GEM NEWS

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DIAMONDS

Argyle production update. Figures for the first six months of 1993 place diamond production by Australia's Argyle mine at 20,013,571 ct from the AK1 pipe primary deposit and 1,060,968 ct from nearby alluvial activity. If production proceeds at this pace, it will undoubtedly exceed the 36,567,849 ct reported for all of 1992. Although the alluvial figure is only a small fraction of Argyle's total output, alluvial diamonds are generally of higher quality than those extracted directly from the pipe. (*Diamond Intelligence Briefs*, August 23, 1993, p. 1031)

Central African Republic has strong reliance on diamonds. The importance of diamonds to a country's economy is well illustrated by figures from the Central African Republic (CAR). According to an August 1993 mining report on Francophone Africa, diamond sales account for 50% of the CAR's gross domestic product and 46% of its export earnings. Annual diamond production is roughly 380,000 ct, of which nearly 80% is reportedly gem quality.

A number of foreign firms have recently started exploration for additional diamond deposits. One, Australia-based Walhalla Mining, has recovered numerous diamonds over 1 ct from alluvium in the firm's 100-km^2 exploration area. Bulk testing of both colluvial and eluvial deposits is scheduled to begin in late 1993. Meanwhile, Canada-based United Reef Petroleum has reported discovering 36 more diamonds, ranging from 0.26 to 7.53 ct, at its Bamingui-Bangoran project in the country's north. (*Mining Magazine*, August 1993, pp. 65, 106; *Diamond Intelligence Briefs*, August 23, 1993, p. 1028)

CSO names first Chinese sightholder. The Central Selling Organisation (CSO) in London has added the first indigenous Chinese firm to its list of sightholders. Located in Shanghai, the China National Pearl, Diamond, Gem & Jewellery Import/Export Corporation is a government-owned entity. It is interesting to note that Gerald L. S. Rothschild, former managing director of I. Hennig brokers, acted as the CSO broker in securing the sight.

The new Chinese sightholder is not the first government-owned operation to be made a sightholder—India and Israel have also had government-owned sightholders. Three more firms, all from India, were also recently added to the list of sightholders. (*Diamond Intelligence Briefs*, July 26, 1993, pp. 1017ff)

Indian polished exports increase. For the one-year period ending March 31, 1993, India reported the purchase of US$2.380 million worth of rough diamonds and the export of polished stones worth $3.240 million, the latter figure representing an added value of 36%, some 10% greater than that recorded for the prior one-year period. The improved export performance was attributed to a move by consumers in recession-hit industrialized nations to the types of smaller stones cut in India. (*Mining Journal*, April 23, 1993, p. 298)

Russian production high but declining. Worldwide revenue from rough diamond sales was US$6.414 billion in 1992, estimates Yorkton Natural Resources, a Canadian stockbrokerage. This figure includes an estimated $1.240 billion for Russia, which places it second only to Botswana ($1.553 billion) in diamond revenue.

Russian production in terms of caratage, however, has declined from a peak of about 20 million carats in 1986 to about 12 million carats in 1991. It is believed that production fell by another 20%–25% in 1992, and De Beers estimates that 1993 output will be around 8 million carats. Continuation of this decline appears likely in the short run. In the eastern Siberian republic of Sakha, production at the Mir pipe is reportedly now negligible, as attempts to move underground have been halted by the presence of huge amounts of methane gas. The Sytykanskaya mine is also reported to be nearing exhaustion, and the Udachnaya mine is expected to be depleted by the year 2000.

Still, there are significant areas with potential for future development if obstacles can be overcome. At least five pipes have been found in the Archangel district of northwest Russia; at least two of these are believed to have economic potential. (For further information on the potential of Russian diamond deposits, see the Levinson et al. article in *Gems & Gemology*, Winter 1992, pp. 234–254.) To develop these, however, an effective way to mine what amounts to a 700-m deep "mud pile"—water-saturated kimberlitic yellow ground—must be found.

Environmentalists are concerned that the outflow from pumping could contaminate local fish-spawning grounds. Dust and material leached from dumps would cause further pollution. Environmentalists, and some of the local populace, are also concerned about possible further damage to the region's swamps and forests. Their position is strengthened by a new national environmental protection law that dictates that development be ecologically sound.

One approach to these potential problems is the use of some alternative mining techniques. For example, Atomredmetzoloto, part of the Russian Nuclear Energy Ministry, has developed a technique by which a grid of wide bore holes (4.6 m or 6.2 m in diameter) is drilled into the diamond-bearing pipes, with the debris then removed in solution for treatment. Design approval for this method has just been granted, and a feasibility study is being conducted. (*Mining Journal*, August 20, 1993, pp. 124–125)

United States sells diamonds from stockpile. The United States Defense National Stockpile Center has sold 932,806.43 ct of industrial and near-gem quality diamonds from a stockpile built up in the 1940s and 1950s for industrial applications. The bidding was reportedly very competitive, with successful bids coming from firms in Antwerp, Chicago, New York, and Ramat Gan, Israel. The U.S. government made a net profit of $77,646,016.94 from the sales. (*Diamond Intelligence Briefs*, July 26, 1993, p. 1022)

Zaire faces severe mining problems. The political crisis in Zaire has led to ongoing problems in that country's mining industry. Diamond production is estimated to have dropped from an estimated 19 million carats in 1991, to about 15 million carats last year. Among the factors accounting for this drop are disruptions in production due to defective operating equipment, shortages of spare parts and fuel, and an influx of illegal miners. (*Mining Magazine*, August 1993, p. 73)

SYNTHETIC DIAMONDS

Chatham proposes commercial production and distribution of Russian synthetic diamonds . . . At the Jewelers of America International Jewelry Show in New York this past July, Thomas H. Chatham announced that his firm, Chatham Created Gems of San Francisco, California, would soon market faceted, gem-quality synthetic diamonds to the jewelry industry. These "Chatham Created Diamonds" reportedly will be produced by Chatham Siberian Gem Company, a firm that Mr. Chatham formed in Russia in June. The production facility, yet to be constructed, will be located in Siberia.

Initially, according to Mr. Chatham, only approximately 100 ct of rough material will be produced monthly and marketed to the trade as faceted stones, the cutting to take place in either Russia or Thailand. He also reported that these stones would be available in a range of qualities and in colors that could include "white" and yellow, among others. Mr. Chatham estimates that the product will sell for approximately 10% of the cost of natural gem-quality diamonds of the same quality.

. . . and GIA says Russian gem-quality synthetic diamonds examined to date can be identified by standard tests. In Spring 1992, GIA received on loan (courtesy of Prof. N. V. Sobolev, director of the Institute of Mineralogy and Petrography, Siberian Branch of the Russian Academy of Science, Novosibirsk) a selection of yellow synthetic diamond crystals and cut stones produced in Novosibirsk. On the basis of separate conversations with Prof. Sobolev and Thomas Chatham, GIA researchers believe that these stones were grown using the same technology that will be used to grow the gem-quality synthetic diamonds that Mr. Chatham proposes to manufacture and distribute. This group of synthetic diamonds is currently being examined by staff members in GIA Research and the GIA Gem Trade Laboratory. The results of this study will be submitted to *Gems & Gemology* for publication in an upcoming issue.

Over the last several years, GIA researchers have reported extensively on synthetic diamonds in this journal, based on their work and on related information in the literature. Articles published in *Gems & Gemology* have described the gemological properties of synthetic diamonds produced experimentally by General Electric and De Beers Diamond Research Laboratory, and those being sold commercially for industrial use by Sumitomo Electric Industries. These reports have covered identification criteria for both colored (i.e., yellow and blue) as well as near-colorless synthetic diamonds. Distinctive features (not seen in natural diamonds) include color zoning (in colored synthetic diamonds), strong fluorescence to short-wave ultraviolet radiation that is often also zoned, rounded metallic flux inclusions, and graining patterns in several geometric shapes. On the basis of this work, GIA researchers have concluded that the gem-quality synthetic diamonds produced to date can be identified by jewelers using standard gem-testing equipment. Further conclusive results may be supplied by advanced testing using, for example, infrared spectroscopy.

This means, however, that gemologists involved in diamond grading must also strengthen their skills in gem identification. Although many of the clues that show that the stone is a synthetic will reveal themselves in the course of standard identification and grading (e.g., metallic inclusions and graining patterns), other tests should be added to ensure that the stone is natural (e.g., stronger luminescence to long-wave than short-wave ultraviolet radiation). Because some of the distinctive visual properties may be subtle, especially in near-colorless synthetic diamonds, gemological identification of this material will probably require more extensive examination of gem diamonds than has been required for diamond grading alone. And, since not every synthetic diamond possesses all the distinctive gemological properties described in past articles, no identification should be based on one gemological property alone.

The Russian synthetic diamonds that GIA is now examining include two cuboctahedral crystals (0.78 and 0.88 ct) and eight faceted stones (0.11–0.51 ct). The two crystals and five of the cut stones are yellow (see, e.g., figure 1). The other three cut stones are greenish yellow; they were reportedly heat treated at high pressure in Novosibirsk during color-enhancement experiments.

The gemological properties of this group exhibit some similarities to, and differences from, what GIA and others have previously reported for yellow synthetic diamonds. The faceted stones were cut from cuboctahedral crystals, so they display internal growth sectors that manifest themselves in several gemological properties (i.e., the distribution of color and U.V. fluorescence, as well as graining). Most of the 10 samples had some kind of uneven color zoning due to differences in impurities between different growth sectors. This color zoning was most apparent when the sample was examined while it was immersed in a heavy liquid such as methylene iodide.

In addition, all responded to short-wave U.V. radiation, although it was surprising to see that all but one also responded to long-wave U.V. However, the long-wave U.V. fluorescence was always less than or equal in strength to the short-wave U.V. response. In all cases, the U.V. fluorescence was unevenly distributed and followed a pattern similar to that of the color zoning.

When examined with a gemological microscope, many of the samples revealed metallic inclusions, weak anomalous birefringence ("strain"), and internal and/or surface graining that marked the boundaries between internal growth sectors. This graining sometimes formed a square, octagonal ("stop sign"), or "hourglass" pattern.

In contrast to what has been observed with other yellow synthetic diamonds, the Russian samples displayed sharp absorption bands in their visible-range spectra that could be seen with a handheld spectroscope. These sharp bands were especially numerous in the three greenish yellow synthetic diamonds that had been heat treated.

On the basis of these features, we believe that the Russian synthetic diamonds produced to date can be identified by standard gemological tests. What impact this material could have on the jewelry industry will depend on how it is marketed, how it is sold, and, ultimately, how it is accepted by consumers. Nonetheless, the ability to identify synthetic diamonds will become increasingly important to insure continued confidence in the diamond market.

Figure 1. GIA researchers believe that standard gemological tests can identify Russian synthetic diamonds produced to date, like this 0.78-ct crystal and 0.51-ct square step cut. Photo by Nicholas DelRe.

Sumitomo Electric synthesizes high-purity diamonds. Sumitomo Electric Industries has successfully synthesized diamond crystals containing less than 0.1 parts per million impurities (and being, therefore, presumably near-colorless), according to *Japan Industrial Journal.* The company has established a purification technology that, during the formation process, adds rare-earth elements to react with impurities. This process can produce diamonds as large as 6 mm on a side, weighing up to 2 ct. The company reportedly plans to market these diamonds for about half the cost of comparable high-purity natural diamonds. Dr. Shuji Yazu, of Sumitomo Electric Industries, has informed GIA researchers that the company does not plan to sell whole crystals and that these synthetic diamonds are not intended for jewelry purposes, but rather for high-tech applications.

COLORED STONES

Significant amethyst find in Maine. In July 1993, three mineral collectors discovered a significant new pocket of amethyst while prospecting a granitic pegmatite on Deer Hill in Stow, Maine, an area known to produce amethyst in the past. Much of the amethyst was found in spaces between large, blocky crystals of altered feldspar, making the crystals easy to remove. Over 2,500 lbs. (about 1,135 kg) of amethyst was reportedly found, although this figure apparently includes massive amethystine quartz as well as single crystals and crystal clusters. A significant number of the crystals are described as being "unblemished"; these range up to 7.4 inches (19 cm) high and 5.9 inches (15 cm) wide. One gem-quality crystal has been cut into a 29.64-ct stone. (*Mineral News*, Vol. 9, No. 8, pp. 1, 4)

Chalcedony colored by large mineral inclusions. Translucent chalcedony colored blue-green by finely disseminated chrysocolla has been known for many years and, in

Figure 2. Concretions of azurite, malachite, and chrysocolla appear to be responsible for the color in this unusual 16.61-ct chalcedony carving. Courtesy of Lehrer Designs; photo by Maha DeMaggio.

the trade, is often called "chrysocolla quartz." Graduate Gemologist Glenn Lehrer, of Lehrer Designs in San Rafael, California, recently sent the Gem News editors a somewhat unusual variation on this material.

Mr. Lehrer had received some rough carving-quality chalcedony from the Baghdad copper mine in Arizona. He noted that distinct blue, blue-green, and green areas were evident in a host rock that was almost transparent. The color in these areas was not caused by finely disseminated mineral matter, but rather by large—up to almost 1 mm in diameter—spherical to hemispherical concretions of what was reported to be azurite, chrysocolla, and malachite. In certain areas, minute yet distinct euhedral crystals with the habit of azurite and malachite were also visible, further contributing to the color of the host chalcedony.

Figure 2 shows a 16.61-ct (54.76-mm-long) free-form carving that Mr. Lehrer fashioned from this material. Note the different colors in this single piece of chalcedony and the eye-visible inclusions.

Massive green grossular garnet from South Africa. At Tucson this past February, Pala International, of Fallbrook, California, offered some exceptional massive green garnets from the Transvaal, South Africa. The color of this material was distinctly brighter and more saturated than that of most massive green garnets that we have seen from this classic locality. The stones they were offering were all cut as oval cabochons, ranging up to about 7 ct. The material is very popular in Asia, no doubt due to its resemblance to fine jadeite, according to Pala International–associate Edward Boehm. However, Pala's Bill Larson indicated that these stones were from an old collection in Germany, not a new source. Only 50 were made available to him.

A 3.31-ct cabochon (figure 3) subsequently examined exhibited the following properties: color—dark, saturated green; diaphaneity—translucent; polariscope reaction—aggregate; spot R.I.—1.74; S.G.—3.60. Examination with a desk-model prism spectroscope revealed a faint absorption line at about 460 nm, a band at 590–610 nm, a fairly sharp line at 630 nm, and another faint line at 670 nm. The stone appeared weak orangy pink when viewed through the Chelsea color filter, and it fluoresced a weak reddish orange to both long- and short-wave U.V. radiation (the short-wave reaction being the stronger of the two), with a strong yellow fluorescence to X-rays. Magnification revealed bands of fluid inclusions and a cloud of small, very dark brown crystals.

The above properties—particularly the relatively high R.I. and S.G.—identified the stone as a massive grossular garnet, not the hydrogrossular type.

"Rainbow" hematite from Brazil. Rock Currier, of Jewel Tunnel Imports in Baldwin Park, California, provided the Gem News editors with samples of an eye-catching iridescent hematite that he has used both for jewelry and as display specimens (figure 4). This fissile (platy) material, called "rainbow hematite," is found in an iron mine near Belo Horizonte, Minas Gerais, Brazil. It fills a very steep, 2+ m (almost 7 ft.) wide vein running about 15 m up a working face in the iron mine, according to Bill Besse, from the same company.

The iridescence is completely natural and appears to be stable to light. Its origin has been researched by Dr. George Rossman of the California Institute of Technology, Pasadena, and by Dr. George Robinson, of the Canadian Museum of Nature in Ottawa. Both detect-

Figure 3. The Transvaal, South Africa, is the reported source of the massive grossular garnet from which this 3.31-ct (9.60 × 6.74 × 5.10 mm) cabochon was fashioned. Courtesy of Pala International; photo by Robert Weldon.

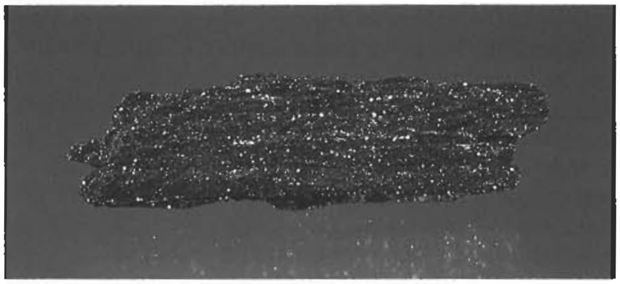

Figure 4. Iridescent hematite, like this 8.73-ct (approximately 35 × 10 mm) specimen, is being recovered in the Belo Horizonte area of Minas Gerais, Brazil. Photo by Maha DeMaggio.

ed a coating, composed of aluminum and phosphorus, on the iridescent surfaces. They hypothesized that this thin film (0.1 micrometer thick in some places) may be responsible for the colorful effect by virtue of an interference phenomenon.

Since the iridescence is confined to this thin film, the surface must be maintained and only the edges worked for jewelry applications.

"Denim" lapis lazuli from Afghanistan. Fine lapis lazuli exhibits a dark, saturated violetish blue color and no white calcite. If pyrite is present, it is in the form of small, dispersed crystals. Such material, associated with the Badakhshan area of Afghanistan, has been readily available in recent years.

This year, however, the editors saw another type of lapis lazuli (figure 5), also reportedly from Afghanistan but with a quite different appearance. This material contained small, medium-to-dark blue areas interspersed with equally small white areas, which produced an overall mottled pale blue appearance. Its resemblance to the color and texture of faded blue denim was not lost on Mahbob Azizi of Liberty Gems and Minerals, Albuquerque, New Mexico, as he was marketing the material as "denim" lapis. Mr. Azizi informed one of the editors (RCK) that the material was being mined in the same general area of Badakhshan that has historically produced lapis lazuli.

Two oval cabochons, 10.39 and 14.02 ct, were purchased for gemological testing. Both were essentially opaque, transmitting only a small amount of light at their edges. Vague spot R.I.'s, obtained at various points on the polished domes of the cabochons, produced values of 1.50 and 1.67, plus a weak "birefringence blink" from about 1.67 to 1.70. The S.G. values (determined hydrostatically) were unexpectedly high—2.98 and 3.02, considering that there was no visual evidence of pyrite. With long-wave U.V. radiation, we noted a mottled fluorescence. The blue areas were inert, and the white areas fluoresced a faint, dull orange. When the samples were exposed to short-wave U.V., the blue areas remained inert, but the white areas fluoresced a moderate greenish yellow. Magnification revealed that the white areas (probably calcite) were interspersed in various combinations with dark blue and lighter greenish blue areas. These areas may be composed of various members of the sodalite group, for example, haüyne, sodalite, nosean, and lazurite, all known components of the complex aggregate gem material called lapis lazuli. Also noted were a few extremely small opaque crystals with a metallic luster, most likely pyrite.

X-ray powder diffraction analyses were performed on minute amounts of material scraped from three areas of one cabochon. All three patterns produced a great number of lines, and we could not conclusively identify any of the individual mineral components. One of the three patterns, however, closely matched one of our standard reference "fingerprint" patterns for lapis lazuli.

Figure 5. This 10.39-ct variegated lapis lazuli cabochon (5.34 × 13.09 × 17.93 mm) from Afghanistan is being marketed as "denim" lapis. Photo by Maha DeMaggio.

Reddish purple mica from New Mexico. Although mica is a common inclusion in gem minerals, it is rarely fashioned for use as a gem material. One exception is pinite, a massive form of muscovite sometimes called agalmatolite (or "Figure Stone") and used as a jade simulant (see, e.g., Gem Trade Lab Notes, Fall 1983, p. 175). At the February Tucson show, however, one of the editors (RCK) spotted the attractive 15.99-ct reddish purple cabochon shown in figure 6. According to Aaron Kuykendall, the material is being recovered in northern New Mexico from a pegmatite that is also rich in white spodumene. Because the material was purple and from a pegmatite, he had tentatively identified it as lepidolite, a lithium-rich mica commonly found in pegmatites in association with such gem materials as tourmaline and spodumene.

Gemological testing of the cabochon revealed: a very vague spot R.I. (due to the poor polish) in the general range 1.55–1.60, an aggregate reaction in the polariscope,

Figure 6. A pegmatite in New Mexico was the source of this 15.99-ct (18.43 × 12.79 × 8.68 mm) mica cabochon. Courtesy of Aaron Kuykendall. Photo by Maha DeMaggio.

a reddish purple appearance through the Chelsea color filter, inert to both long- and short-wave U.V. radiation, a diffused absorption band from about 530 to 580 nm (as seen through a desk-model prism spectroscope), and a 2.85 S.G. (determined hydrostatically). Magnification revealed a pitted surface on a compacted aggregate of micaceous platelets. Also noted was a large, flat break—like the perfect basal cleavage typical of micas.

X-ray powder diffraction analysis revealed a pattern similar to GIA's standard reference patterns for muscovite and pinite. Qualitative analysis by EDXRF revealed a chemical composition consistent with that of micas. Although the chemistry could not help differentiate muscovite from lepidolite, it did reveal the presence of a significant amount of manganese, which could account for the purple color. Because the diffraction pattern did not exactly match that of muscovite, we characterized this material simply as mica.

Nepal update. Gemologist Mark H. Smith of Bangkok, Thailand, reports that on a recent trip to Nepal he was shown numerous local gem materials. Most abundant were specimen-quality, gem-quality, and fashioned elbaite tourmalines, represented as originating from a number of different deposits within Nepal. Large, fine mineral specimens of dravite tourmaline were offered as well. Translucent pink-to-purple corundum was available from mines located at elevations of 3,000–4,500 m (about 10,000–15,000 ft.) above sea level in the Ganesh Himal region. Mr. Smith also saw beryl crystals, some faceted aquamarine, fine blue kyanite crystals, and large quantities of quartz crystals.

Peridot from Vietnam. While visiting the Research Center for Industrial Mineralogy at Hanoi University in November 1992, *Gems & Gemology* Editor Alice S. Keller and one of the Gem News editors (RCK) were shown samples of materials, found throughout Vietnam, that university staff members thought might have commercial gem potential. Among these were what we estimated to be many hundreds of carats of peridot rough.

In July 1993, the Gem News editors learned more about Vietnamese peridot from Saverio Repetto of the Gemological Institute of Vietnam, a joint-venture firm located in Hanoi. According to Mr. Repetto, two deposits were discovered in mid-1993: (1) in Lam Dong Province, southern Vietnam; and (2) in Gia Lai Province, central Vietnam, near the Cambodian border. In their first few weeks of operation, the two localities produced an estimated 100–200 kg of peridot. Production dropped off greatly in August, however, because of the onset of the rainy season.

Mr. Repetto has seen about 60 kg of the peridots from Gia Lai. He described them as averaging about 2–6 ct, with perhaps no more than 5% being larger than 4 ct. The average quality is rather poor, however, as the stones are highly fractured and included, as well as light in color. He estimated that about 15% are suitable for fashioning, with the weight retention being only 5%–10%. Although he has seen significantly less of the Lam Dong material, the rough he has examined to date has generally been of better quality. From the Lam Dong rough, his firm has cut stones up to 7 ct.

Mr. Repetto sent the Gem News editors five faceted Lam Dong peridots (1.60 to 5.56 ct; figure 7) for examination. These transparent stones ranged from yellowish green to brownish green, in medium light to medium dark tones. We measured R.I.'s of $\alpha = 1.650$, $\beta = 1.665–1.667$, $\gamma = 1.687–1.688$, with resulting birefringence

Figure 7. Lam Dong Province in southern Vietnam is the source of these peridots, which range from 1.60 to 5.56 ct. Courtesy of the Gemological Institute of Vietnam; photo by Maha DeMaggio.

Figure 8. "Lily pad" inclusions like these were seen in all of the Vietnamese peridots shown in figure 7. Photomicrograph by John I. Koivula; magnified 35×.

of 0.037–0.038. S.G. values (determined hydrostatically) ranged from 3.33 to 3.35. With a desk-model prism spectroscope, we saw absorption bands typical of peridot, at approximately 453, 473, and 493 nm. Magnification revealed small, white pinpoint inclusions in association with "lily pads" (figure 8); wispy, whitish planar clouds; partially healed fractures; and occasional dark reddish brown to black crystals that may be chromite or chromian spinel. EDXRF analysis of one specimen indicated the presence of magnesium, iron, and silicon—essential components of peridot—as well as nickel, chromium, manganese, and calcium. These data are consistent with those for peridot from other localities.

Brazilian paragonite mistaken for ruby. Among the more unusual materials seen by one of the editors (RCK) this year was a piece of variegated rough with a dark purplish red core that bore a superficial resemblance to both ruby in zoisite from Tanzania and the pink-purple sapphire in fuchsite from Afghanistan (see, e.g., Gem News, Summer 1991, p. 120). This newest material, reportedly from Brazil, was believed by the vendor to be ruby.

The vendor gave us a 27.75-ct unpolished slab (figure 9) for gemological examination. Testing of the translucent purplish red core revealed: a faint weak red reaction through the Chelsea color filter; a weak red fluorescence to long-wave U.V. radiation (with a similar but slightly weaker reaction to short-wave U.V.); and a visible absorption spectrum consisting of general absorption from about 400 to 480 nm, a band from about 520 to 610 nm, and a series of four fine lines between about 660 and 690 nm. X-ray powder diffraction analysis produced a match with a standard pattern for paragonite—$NaAl_2(Si_3Al)O_{10}(OH)_2$—a member of the mica group; EDXRF analysis supported this identification. These two tests also confirmed that the pale greenish blue layer surrounding the red core was paragonite, too. This is another example of a mica with commercial potential as a gem material (see "reddish purple mica" entry above).

Unusual double star sapphire. Last spring, N-Ter-National Gems of Oklahoma City, Oklahoma, brought to our attention a 38.56-ct translucent, grayish blue sapphire with unusual asterism: two superimposed six-rayed stars, with the rays of one star almost parallel to and just to the side of the other (figure 10).

Magnification revealed that the "silk" that produced the asterism, most likely exsolved rutile, was rather evenly distributed throughout; lamellar polysynthetic twinning, pervasive throughout the stone, was the cause of the unusual effect. The three sets of these needle-like inclusions in one of the orientations of lamellae were not quite parallel to those in the second set of lamellae, so that the rays they produced by light scattering were also not quite parallel. This resulted in two complete, but slightly offset, six-rayed stars when the stone was illuminated with a single point light source.

Black spinel from Mexico. Gray and black gems appear to have regained popularity in recent years. The editors recently obtained a 0.87-ct black faceted material that the dealer, Sri Lanka–based Sally Gems, represented as spinel from Mexico. The stone had a high luster and was opaque throughout; even the thin edges did not transmit the intense light from a fiber-optic illuminator. Both the R.I. of 1.765 and S.G. (determined hydrostatically) of 3.93 were significantly above the mean values for spinel (1.718 and 3.57–3.70, respectively). The stone was inert to both long- and short-wave U.V. radiation, and it had

Figure 9. The purplish red core and greenish blue rim of this specimen (approximately 29.3 × 24.4 × 3.49 mm), which is reportedly from Brazil, are the mica paragonite. Photo by Maha DeMaggio.

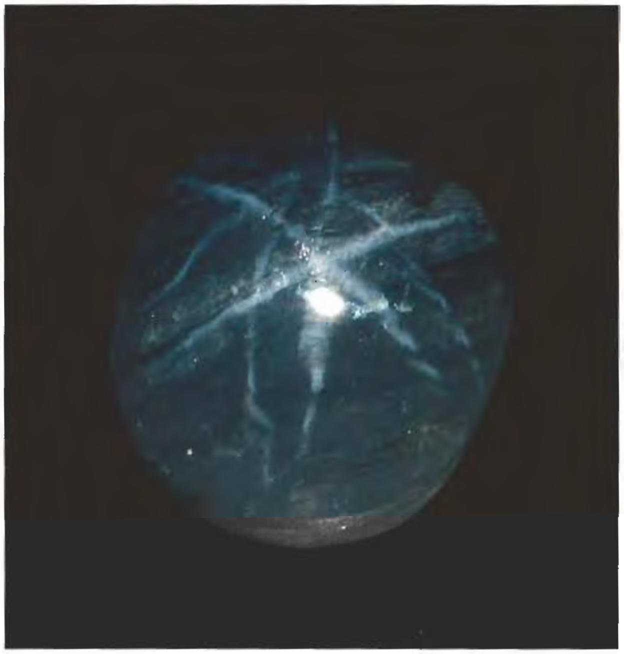

Figure 10. Two distinct, overlapping six-rayed stars can be seen in this 38.56-ct sapphire. Photo by Maha DeMaggio.

no change of appearance through the Chelsea color filter. Examination with a desk-model spectroscope revealed no distinct absorption features.

EDXRF analysis identified magnesium and aluminum in proportions similar to natural spinel, with abundant iron and impurities of titanium, vanadium, chromium, manganese, and zinc. X-ray diffraction analysis showed a standard pattern for hercynite ($FeAl_2O_4$), a member of the spinel group that has a structure similar to that of the spinel species ($MgAl_2O_4$) but a different chemical composition. However, the properties of this stone do not match those reported in the literature for hercynite, that is, R.I. of 1.835 and S.G. of 4.40 (see J. Arem, *Color Encyclopedia of Gems,* second edition, 1987, p. 177).

On the basis of the R.I. and S.G. values measured, we concluded that the material under study is probably a mixture of true spinel and hercynite, approximately halfway between the two species. These properties are, in fact, very close to the material called ceylonite in the gem trade, or pleonaste (R.I.—1.77 to 1.80, S.G.—3.63 to 3.90; again, see Arem, 1987), which is a mixture of both species. According to the *Larousse Encyclopedia of Precious Gems* (P. Bariand and J. -P. Poirot, 1992, p. 178), this black iron-rich spinel is abundant in the gem-bearing gravels of Sri Lanka.

Spinel from Vietnam. Spinel is often found with corundum, for example, in the gem deposits of Sri Lanka and Myanmar (formerly Burma). The corundum deposits of Vietnam are no exception. In fact, gemologist Kenneth Scarratt, who has made a number of trips to the ruby-producing areas of northern Vietnam, was told by a knowledgeable Vietnamese colleague that the discovery of gem spinel in Vietnam (1984) predates the discovery of ruby. Today, significant quantities of spinel—in a broad range of colors and sizes—can be seen in local Vietnamese gem markets, such as the Luc Yen market shown in figure 11.

Saverio Repetto, of the Gemological Institute of Vietnam subsequently loaned one of the Gem News editors (RCK) 11 faceted Vietnamese spinels (0.36 to 4.30 ct) for examination. These stones represented a range of colors, including orangy red to purple, orangy pink to purplish pink, and violet to blue (see, e.g., figure 12). Gemological testing revealed properties consistent with those reported in the literature for spinels, including R.I.'s of 1.714–1.719, an S.G. range (determined hydro-

Figure 11. Spinel is one of the local materials sold at the government gem market at Luc Yen, in northern Vietnam. Photo by Robert C. Kammerling.

Figure 12. These five spinels (1.21–4.30 ct) were fashioned from rough recovered from the same deposits in northern Vietnam that produce rubies. Courtesy of the Gemological Institute of Vietnam; photo by Maha DeMaggio.

statically) of 3.59–3.63, and weak to moderate anomalous birefringence when examined between crossed polarizers. When exposed to long-wave U.V. radiation, the stones that were predominantly red or pink fluoresced a weak to moderate red, and those with more of a purple component exhibited a weaker reaction or were inert. Short-wave reactions were similar in color but of lesser intensity. The blue stones were inert to both wavelengths. Most of the stones with a pink to red component in their body color revealed the "organ pipe" fluorescence spectrum (as described by B. W. Anderson for red spinel) when examined with a desk-model spectroscope. The blue stones displayed spectral features that are attributed to iron.

Magnification revealed internal features that have been noted in spinels from various localities. On the basis of their appearance, these inclusions were tentatively identified as: hexagonal platelets of muscovite mica; apatite crystals; zircons with radiation-induced strain halos; small, black opaque graphite crystals; secondary healing planes, i.e., "fingerprint" inclusions; bundles of parallel and intersecting fine rutile "silk;" decorated intergrowths; and ribbon-like stepped growth planes.

ENHANCEMENTS

World Diamond Congress addresses treatments. The topic of diamond treatments and their disclosure was the focus at the World Diamond Congress this past June in Antwerp, where it was debated by both the International Diamond Manufacturers Association (IDMA) and the World Federation of Diamond Bourses (WFDB). A resolution passed by the latter reinforced and expanded a previous pronouncement on the topic. It reads:

1. The fact that diamonds have been artificially infused with foreign matter, or are coated, or are wholly or partially synthetic, or have been treated by irradiation, must be disclosed as such when offered for sale and in writing on the invoice and memorandum. Any breach of the above rules by a member of an affiliated Bourse shall be regarded as fraudulent.
2. Any violation of the above rule shall be referred to the Bourse for disciplinary action and shall be grounds for suspension, expulsion, fine or such other appropriate disciplinary measure as provided by the by-laws of the Bourse. If the seller alleges that he was not aware of any treatment, he shall bear the burden of proof thereof in order to avoid any sanction.
3. If the seller of a diamond, even in good faith, fails to abide by the above rule, the buyer shall be entitled to cancel the sale, return the diamond, obtain a refund of the purchase price and any direct damage as they, the buyer, may have suffered.

It is particularly interesting that this resolution addresses disclosure not only of such enhancements as fracture filling and irradiation, but also of synthetic diamonds; the wording "wholly or partially synthetic" apparently refers to the possibility of a synthetic diamond thin-film coating on natural diamond, an experimental example of which was described in a Summer 1991 Gem News report. (*Diamond Intelligence Briefs*, June 30, 1993, p. 1009)

Update on ruby enhancement. The Fall 1992 Gem News section (pp. 206–207) contained information from Juan S. Cozar, laboratory director for the Spanish Gemological Institute in Madrid, about what might be a new ruby enhancement, somewhat similar to the glass filling of surface cavities in fashioned corundums.

In response to that entry, Dr. Henry A. Hänni, of SSEF Swiss Gemmological Institute in Zurich, told us of a very similar enhancement that he had encountered in May 1985 in a 9.00-ct East African ruby cabochon. Dr. Hänni reported that he had observed octahedra in the glassy surface layer of a shallow pit on the base of the cabochon. Microprobe analyses of the "glass" and octahedra revealed that the "glass" surrounding the octahedra had the approximate composition of zoisite, while the octahedra had the composition of spinel. A third analysis, taken around the rim of the pit, identified a glass enriched with alumina and calcium oxide. These findings were published the following year in *Zeitschrift der Deutschen Gemmologischen Gesellschaft* (Vol. 35, No. 3/4, pp. 87–96).

On the basis of this research, Dr. Hänni identified the three components found in and around the pit in the ruby cabochon as artificial glass, zoisite, and spinel, the latter two resulting from residual original minerals adhering as devitrification minerals of the glass coating. Since carrying out this examination, however, Dr. Hänni has examined other treated rubies that show microscopic evidence of heat treatment, devitrification, and recrystal-

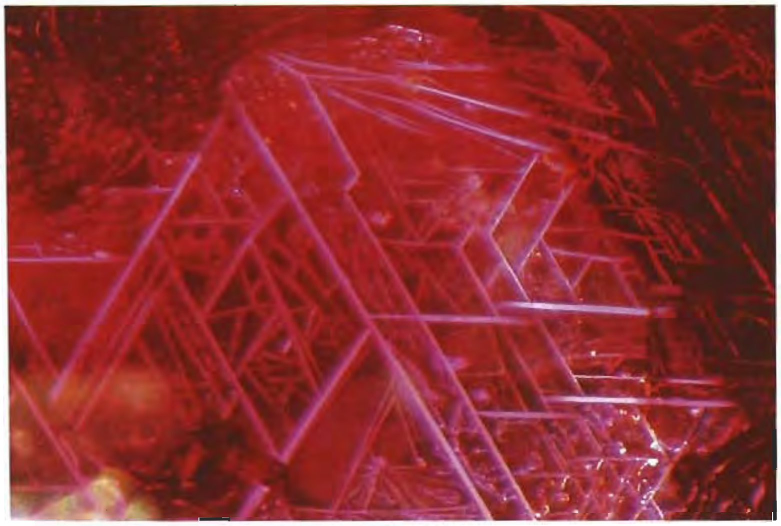

Figure 13. Evidence of recrystallization can be seen in a glass-filled fracture in this treated ruby. Photomicrograph by Dr. H.A. Hänni, courtesy of SSEF Swiss Gemmological Institute; magnified 50×.

lization (see, e.g., figure 13). He theorizes that not every such glassy filling is produced intentionally to fill surface pits and cracks. Rather, corundum is often coated with boron or fluorine compounds to protect the stones during routine heat treatment. As these coatings melt, they can act as a flux, dissolving alumina and other chemicals from the host corundum, and then crystallizing them in pits and surface-reaching fractures.

SYNTHETICS AND SIMULANTS

Glass imitating Vietnamese ruby. Numerous reports in the trade press have discussed episodes of synthetic ruby being misrepresented as natural ruby rough from Vietnam. We recently learned of another unfortunate incident. In this case, the individual purchased a parcel of five "badly waterworn stones" at a mine site in Vietnam; when he subsequently had them tested in the United States, he learned that four of the five were actually flame-fusion synthetic ruby—and the fifth was identified as glass.

The glass specimen was loaned to the editors for examination. It was a very convincing, medium dark purplish red (figure 14), and revealed the following properties: a 1.649 R.I.; a 3.84 S.G.; anomalous double refraction ("strain birefringence") in the polariscope; a red appearance through the Chelsea color filter; inert to long-wave U.V. radiation and a weak, chalky blue fluorescence to short-wave U.V. Magnification revealed two wedge-shaped layers of spherical gas bubbles. Perhaps most interesting gemologically was the absorption spectrum, which included many distinct lines throughout the visible range, with two relatively broader, but still distinct, lines between 570 and 590 nm.

Because of the convincing color and the interesting "rare-earth" type of spectrum, chemical analysis by EDXRF was performed. Among the elements detected were neodymium and lead, which suggests that the material is a lead glass with neodymium producing the ruby-like color.

Dyed magnesite misrepresented as "howlite lapis." Howlite is a mineral species that is usually encountered in its massive form and is occasionally seen in its natural, opaque white color as fashioned beads and cabochons. Because of its neutral body color and porosity, however, it also may be dyed to imitate various other ornamental gems, commonly turquoise.

At a recent gem and mineral show, one of the editors (RCK) spotted some large violetish blue cabochons that were labeled "howlite lapis." The material made a rather convincing imitation of lapis lazuli, as it contained white, dye-resistant veining that resembled the calcite seen in some natural lapis.

A sample was purchased for examination (figure 15). Gemological testing, however, quickly revealed properties inconsistent with those of howlite, including a "birefringence blink," which indicates a high birefringence typical of carbonate minerals. Further testing, including X-ray diffraction analysis, identified the material as magnesite. The presence of dye was confirmed when an acetone-dipped cotton swab produced a blue discoloration when rubbed on the stone. In fact, the dye treatment was so unstable that some of the color was removed by the contact liquid during R.I. testing. Subsequent experimentation showed that even a mild soap solution removed some of the dye.

Figure 14. This convincing 6.41-ct imitation of a waterworn ruby crystal (here with optical flats cut to facilitate testing) was identified as neodymium-doped lead glass. Photo by Maha DeMaggio.

Figure 16. When examined at one orientation, this 24.10-ct synthetic quartz crystal appears a uniform blue (left). Turned 90°, the specimen is seen to consist of synthetic colorless quartz grown on a blue seed crystal wafer (right). Photos by Maha DeMaggio.

Unusual synthetic blue quartz. One pleasure in attending a gem show is discovering the unexpected gemological curiosity. While looking through a dealer's collection of synthetic quartz specimens at one show, one of the editors (RCK) spotted what at first appeared to be an evenly colored light blue crystal (figure 16, left). When examined from the side, however, the true nature of the piece became apparent: Colorless synthetic quartz had been grown on a medium dark blue seed-crystal wafer (figure 16, right). The orientation of the crystal faces was such that the color from the seed crystal was reflected, an effect identical to that seen in synthetic spinel triplets and other assembled stones. Examination of the seed crystal with a desk-model spectroscope revealed the "cobalt" absorption bands that are characteristic of blue synthetic quartz.

Imitation gems from Zaire. Gordon T. Austin, Gemstone Commodity Specialist for the United States Bureau of Mines, has advised the Gem News editors that glass imitations of emerald are still being offered for sale in Africa. While traveling in Zaire, an individual was invited to purchase what was described as a "very fine quality Zambian emerald" (figure 17) for a modest price that negotiations eventually lowered to one-fifth of the original quote.

Figure 15. This 19.41-ct cabochon of dyed magnesite, offered as "howlite lapis," is a rather convincing imitation of lapis lazuli. Photo by Maha DeMaggio.

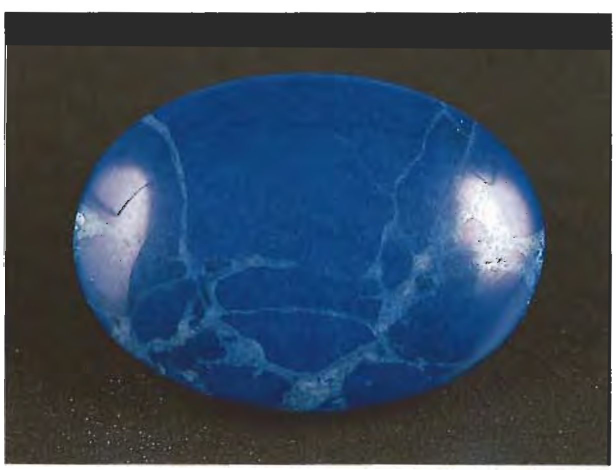

Figure 17. This 33.49-ct (22.89 × 17.38 × 12.19 mm) glass imitation was misrepresented as a Zambian emerald in neighboring Zaire. Courtesy of Gordon T. Austin; photo by Maha DeMaggio.

Subsequent examination by the Gem News editors revealed that the 33.49-ct "emerald" consisted of green glass with a glued-on matrix of pulverized orangy brown limonite and biotite flakes. Microscopic examination of this imitation revealed many spherical gas bubbles.

Mr. Austin informed us that another item purchased at the same time and represented as top-quality ruby was subsequently determined to be cuprite, a dark red copper mineral from Zaire.

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