GEM NEWS

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DIAMONDS

Native Appalachian diamonds. Occasionally, diamonds are found in the Appalachian Mountains of the United States, including New York, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Alabama, Kentucky, and Tennessee. W. D. Hausel and J. E. Bond, in the November 1994 issue of *International California Mining Journal*, suggest that these diamonds may have local sources, warranting exploration of the Appalachian area. Previous explanations for these diamond occurrences include glacial transport and "deposition by migrating birds from South America."

Diamond developments in Tanzania. Initial surveying is complete on five leases held by Serengeti Diamonds at the Kahama/Shinyanga diamond property. These lag-type deposits (i.e., secondary deposits in which the diamonds are concentrated by wind action) consist of gravels from around the Shinyanga diamond pipes that can occur up to 1 km from those sources. Because of preferential sorting by wind, these deposits tend to be a higher grade than the primary pipes. The Serengeti Diamonds deposits contain an estimated 258,100 carats in two types of gravels: 123,700 metric tons yielding 100 carats per 100 tons, and 1.68 million metric tons yielding 8 carats per 100 tons.

The Tanzanian Parastatal Reform Commission and Willcroft Co. (a subsidiary of De Beers Centenary AG) plan a US$8 million upgrade of the Mwadui mine, including a new diamond recovery plant. Production has declined at the Mwadui pipe, discovered by Dr. John Williamson in 1940, since superficial reserves were exhausted in the 1980s. A second concession near the Mwadui mine is currently being explored. (*Mining Journal*, September 9 *[p. 182]*, November 4 [pp. 325, 330], 1994).

Other African diamond mining ventures. United Reef Ltd. of South Africa has reported the results of independent valuation in Antwerp of 417 carats of diamonds from its Bamingui project in the *Central African Republic*: The diamonds average US$150 per carat, making this deposit "among the world's highest in terms of dollar value per carat." (*Mining Journal*, November 4, 1994, p. 325)

After an absence of six years, De Beers plans to begin exploration along a 16,000-km^2 area of the *Sierra Leone* seacoast. (*Mining Journal*, August 19, 1994, p. 137)

Canadian diamond rush bruised but still alive. Despite very poor yields at two major Canadian diamond prospects and a devastating crash in diamond stocks, diamond exploration consultant A. J. A. "Bram" Janse of Perth, Australia, remains cautiously optimistic about several other diamond prospects in Canada. If the sources he cites are correct, it appears likely that at least one prospect will become an operational diamond mine.

The first big blow to the then-booming diamond exploration industry in Canada came on August 5, 1994. RTZ/Kennecott said that their underground sampling of the Tli Kwi Cho kimberlite pipe in the Lac de Gras area of the Northwest Territories had produced unexpectedly low grades of diamond. This immediately devastated diamond stocks on the Canadian exchanges, where investors lost an estimated C$500 million.

The second blow came when resampling of another pipe turned up very disappointing results. This one, the Torrie pipe in the Yamba Lake area, was being worked by Monopros, a joint-venture partner of Tangueray/Mill City Gold (and the Canadian prospecting subsidiary of De Beers).

The bad news about these two kimberlite pipes and the ensuing crash in diamond stocks has hurt investor confidence in geologists' predictions of rich Canadian diamond fields. However, these events have overshadowed another potentially lucrative find, according to research by Dr. Janse. Very encouraging results have been obtained from underground and large-diameter drill-core sampling on the BHP/Dia Met cluster of six pipes—Koala, Panda, Falcon, Misery, Fox, and Leslie. These are located 12 km south of Exeter Lake at about 64°40′N and 110°38′W, in the middle of the Corridor of Hope, which cuts through the Lac de Gras area. BHP/Dia Met is starting to study the feasibility of mining ore from two, three, or possibly all six pipes in the cluster. The company maintains that it expects to start mining diamonds from the 3-hectare (7.5-acre) Panda pipe before the year 2000. BHP has applied for the necessary environmental permits and filed a plan of operations. The company has also made presentations of planned future development to the local Dogrib people (*Northern Miner*, May 16 [p.1], June 27 [p.6], August 15 [p.1], September 5 [pp. 1, 6], 1994; *Financial Post*, Toronto, August 6–8, 1994, p. 1; *Globe & Mail*, Toronto, August 25, p. B6).

In addition, Aber Resources' exploration of diamondiferous kimberlite A-154, located about 25 km south of the BHP/Dia Met cluster, produced unexpected results. Two commercial-size diamonds, 1.75 and 0.25 ct, were found in a single drill core. A drilling barge has been set up to continue work. (*Mining Journal*, May 6, 1994, p. 328; June 24, 1994, p. 460; September 30, 1994, p. 236; December 3, 1994, advertising supplement).

Other Canadian regions with diamond potential include central Saskatchewan, where many companies are actively exploring, and the James Bay Lowlands of northern Ontario, which is now being prospected by KWG Resources (see, e.g., Gem News, Summer 1994, pp. 122–123).

Diamonds found in Finland. Bram Janse also reported heightened interest in diamond prospecting in Finland following Melbourne (Australia)-based Ashton Mining's recent disclosure that they had secured exploration leases covering large areas in northern Finland, found 21 kimberlite pipes, and recovered several diamonds over two carats. For instance, one two-hectare pipe yielded six carats of diamonds from a 23-metric ton sample (*Mining Journal*, September 9, 1994, p. 177). Ashton emphasized that it would still take two or three more years to evaluate these finds fully, but added that costs to develop a mine in Finland should be much lower than in Canada or Russia because of Finland's more advanced infrastructure (*The Australian*, August 31, 1994, pp. 1, 26). Some newspapers have called the finds "secret" (*The Australian*, above) or "sensational" (*Aftenposten*, Oslo, September 8, p. 2). The latter newspaper said that RTZ and De Beers also have large areas under diamond exploration leases.

Encouraged by discoveries in Finland, the Nordic Exploration Group (NordEx) is exploring two 100-km² diamond properties: one near Alno and the Swedish Baltic Coast; and the other, called Kalix, near the Finnish border with Sweden. Magnetic anomalies, similar to those associated with Canadian kimberlites, have been discovered in aeromagnetic data from the Kalix region. (*Mining Journal*, November 4, 1994)

Figure 1. This 4.09-ct trilliant-cut amethyst is typical of material being recovered from a mine in northern Namibia. Courtesy of Barker & Co., Scottsdale, Arizona; photo by Maha DeMaggio.

COLORED STONES

Amethyst from Namibia. Amethyst, a staple of the colored stone industry, is always well represented at gem and mineral shows. Typically, it is available in many forms, including faceted stones, cabochons, carvings, cobbed material (i.e., pre-trimmed rough), and mineral specimens as large as hundreds of kilos. Much of the rough material comes from Brazil; Zambia is also a major source.

At shows both this year and last, we also saw material from Uruguay, amethyst-citrine from Bolivia, pale-colored amethyst crystal clusters from the Ural Mountains of Russia (a classic source of amethyst), and even some attractive, medium- to dark-toned faceted material from Namibia (see, e.g., figure 1). According to Hannes Kleynhans, president of Amethyst Mining & Export, Karibib, Namibia, this material comes from a mine on the Burgershof Farm in the Platveld area of northern Namibia, very near the highway that runs from Windhoek to Tsumeb. A dirt ramp leads from the edge of what has become a huge excavated open pit to 150 feet (45 m) below the surface, where a large mineralized vein is being worked.

Mining takes place only during the dry season, roughly from April through September. Groundwater fills the pit during the rainy season, making mining impossible for the remaining six months. The mine is very productive, yielding several tons of material of all qualities annually, according to Mr. Kleynhans.

Chatoyant demantoid garnet. The editors recently examined a most unusual cabochon-cut demantoid garnet loaned by Yoshiko Doi, president of GIA Japan in Tokyo. The 1.94-ct stone (figure 2) displayed distinct chatoyancy in the form of a greenish yellow band, the result of light reflecting from a myriad of more-or-less parallel, fibrous inclusions.

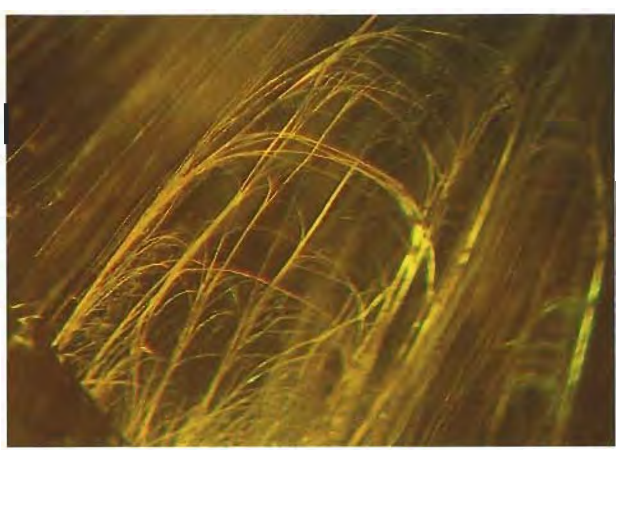
These inclusions do not appear to be arranged in any specific crystallographic orientation within the host, as is normally the case for chatoyant gems (for example, in tourmaline the "eye" is caused by light reflection from

Figure 2. Distinct chatoyancy is displayed by this 1.94-ct (approximately 7.54 × 5.09 × 4.10 mm) demantoid garnet. Photo by Maha DeMaggio.

growth tubes that run parallel to the optic axis of the host). Instead, the "parallel" arrangement of the fibrous inclusions seems to be more random, with some fibers actually curving back on themselves completely (figure 3). This unusual arrangement of "horsetail" inclusions (which creates the "eye") makes the host demantoid garnet a true rarity.

Color-change diaspore from Turkey. Although the editors have known for some time about diaspore from Turkey, material seen thus far has been mostly brown with only a minor color change. However, one of the editors (EF) recently examined rough and faceted samples from a new deposit in Turkey. The best specimens of this new find show a very distinct color change—brownish pink in incandescent light (figure 4) and brownish green in daylight/fluorescent light. The samples were provided by Guven Cankur and Debbie Deatker of Eur-Asia Ltd., North Miami Beach, Florida. The faceted stones that we examined with this distinct color change ranged from 3.38 to 16.44 ct.

Figure 3. Magnification reveals that the fibrous inclusions responsible for chatoyancy in the demantoid in figure 2 are randomly arranged. Photomicrograph by John I. Koivula; magnified 25×.



Other gemological properties were typical for diaspore: refractive indices of α = 1.700–1.701, β = 1.723–1.726, γ = 1.749–1.750; S.G. (measured hydrostatically) of 3.40; a moderately intense broad line visible at about 450 nm in the handheld spectroscope; inert to long-wave UV radiation, with a weak yellow fluorescence to short-wave UV.

Energy-dispersive X-ray fluorescence analysis detected aluminum—a major constituent of diaspore, AlO(OH)—and traces of titanium, chromium, and iron.

Figure 4. This color-change diaspore from a new find in Turkey appears brownish pink in incandescent light. The cut stone shown here weighs 3.38 ct. Photo by Maha DeMaggio.

Figure 5. Myanmar is the reported source of this 7.91-ct cabochon of plagioclase feldspar with ruby inclusions. Photo © GIA and Tino Hammid.

UV-visible absorption spectroscopy taken in a random orientation also showed features typical of iron (Fe^{3+}) in all gems, which we believe is responsible for the brown color of most gem diaspores from Turkey documented so far. Also detected was chromium. Preliminary investigations indicate that the chromium (Cr^{3+}) is responsible for the color-change behavior (as it is in many gems, such as alexandrite and some color-change pyrope-spessartine garnets). The variable position of the absorption cut-off at short wavelengths was tentatively attributed to charge-transfer phenomena, possibly involving titanium and iron.

Mr. Cankur indicated that exploratory mining revealed good-quality material in many areas, so future production may be significant.

Feldspar with ruby inclusions. In October 1993, Karl Schmetzer of Petershausen, Germany, received for identification some translucent white cabochons with red crystal inclusions (see, e.g., figure 5). X-ray diffraction analysis of the two materials revealed that they were plagioclase feldspar and ruby, respectively. At about the same time, Dr. Schmetzer learned that Martin P. Steinbach, a gem dealer in Idar-Oberstein, Germany, had some 20 cabochons, ranging from 5 to 13 ct. Mr. Steinbach said that the material reportedly came from Myanmar, although he did not know the exact locality. He purchased all of the specimens in northern Thailand, near the Myanmar border.

In November 1993, Michael Gray of Graystone Enterprises in Missoula, Montana, showed one of the editors (JIK) a cabochon of a similar-appearing material, also reportedly from Myanmar but obtained in Europe. Subsequent gemological testing confirmed that this was also a feldspar with ruby inclusions.

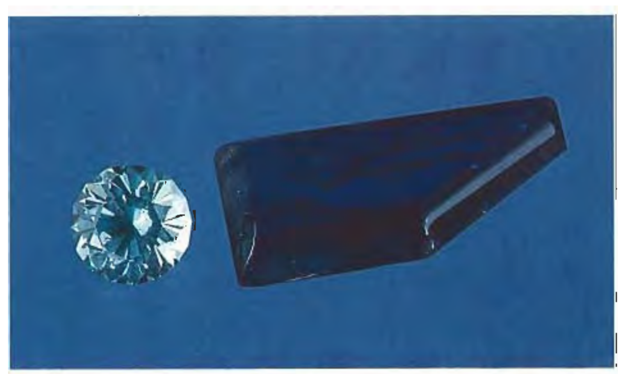
The ruby inclusions have somewhat rounded edges and vary greatly in size. They range in diaphaneity from translucent to transparent. Because some of the inclusions are large (as much as 5 mm long) and often break the surface of the host stone, it is quite easy to determine their refractive indices, absorption spectra, and pleochroism.

Gems from North Carolina. The Summer 1993 Gem News section contained an entry on "emerald matrix" from North Carolina, the only emerald locality in the United States. This material, first seen by the editors at the 1993 Tucson event and again at the one in 1994, was offered by the Emerald City Gem Shop of Spruce Pine, North Carolina. They showed us 152 cabochons, ranging from 2.66 to 31 ct, as well as some attractive unfashioned mineral specimens.

They also distribute other beryls from North Carolina, including pale-colored aquamarines (figure 6) and green beryl cabochons with moderately distinct chatoyancy. They reported that the aquamarine comes from the Hanson Creek Aquamarine mine in Avery County, an abandoned mica mine that the firm purchased in 1992 and subsequently reopened for its gem potential. We saw 125 cabochons ranging from 2 to 22 ct and 58 faceted stones ranging from about 1 to 6 ct.

Another North Carolina gem material offered was kyanite (again, see figure 6) from the Balsam Gap Blue Kyanite mine near Barnardsville. According to co-owner Gary Ledford, kyanite was first discovered at this locality in 1989, but the firm did not start selling it until recently, when they felt they had an adequate supply of fashioned goods. Some of this material is similar to some kyanite from Brazil, the hues ranging from medium greenish blue to blue with colorless areas. However, some of the darker blue material from North Carolina has areas of a darker, more saturated blue than anything we have noted in Brazilian material. We saw two faceted stones (5.38 and 9.58 ct) that were exceptional for their absence of eye-visible inclusions, their transparency, and their well-defined dark blue/colorless bicoloration.

Figure 6. North Carolina is the source of this 1.14-ct faceted aquamarine and 9.88-ct freeform kyanite tablet. Courtesy of Emerald City Gem Shop; photo by Maha DeMaggio.



More on peridot from Pakistan. The Fall 1994 Gem News section contained an entry on a new and potentially significant commercial source of peridot in the far western region of the Himalaya Mountains in Pakistan. Since then, the editors have had an opportunity to study both rough and cut stones from this locality.

At first glance, these orthorhombic peridot crystals may look hexagonal, because of equal sizes among different faces of "columnar" and "pyramidal" shapes. Faces were identified through comparison of these crystals with Goldschmidt's *Atlas der Krystallformen* (olivine group in volume 6 [reprinted by the Rochester Academy of Science, Rochester, NY, 1986]). Faces identified include pinacoids (001), (100), and (010); prisms (120) and (110); brachydome (021), macrodome (101); and pyramid (111). The most prominent of these were the basal pinacoid (001), "columnar" faces (010) and (110), and "pyramidal" faces (021) and (111). While all the crystal faces on the first three uncut specimens we were able to examine closely were etched, striations parallel to the c-axis were clearly visible on the (010) and (110) faces. However, Laura Thompson, president of Shades of the Earth, Phoenix, Arizona, which is marketing the material, reported that many of the crystals recovered are not etched to this extent and actually display lustrous crystal faces. We subsequently saw additional crystals that substantiated Mrs. Thompson's comment (see, e.g., figure 7).

Gemological testing on two faceted stones, a 5.23-ct cut-cornered rectangular mixed cut and an 18.37-ct cushion modified brilliant, gave the following results: color—medium yellowish green; diaphaneity—transparent; R.I.—$\alpha = 1.651$, $\beta = 1.669$, $\gamma = 1.687$; birefringence—0.036; S.G. (determined hydrostatically)—3.35; pleochroism—weak, yellowish green and brownish yellowish green; UV fluorescence—inert to both long and short wave; absorption spectrum—distinct but somewhat diffuse absorption bands at about 453, 477, and 497 nm, as well as a weaker band at about 529 nm (this last absorption feature is typically noted only in fairly large specimens of peridot—see, e.g., Webster's *Gems*, 4th ed. [rev. by B. W. Anderson], 1983, p. 162). All these features are consistent with those reported in the gemological literature for peridot from various localities.

Peridot is the gem variety of the mineral olivine, which is a solid solution between a magnesium end-member, forsterite, and an iron end-member, fayalite. R.I.'s and S.G. vary systematically with composition (see Deer, Howie, and Zussman, *Introduction to Rock Forming Minerals*, Longman Group, London, 1974). On the basis of the R.I. and S.G. values we obtained, the Pakistan material is about 90% forsterite and 10% fayalite.

Magnification did not reveal any inclusions in the two faceted specimens described above. Further, we did not see internal features in any of the other faceted stones we were able to examine briefly (again, see figure 7). However, some of the rough specimens had black rod-like inclusions that, according to Mrs. Thompson, are fairly common in cabochon-quality rough. X-ray diffraction analysis of one such inclusion that broke the surface of a rough specimen revealed a pattern consistent with the magnesium iron borate mineral ludwigite.

Figure 7. A new locality in the far western Himalayas of Pakistan is the source of these rough (128.82 and 393.83 ct) and faceted (18.50–64.61 ct) peridots. Courtesy of Shades of the Earth; photo by Shane F. McClure.

Sapphire from Scotland. In an article in the Winter 1984 *Journal of Gemmology*, Brian Jackson described a then-new occurrence of sapphire in Scotland. Blue sapphire was found as large single crystals (up to almost 5 cm in diameter) in a xenolithic dike at Loch Roag, Isle of Lewis, Outer Hebrides, Ross and Cromarty, Scotland. The dike has a composition similar to lamprophyre, and contains biotite, augite, apatite, sanidine, anorthoclase, and—rarely—corundum. The dike varies from 0.5 to 1.5 m in width, and was exposed over a section 4.5 m high and 24 m in length at an excavation site. Because this occurrence is so unusual, the government immediately declared the

Figure 8. Five stones (0.50–1.02 ct) fashioned from the 242-ct sapphire found at Loch Roag flank what remains of that crystal after cutting. Photo courtesy of Ian Combe and Alan Hodgkinson.

locality a Site of Special Scientific Interest, and mining there was prohibited.

Ian Combe of the Knockan Studio, Sutherland, United Kingdom, reported that a group of gemologists—the Edinburgh Gemmological Group, including himself—was recently permitted to examine loose, fragmentary material at the site. Their discoveries included a heavily fractured 242-ct sapphire crystal and a 39.5-ct fragment. A number of small stones were cut from the large crystal (figure 8), and the fragment produced an attractive 9.6-ct barion cushion-cut sapphire. According to Mr. Combe, the cut stone has the following properties: refractive indices of 1.762–1.770; strong general absorption in the blue region when viewed with a handheld spectroscope; pleochroic colors of blue and green; and no visible inclusions. The color has been described as "medium dark greenish blue"; there is some color zoning, but it is not visible table up. Mr. Combe believes that this is the largest gem sapphire faceted from United Kingdom material.

Update on Montana sapphires. American Gem Corporation (AGC) of Helena, Montana, now controls over 110 square miles (285 km^2) of Montana's alluvial sapphire claims, including Dry Cottonwood Creek, Eldorado Bar on the Missouri River, and Gem Mountain in the Rock Creek area, according to AGC chairman and CEO Greg Dahl. Sapphire yields have averaged 44 to 225 carats per cubic meter in the Dry Cottonwood Creek gravels, with some gravels yielding 1,000 carats per cubic meter, he said. Testing was done for AGC by Watts, Griffis, and McOuat, a Toronto-based consulting firm. Currently, all three claims have a combined resource of over 50 million carats, but Mr. Dahl noted that only 5% of AGC holdings have been tested.

Although usually high in clarity, most stones from these particular alluvial deposits are light in color without heat treatment. Therefore, AGC purchased Crystal Research of Pleasanton, California, to do the color enhancement (see "Heat Treating the Sapphires of Rock Creek, Montana," J. Emmett and T. Douthit, *Gems & Gemology*, Winter 1993, pp. 250–272). This process can intensify or change the color (figure 9). AGC expects production of six million carats of rough sapphire next year from its Montana claims. Before winter conditions halted mining this year, two different mine sites were fully operational. Mining will resume in the spring, Mr. Dahl said.

"Teal" blue cobalt-colored spinel. At the 1994 Tucson show, one of the editors (EF) was drawn to the unusual color of a slightly greenish blue (or "teal") 4.88-ct cushion-cut spinel at the booth of Fu Gemstone Imports, Seattle, Washington (see figure 10). The stone reportedly was from Burma. It was subsequently loaned to us for study, particularly an investigation into the origin of its color.

We recorded gemological properties as follows: R.I.—1.714, with anomalous double refraction; S.G.—3.60; inert to both long- and short-wave UV radiation; red fluorescence to visible light; and a moderate red reaction in

Figure 9. These sapphires (0.66–5.69 ct) are from the Dry Cottonwood Creek, Gem Mountain, and Eldorado Bar alluvial deposits in Montana. All except the pink one have been heat treated by Crystal Research. Courtesy of American Gem Corp.; photo © 1994 Tino Hammid.

Figure 10. This 4.88-ct natural cobalt-bearing spinel is slightly greenish blue because of its unusually high nickel content. Courtesy of Fu Gemstone Imports; photo by Shane F. McClure.

the color filter. This behavior is typical of natural cobalt-blue spinel. Indeed, the handheld spectroscope revealed broad bands at about 460, 550, and 585 nm and total absorption above 610 nm—a spectrum quite typical of such gems (see, e.g., Muhlmeister et al., "Flux-Grown Synthetic Red and Blue Spinels from Russia," *Gems & Gemology*, Summer 1993, pp. 81–98). The stone was essentially clean, except for a few elongated yellow stains in surface-reaching fractures at the corner of the table (which could be mistaken for flux inclusions). The natural origin was confirmed by EDXRF analysis with a Spectrace 5000 spectrometer, which detected large amounts of zinc and gallium, typical of natural spinel. Besides these elements and the main constituents (magnesium and aluminum), EDXRF detected abundant iron, a trace of manganese, and an unusually high nickel content (compared to other natural blue spinels in our data base). As expected, cobalt was not detected (the amount of cobalt typically found in natural cobalt-blue spinels is below the detection limit of our instrument).

Natural cobalt-blue spinels are best known for a saturated, "royal blue" color, not the slightly greenish blue of this gem. UV-visible absorption spectroscopy, recorded with a Hitachi 4001 spectrometer, revealed the small, but significant, difference in absorption that was responsible for the difference in color. Typical natural cobalt-blue spinels have a 490-nm transmission window, which corresponds to the classic "royal blue"; this stone has one at 500 nm, which corresponds to a slightly greenish blue. This 10-nm shift is apparently due to a broad absorption underlying the main Co^{2+} feature. Also, the absorption at 480 nm in this stone is about the same intensity as that at 460 nm; in other natural cobalt-blue spinels, it is usually weaker. We determined that the extra absorption is probably due to nickel (using a Russian flux-grown synthetic Ni^{2+}-doped spinel as a reference). This is consistent with the unusually large amount of nickel found with EDXRF. We believe that this is the first report of nickel contributing to the color of a natural spinel.

Update on Sri Lanka. Unusual weather and other factors are blamed for a general shortage of gems from Sri Lanka, especially good-quality blue sapphires. Nevertheless, that gem-rich country continues to produce attractive and interesting material, including rare examples of gem crystals in matrix, kornerupine, and hessonite garnets.

Five months of heavy rain last winter halted some mining operations during what is usually the most productive time of year, according to Gordon Bleck, of Radiance International, San Diego, California, a gemologist and part-time Sri Lanka resident. Some mines suffered lower production because of other problems. For example, a major South African mining company was authorized to mine the Kalu Ganga, an important river. This caused strong protest from local miners and gem dealers, as well as from residents who lived downstream and feared the environmental impact. As a result, all mechanized mining, small and large, was prohibited—further reducing already faltering production. Terrorism continues to be a limiting factor.

Even so, significant amounts of sapphire, zircon, and spinel crystals in matrix (figure 11) have been found in the Opalle Jungle mining area, about 9.5 km from Wellewatte village in the Kollone electorate, south-cen-

Figure 11. Rare examples of Sri Lankan gems found in matrix include blue sapphire (bottom center), spinel (left, top), and zircon (right). Samples range from 2.5 cm to 7 cm in their longest dimension. Photo by Robert Weldon.

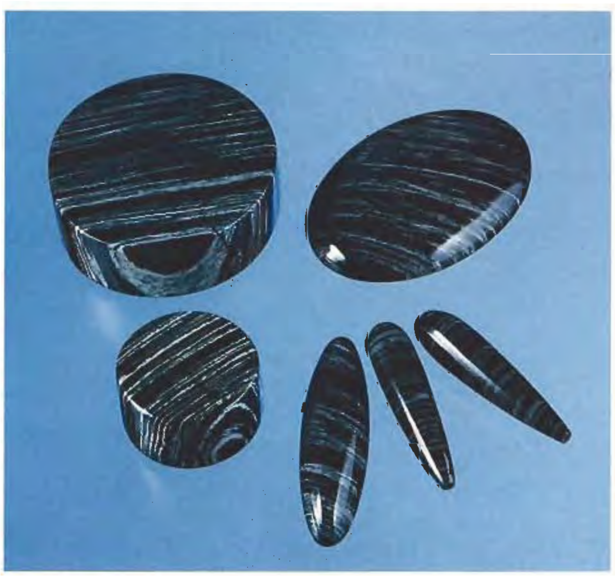
tral Sri Lanka. The material was found less than 1 m beneath the floor of the jungle and adjacent rice paddies. The spinel crystals are dark purple to black, well-formed octahedra, up to 2.5 cm on an edge. They occur in a matrix of large crystals of white calcite, dark green serpentine, and gray forsterite. The zircons are brown, doubly terminated tetragonal prisms and were found on quartz. The blue sapphires were associated with black mica plates in a white rock containing the minerals analcime, albite, and nepheline.

Dark green and some light green kornerupines have been reported before from various areas in Sri Lanka, but this year attractive brown kornerupine was discovered. Gems from this new find range from brown to slightly orangy brown or yellow-brown, with medium to dark tones. Faceted stones weigh from 0.75 ct up to 2.5 ct. All were found in the Dasgiriya area, off the Wellewa road in the Elahera district, in north-central Sri Lanka. Okkampitiya, which has produced some dark brown to black chatoyant kornerupine that is typically under 1 ct, this year yielded an exceptionally large, 10.15-ct dark brown cat's-eye kornerupine.

Gem hessonite garnets up to 110 ct in the rough were discovered in the Balangoda area. They are slightly brownish orange and, because of their generally poor quality, typically yield faceted stones no larger than 6 ct.

"Zebra stone" from Arizona. Soon after a Summer 1994 Gem News entry discussed two "zebra rocks" from Australia, we came across a handsome material banded black and off-white that is called "Arizona zebra stone." Offered by JPS Trading of Tucson, Arizona, this material has a Mohs hardness of about 6 and takes a good polish.

Figure 12. These pieces of polished "Arizona zebra stone" range from 17.54 to 292.22 ct. Photo by Maha DeMaggio.



Further examination of six variously fashioned pieces of this material (figure 12) and a strand of 15-mm beads revealed that it typically has roughly parallel stripes of varying thicknesses. Other patterns reportedly include lenses, mottled patches, chevrons, and folds.

The samples we examined consisted primarily of a black material that had a spot R.I. of 1.66–1.67 and an X-ray powder diffraction pattern that matched that of actinolite or tremolite amphibole. The lighter material had a spot R.I. of 1.55 and a diffraction pattern that matched that of calcium-rich plagioclase feldspar. Some pieces contained green alteration patches of epidote, also determined by X-ray diffraction analysis.

According to JPS Trading, this "zebra stone" is quarried near Prescott, Arizona. It is found associated with Precambrian ore deposits containing gold, silver, copper, and zinc. EDXRF analysis of the "zebra stone" revealed significant amounts of zinc and manganese. This material has been subjected to metamorphism; the parent rock was probably greywacke, similar to that being formed today off the west coast of North America.

All patterns are available in pieces weighing up to 500 pounds (227 kg), and some are available in multi-ton pieces, which makes it particularly useful as an ornamental material. JPS Trading also reports that reserves should last for years.

SYNTHETICS & SIMULANTS

"Minkovite" from Russia. At the February 1993 Tucson show, the editors saw examples of what was described by the vendor as a new laboratory-grown gem material from Russia. Although we could not obtain samples for testing at the time, we did obtain a promotional brochure. It said that the material's developers—B. I. Minkov (after whom the material appears to have been named), M. K. Meilman, and V. A. Voloshin—had applied for a patent on it in Russia.

Early in 1994, we received two "Minkovite" samples from Brian D. Kvasnik, president of Gem Resources of Minneapolis, Minnesota. These two faceted stones, a 1.19-ct round brilliant and a 4.50-ct emerald cut (figure 13), were subsequently examined at GIA. Both are a dark, saturated, slightly violetish blue, reminiscent of cobalt-doped synthetic spinel. R.I. values were determined as $\alpha = 1.785$, $\beta = 1.788$, and $\gamma = 1.810$, with a birefringence of 0.025. The material was biaxial positive and strongly pleochroic, in light blue, slightly greenish blue, and violetish blue. The samples fluoresced a weak, chalky blue to long-wave UV radiation, and were inert to short-wave UV. Specific gravity values were determined hydrostatically to be 4.47 ± 0.01. Examination with a desk-model prism spectroscope revealed a complex absorption spectrum (see below). With magnification, both stones showed curved color banding. In addition, the larger specimen contained irregular wisps of dark blue color concentrations, one white acicular inclusion, and several small angular inclusions.

Because the specimens' properties did not match

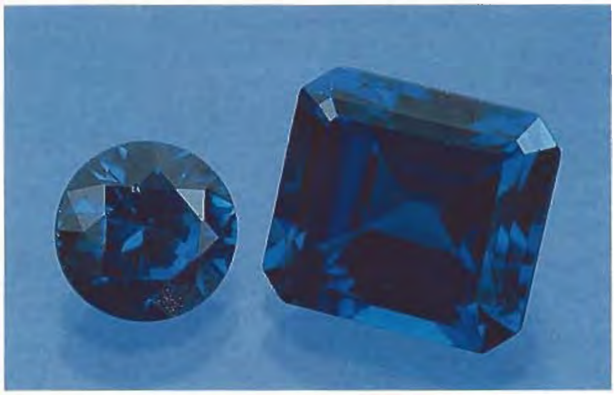


Figure 13. These two laboratory-grown, neodymium-doped yttrium silicate gems (1.19 ct and 4.50 ct) have been promoted under the trade name "Minkovite." Photo by Maha DeMaggio.

those of any known gem materials of natural origin, we conducted additional tests. EDXRF analysis revealed yttrium (Y), silicon (Si), and a trace of neodymium (Nd). A UV-visible absorption spectrum showed several sets of multiple sharp peaks, including sets at 352–365, 528–539, 575–597, 740–766, and 798–816 nm. These are consistent with Nd as a coloring agent. X-ray powder diffraction analysis performed with the assistance of Paul Carpenter at the California Institute of Technology, Pasadena, produced a pattern that matched that of monoclinic synthetic yttrium silicate, Y_2SiO_5.

This is not the first blue synthetic yttrium silicate that the editors have seen. In August 1992, at the 10th International Conference on Crystal Growth in San Diego, California, one of the editors (EF) obtained two faceted samples of such a material for examination (see Winter 1992 Gem News, p. 277). However, those two samples were lighter and less saturated in color, and chemical analyses revealed chromium as the coloring agent.

Visit to Russian synthetics facility VNIISIMS . . . The Fall 1994 Gem News section described a visit by one of the editors to a new synthetic-gemstone production facility in Novosibirsk, Siberia. On this same trip to Russia, the editor (RCK) also toured a large facility in the Moscow area that is involved in synthetic-gemstone research and production. Located in the city of Alexandrov, about 112 km (70 miles) north of Moscow in the Vladimir region, the Russian Research Institute for the Synthesis of Minerals and Pilot Plant is also known as State Enterprise VNIISIMS. The organization employs about 2,000 people, 1,500 of whom are involved in production and support services. The remainder—including about 60 with doctorates—are engaged in research.

VNIISIMS was founded in 1954 to produce synthetic colorless quartz for various technical applications, and this is still its main product by volume. Two interesting items on display were a large cluster of synthetic quartz crystals grown on a base of natural quartz (figure 14) and hydrothermally grown synthetic calcite (figure 15). The firm also produces synthetic diamond for various technical applications. These synthetic diamond products include diamond powders, diamond-impregnated cutting wheels, and larger crystals—reportedly up to 5-mm long—for use in cutting tools such as diamond scalpels.

The facility also produces a number of materials specifically for gem and jewelry use. The most commercially important (by volume) is synthetic amethyst, but others include synthetic citrine (some in a reddish

Figure 14. These synthetic quartz crystals have been hydrothermally grown on a natural quartz base (more than 12 inches—30 cm—across). Photo by Robert C. Kammerling.

Figure 15. The Russian State Enterprise VNIISIMS also synthesizes calcite hydrothermally for technical applications. Note the strong doubling through the smaller of the two crystals on the left. Photo by Robert C. Kammerling.

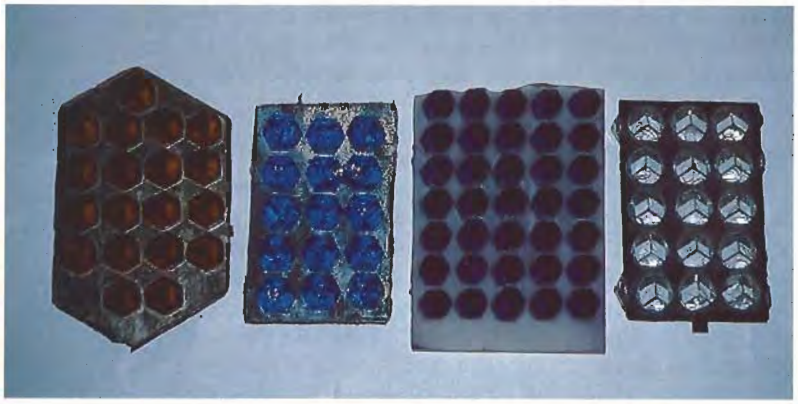


Figure 16. These synthetic quartz crystals were grown on masked, oriented seed plates at the Institute of Experimental Mineralogy, Russian Academy of Sciences. Photo by Robert C. Kammerling.

"Madeira" color), smoky quartz, a dark green type for use as an emerald simulant, a blue in medium-to-dark tones, and a white, translucent (opalescent) type. Seen, too, was a yet-to-be commercially produced synthetic aventurine quartz: synthetic rock crystal containing precipitated platelets of copper.

The facility also uses melt techniques to grow materials for jewelry applications, including cubic zirconia, both colorless and in a range of colors. Production includes nontransparent white and pink CZ for use as pearl simulants, as well as black CZ (see "An examination of nontransparent 'CZ' from Russia, by Kammerling et al., *Gems & Gemology*, Winter 1991, pp. 240–246). A melt technique known as horizontal growth is used to produce YAG in a wide range of colors. Among the most recent gem products are synthetic opal and synthetic malachite.

. . . and two centers in Chernogolovka. The Russia trip also included a visit to two facilities under the direction of the Russian Academy of Sciences in the town of Chernogolovka, 100 km north of Moscow. One, the Institute of Experimental Mineralogy (IEM), is headed by Dr. Vladimir Balitsky. A major focus of this institute appears to be the growth of minerals that may have jewelry applications, especially synthetic quartz in a variety of colors. Of particular interest were quartz crystals on which the largest surface is in the plane perpendicular to the c-axis. To produce this effect, the seed plates on which these crystals were grown had been masked with a metallic-appearing template containing numerous openings, allowing for the simultaneous growth of several parallel crystals (figure 16). Examples seen were synthetic rock crystal, amethyst, citrine, and blue quartz. IEM has also grown synthetic pink quartz, emerald, turquoise, and malachite. Some materials produced at this facility are marketed in the United States by HRI International of Middletown, New York (see "More on Russian synthetics and simulants," Spring 1994 Gem News, p. 57).

Also visited in Chernogolovka was the Institute of Solid State Physics, headed by Professor Gennady Emel'chenko. One current research project involves flux-grown synthetic ruby.

Miscellaneous synthetics and simulants. In addition to the materials described above and in the Spring 1994 Gem News section, the authors have seen a number of other laboratory-grown products this year that are worth noting. These include a saturated, medium-dark blue GGG (gadolinium gallium garnet), reminiscent of the rare gem material haüyne (a small amount of which we have seen recently in faceted form). Also offered was "YAP" (yttrium aluminum perovskite) in several colors. One interesting variety of hydrothermal synthetic quartz encountered lately is predominantly brown with a relatively shallow green layer (parallel to the plane of the seed plate) near the periphery of the crystal. This material was offered as a simulant for andalusite. The editors presume that a gem cut from this material in such a way that it showed both colors might superficially mimic the eye-visible pleochroism of andalusite.

ANNOUNCEMENTS

Visit *Gems & Gemology* at the Basel show. *Gems & Gemology* Editor Alice Keller will be in the *Gems & Gemology*/GIA booth (stand 197, hall 202) at the Basel 95 World Watch, Clock and Jewelry Show. Held in Basel, Switzerland, the show runs from April 26 to May 3, 1995. Drop by to ask questions, share information, or just say hello.