 660, 646, 635, 612, 477, and 472 nm, and a broad absorption band between 560 and 600 nm. When the crystals were viewed with the microscope, two- and three-phase inclusions, growth zones, and fracturing were visible. It is interesting to note that the refractive indices and specific gravity of this material are somewhat lower than those for emeralds from the nearby Swat Valley in Pakistan (Gübelin, 1982).

Distribution and Production. Most of the Panjsher emeralds are transported (year round) in rough form to refugee camps in northern Pakistan. The trip takes approximately 20 days; all travel is by foot. The border area is particularly dangerous because explosive devices have been scattered throughout. From these camps the stones are purchased by Pakistan buyers from Karachi or by the very few Western buyers who travel to the area.

During the three weeks the author was on the Afghanistan border in September 1985, he viewed

approximately 4,000 carats of cuttable gem-quality emeralds from Panjsher. According to the miners with whom he spoke, production of emerald continues on a regular basis despite the war, and prospects for the future seem excellent in terms of the emerald resources available.

Emeralds have also been reported from Budel, in Nagarhar Province, south of Jalalabad (Afzali, 1981). The crystals appear to be relatively small (1-2 cm maximum); little else has been published on this locality.

TOURMALINE AND SPODUMENE FROM THE NURISTAN REGION

Literally hundreds of thousands of carats of good, gem-quality tourmaline and fine kunzite have emerged from the Kolum district of the Nuristan region northeast of Kabul since active mining began there in the early 1970s. This area is also known for its production of fine aquamarine (Bariand and Poullen, 1978; Sinkankas, 1981); however, because the author has had little experience with this material, and has not seen much recently, it is not covered in detail here.

The tourmalines and kunzites are found in pockets within the pegmatites that dot the Nuristan region (figure 1). The most active mines currently are Mawi and Suraj. In addition, Nilaw and Korgal have historically been important (Bariand and Poullen, 1978); Rossovskiy et al. (1978) report that between 1973 and 1975, more than 1,260 kg of gem-quality kunzite was mined from the Kolum district.

Access, Geology, and Mining. Access to this sparsely populated region is difficult even during peacetime conditions. From the Kabul-Jalalabad road go due north to Mehtar Lam approximately 20 km and then 40 km northeast to the village of Nuristan. The passable road ends several kilometers past Nuristan, and all further travel to the mines must be by foot. Bariand and Poullen (1978) report that they had to travel two full days along narrow gorges and rocky trails to reach the deposit at Nilaw.

The key geological features of the Nuristan region have been summarized in Bariand and Poullen (1978). The rocks of this area are quite varied, and include metamorphic (gneisses, schists, quartzites, and migmatites) and igneous (gabbros, diorites, and granites) rock types. Details of the regional geology can be found in Fuchs et al. (1974) and in Wolfart and Wittekindt (1980).

Gem-bearing pegmatites in Nuristan were first studied in the early 1970s by Soviet geologists (Rossovskiy et al., 1976; Rossovskiy et al., 1978; Rossovskiy, 1981). A number of separate pegmatite localities are known, but the most important gem producers seem to be those north of the village of Nuristan at Nilaw, Suraj, Mawi, and Korgal.

The pegmatites vary greatly in size and shape - in veins or lenses up to 40 m thick and up to several kilometers long. The pegmatites range from simple unzoned bodies to those that have complex internal zonation, but the latter group appear to be the more important gem sources. Major minerals include quartz, albite, microcline, schorl tourmaline, muscovite, and lepidolite, along with various minor phases. Crystals of gem tourmaline, spodumene, and beryl occur in cavities up to 50 cm across that are distributed along the central portion of the pegmatite. These crystals are quite remarkable in terms of their size, crystal perfection, and diversity of color. For example, Rossovskiy (1981) describes tabular, gemmy crystals of spodumene up to 45 cm long and "pencil" crystals of gem tourmaline up to 20 cm, both in a wide variety of colors.

For the most part, the crystals are found in soft, powdered clay that fills pockets within quartz-rich zones in the pegmatite. While the kunzite and tourmaline crystals usually occur in close proximity (within a few meters) of each other, only occasionally are the two gem minerals found in the same pocket. Because both are, for the most part, found in situ in the primary pegmatite, the crystals are usually well formed and complete.

Approximately 500 miners work the Nuristan region on a daily basis. To penetrate the hard pegmatite, they commonly use large drills. The gem-bearing areas of the pegmatite are usually encountered between 11

and 20 m below the surface. When they reach a pegmatite pocket, the miners remove the gem crystals by hand, using only a few small tools to scrape away the encasing clay. As with the emerald mines in Panjsher, the Nuristan miners usually work year round, in spite of the severe weather conditions that commonly plague the area.

Description of the Material and Gemological Properties. *Tourmaline.* Gem tourmaline from Nuristan occurs in an astonishing array of colors - various shades of pink, green, blue, and multicolored. Bariand and Poullen (1978) describe the intense shades of blue and green tourmaline as the most valued. The cuttable crystals, which range up to 15 cm in length and 4 cm in width, also represent magnificent mineral specimens in themselves. For the most part, these crystals are well formed, often clean and free of inclusions and fractures, and, at the time they are purchased for cutting, are free of matrix. Color zoning perpendicular to the length of the crystal varies from sharp color transitions to a smooth grading of one color into another. Most of the crystals examined in this study were not color zoned.

Some data have been published on the Nuristan tourmalines. Leckebusch (1978) reported chemical compositions of these tourmalines, which are elbaïtes, and related the color zonation in individual crystals to variations in chemistry. Dunn (1974) examined a range of tourmalines from this area, in particular the colorless crystals, or achroites. For pale to deeply colored crystals, he reported refractive indices of 1.617 and 1.639 (± 0.003) with no particular correlation of these values with color. For the achroites, the indices were 1.615 and 1.633. The specific gravity ranged from 3.02 to 3.07.

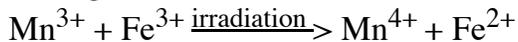
Examination of a parcel of green, blue-green, and blue tourmalines revealed refractive indices of 1.619 and 1.639 and specific-gravity values of 3.04-3.09. The crystals displayed grayish blue to greenish blue pleochroism. They were inert to long- and short-wave ultraviolet radiation, except for some of the color-zoned crystals that were weakly fluorescent with a chalky bluish color under short-wave at the pale end of the crystal. Two-phase inclusions, fractures, and color zoning were visible with the microscope. In the hand spectroscope, bands at 495, 490 and 440 nm were present in the blue crystals, with an additional band at 540 nm present when the stone being examined was oriented perpendicular to the c-axis. The spectra displayed total absorption above 598 nm. The most distinctive feature of these tourmalines is their attractive blue to green color.

Spodumene. The spodumene crystals from the Nuristan region are among the finest examples of this mineral ever found. Many details on the pegmatite deposits of spodumene are given in Rossovskiy et al. (1978) and Bariand and Poullen (1978). The transparent, gem-quality spodumene crystals from Nuristan come in a wide range of colors - purple and pink, as well as blue, green, and yellow. Some of these crystals are up to one meter in length. In general, they are well formed, with large, flat crystal faces, relatively sharp edges, a tabular shape, and are often twinned. As with tourmaline, the spodumene crystals are free of any attached minerals at the time they are sold to gem buyers. As is typical of spodumene, which is pleochroic, the crystals from this area display different hues when viewed in different orientations, with the strongest color for light passing parallel to the long direction (c-axis) of the crystal. Dunn (1974) describes some of the crystals as color zoned, but the crystals examined for this paper were more or less of uniform color.

From the study of a parcel of light pink spodumene crystal fragments and several additional faceted stones, refractive indices of 1.659 and 1.677 (± 0.003) and specific-gravity values of approximately 3.20 (± 0.02) were found. These fragments were pleochroic from brownish pink to pink. No features were visible in the hand spectroscope. When exposed to long-wave ultraviolet radiation, the fragments displayed a strong orangey pink fluorescence. When exposed to short-wave ultraviolet radiation, they exhibited a strong bluish pink fluorescence with a red phosphorescence that lasted for about one minute. When viewed with the microscope, the spodumene fragments revealed three-phase inclusions, growth tubes, and cleavages, and displayed twinning. In general, these properties are identical to those reported for Afghanistan spodumene by

Dunn (1974) and Rossovskiy (1981).

Most spodumene exhibits the property of tenebrescence, which involves a reversible darkening and lightening of its color with changes in conditions (Claffy, 1953). Pure spodumene is colorless; the various colors (pink, purple, green, yellow) are due to the presence of trace elements such as manganese and iron. Manganese substitutes for silicon, and iron for aluminum, in the spodumene crystal structure. According to Hassan and Labib (1978) and Nassau (1983), a darkening of the color of spodumene to pink or purple (kunzite) can be brought about by exposure to a source of high-energy radiation (gamma or X-rays) that removes an electron from the manganese and changes its oxidation state from 2⁺ to 3⁺. Further irradiation produces a coupled oxidation- reduction reaction involving both iron and manganese to turn the pink spodumene green.



These radiation-induced color changes are thermally unstable, and the color-change sequence described above can be reversed by exposure to daylight, ultraviolet radiation, or moderate heat of a few hundred degrees Celsius. The exact color- alteration behavior of spodumene, and the relative persistence of radiation-induced colors, will vary depending on the nature of the trace elements and the color-treatment history of the stones in question. Because it is colored by chromium, which in spodumene is not susceptible to oxidation or reduction, hiddenite does not exhibit changes in coloration under similar conditions.

When mined, spodumene emerges from the ground with a blue-violet or green color. This suggests that the crystals have been exposed to some natural source of radiation that produced these colors by the mechanism described above. According to the miners, leaving the crystals in the sun for several days, often after having boiled them in water, is sufficient to turn the material to an attractive purple or pink color. Fade tests were conducted to document the thermal stability of the purple kunzite, and determined that heating crystal fragments to temperatures of 400°C for six hours was adequate to entirely bleach the pink color. Exposure of several pieces from a single pink crystal to direct sunlight produced fading to virtually colorless within several days (less than a week). As described above, the pink color can be restored by re-irradiation.

Distribution and Production. The mined crystals of tourmaline and spodumene are carried on the backs of the miners, who usually travel by foot approximately 560-640 km (350-400 mi.) over rough mountain terrain and through a border area dotted with land mines to reach Pakistan. The author purchased most of his material from miners whose primary trading area is the Bajaur Agency.

The Nuristan region has produced hundreds of thousands of carats of gem-quality tourmaline since 1980. The author estimates that approximately 2,000 kg of fine kunzite are being mined each year.

JEGDALEK RUBY

Although very little mining is being conducted at the current time because the area is so volatile politically, a number of fine rubies have been mined from the southern portion of the Sorobi district (again, see figure 1). Local miners refer to the main deposit as the Jegdalek mine. Although little research has been done on the geology of the ruby-producing area and the occurrence of the rubies, it is known that they are usually found in situ in marble cut by granitic intrusions of Oligocene age (Afzali, 1981). The crystals range in color from a light purple-red to a deep "pigeon's blood" red. The best-quality stones are similar to those found at Mogok, in Burma. The author has seen fair-quality faceted stones as large as 10 ct, although top-quality rubies from this area rarely exceed 5 ct.

While current supplies appear to be small - the author saw fewer than 100 ct of gem-quality material during his most recent visit - communications from the miners indicate that the reserves are significant. Larger amounts of this material will most likely be available once the political situation in the area stabilizes.

Gemological Properties. Examination of a small number of cut stones and crystal fragments of ruby produced the following properties of a typical stone: refractive indices, 1.762 and 1.770; specific gravity, approximately 4.00; moderate to strong fluorescence to long- and short-wave ultraviolet radiation; and purplish red to orangey-red pleochroism. In the hand spectroscope, absorption bands were visible at 469, 473, 660, 668, 693, and 694 nm, and a broad band from 520 to 560 nm. Under the microscope, fractures, small unidentified crystals, and needles thought to be boehmite were generally abundant. Some twinning was also noted. The most interesting feature was a strong blue color zoning present in some of the rubies.

OTHER GEM MATERIALS FROM AFGHANISTAN

Much has been written about lapis lazuli from Afghanistan (e.g., Wyart et al., 1981). In recent years, however, the production and supply of lapis from Badakhshan has been greater than ever before, and many examples of superb material can be seen in gem markets worldwide. In 1981, reserves of 1,300 tons were estimated (Afzali, 1981).

A single deposit of garnets has been found at Pachighram, in Nangarhar Province. Well-formed crystals of dark red almandine occur in Proterozoic schists. The garnet-bearing schists cover an area approximately 160-240 km wide and 800-1,100 km long (Afzali, 1981). However, the author has not seen any Afghan garnet for sale in the Pakistan trading centers during the last three years.

Small quantities of aquamarine are currently being mined in the area of Gur Salak, in Konar Province. The rough material occurs in pegmatites as well-formed crystals up to 2 cm thick and 7.5 cm long (1 x 3 in.). The crystals range in color from light blue to dark blue as well as various intensities of blue-green.

The author observed a few morganite crystals during his most recent trip. These crystals, which ranged in color from pink to brownish pink to peach, were reported by Afghan miners to come from the mine at Mawi, in the Nuristan region. Spinel has historically been reported from Badakhshan, northeast of the lapis mines (Scalisi and Cook, 1983), but little spinel has been seen in recent years. A 1970s edition of *Afghan Development in Brief*, published by the Afghan government, reported that amethyst had been found in both Badakhshan and Kandahar. The author has not, however, seen any of this material in the local gemstone market.

CONCLUSION

Significant quantities of a variety of high-quality gem materials are now emerging from northeastern Afghanistan. More material than ever before has reached cutting centers in Thailand, Hong Kong, Germany, Brazil, and the U.S. While the present hostilities and war-like conditions in Afghanistan have made mining and subsequent transportation of the gem materials difficult, the need for capital appears to have stimulated mining operations to their greatest heights in many years. For example, greater amounts of fine-quality lapis lazuli are available now than at any time in recent decades. The reserves of tourmaline and spodumene, in particular - and to a lesser extent also emerald - appear to be good. Political conditions permitting, Afghanistan should continue to supply significant quantities of these gem materials for several years to come.

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