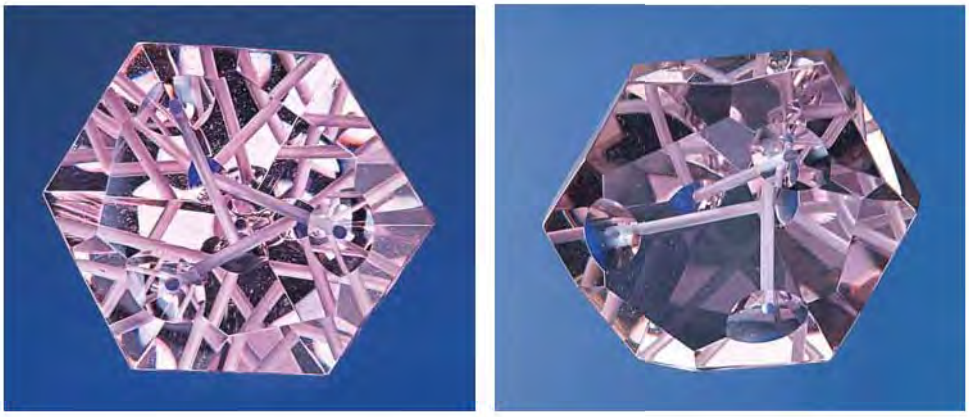


Figure 6. Careful arrangement of facets and tubes in this 89.40 ct carved Nigerian tourmaline produces a clever optical illusion. In the face-up view (left), facet reflections create the appearance of dozens of internal tubes; from the back (right), the true nature of the carving—a mere three tubes—is seen. Courtesy of Michael Dyber; photos by Maha Tannous.

the reported discoveries have been morganite/aquamarine or a combination of colorless beryl (goshenite) with another variety. Aquamarine/green beryl and green beryl/heliodor combinations such as those from the São João mine appear to be considerably rarer. Rains in 2000 collapsed some of the tunnels, but Mr. Elawar reported that there have been recent attempts to reopen this mine, so more of this material may become available in the future.

Also on display at Mr. Dyber's booth was a carving he called "Pink Snowflake," an 89.40 ct Nigerian tourmaline that showed a remarkable optic effect. Viewed through the table (figure 6, left), this carving created a snowflake-like illusion of numerous small tubes intersecting throughout the piece. When viewed from the back (figure 6, right), the true nature became apparent: Only three 1-mm wide tubes had been drilled into the stone, and careful alignment of the tubes and facets created the illusion of many more. The even dimensions and frosted polish of the tubes, called "Luminaires" (see Spring 1999 Gem News, pp. 57–58) were achieved through a proprietary process that Mr. Dyber developed after years of research and experimentation.

Thomas W. Overton

A new saturated purplish pink Cs-"beryl" from Madagascar: Preliminary analyses. One of the most exciting materials to debut at Tucson this year was deep purplish pink "beryl" from a new find in Madagascar. In addition to its color, this material was particularly interesting because it showed anomalous properties for beryl (e.g., higher refractive indices than previously known), which were attributed to very high concentrations of cesium (Cs). The primary suppliers were Polychrome (Laurent Thomas, Chambray-les-Tours, France), Le Minéral Brut (Denis Gravier and Fabrice Danet, Saint-Jean-le-Vieux, France), and MJ3 Inc. (Marc Jobin, New York). The material was sold as "red beryl," "raspberyl," and "hot pink-red beryl." Combined, these dealers had about 5 kg of rough and a small number of faceted stones and cabochons at Tucson, although additional pieces were cut during the show. The largest supplier of rough was Mr.

Figure 7. In mid-November 2002, an usual Cs-"beryl" showing a deep purplish pink color was found at this mine, located near the village of Mandrosonoro in central Madagascar. The underground workings are located to the lower left of the photo. Photo by Laurent Thomas.

Thomas, who had approximately 0.5 kg for cutting faceted gemstones or cat's-eye cabochons, 2 kg that were carving quality, and 1 kg of crystal specimens. The material is referred to here as "beryl" in quotation marks, because work is still in progress to determine its mineralogical identity (see below).

GIA was first notified about this unusual new material by Tom Cushman (Allerton Cushman & Co., Sun Valley, Idaho), who obtained a crystal during a buying trip to Madagascar in December 2002 and subsequently donated it for research. According to Dr. Federico Pezzotta (Natural History Museum, Milan, Italy) and Mr. Thomas, both of whom were in Madagascar during the discovery, the deep pink "beryl" was mined in mid-November 2002 from a pegmatite located a few kilometers south of the village of Mandrosonoro, which is 140 km by dirt road west of Ambatofinandrahana in central Madagascar (figure 7). Mr. Thomas visited the mine soon after the pocket was discovered, but he had to flee the area when he drew gunfire. It is not surprising that foreigners are not welcome there, since Mandrosonoro is considered to be among the most dangerous areas in Madagascar.

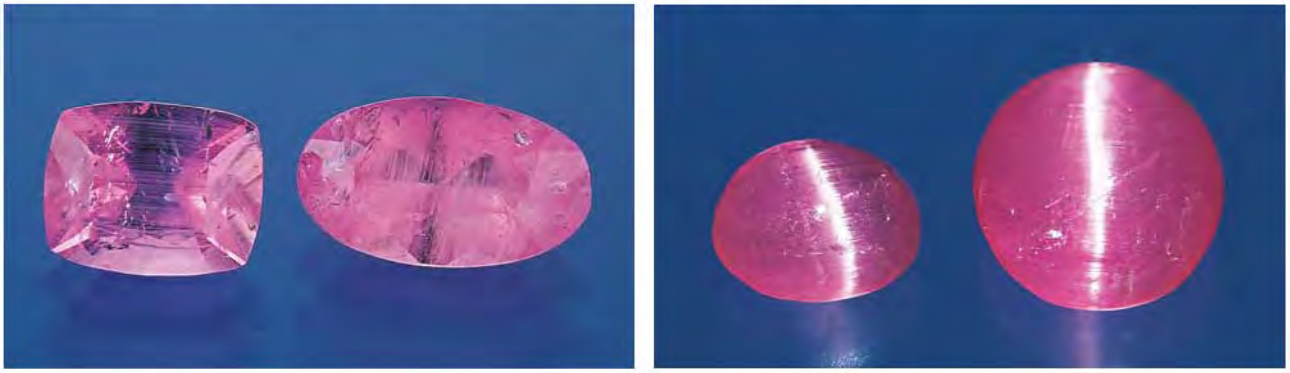
The almost vertical pegmatite, which measures about 4–6 m thick and over 200 m long, was originally explored by French colonists for tourmaline. Recent mining by local people resulted in the discovery of the pink "beryl" about 6 m below the surface. It was recovered from a single large pocket containing mostly smoky quartz, multicolored tourmaline, and pink or yellow-green spodumene; amazonite, cleavelandite (albite), lepidolite, and danburite also were found in this pocket.

The "beryl" has been seen to occur in three different morphologies: (1) large flattened masses (up to 8 cm in diameter) of irregular shape that grew interstitially to other minerals in the pocket; (2) well-formed tabular hexagonal crystals up to 6–7 cm in diameter, occasionally in aggregates (figure 8); and (3) euhedral, small (up to a few millimeters in diameter), tabular-to-elongate crystals on the faces of large tourmaline crystals. The unusual elongate crystals formed by parallel intergrowth of numerous tabular crystals.

Figure 8. Well-formed tabular crystals and aggregates of pink Cs-"beryl" (here, up to 3 cm) created excitement at the 2003 Tucson gem shows. Courtesy of Stuart Wilensky and Irv Brown; photo © Jeff Scovil.

According to Dr. Pezzotta, the production of deep pink "beryl" amounted to 40 kg of crystals and fragments of variable quality, and many tens of kilograms of low-quality fragments and deeply corroded crystals. Gemmy portions in crystals are rare and very limited in size, so faceted stones are typically small and/or contain eye-visible inclusions (figure 9, left). Some of the material is of carving quality, and a small proportion contains microscopic tubes parallel to the c-axis in sufficient abundance to yield attractive chatoyant gems (figure 9, right). The color is similar to pink tourmaline, and in fact one piece of tourmaline was discovered in a parcel of samples that GIA obtained for research.

Figure 9. Faceted examples of the Cs-"beryl" are uncommon, since much of the rough is heavily included. The samples on the left (0.89–1.02 ct, courtesy of Mark Kaufman) show characteristic growth tubes, fractures, and fluid inclusions. The cabochons on the right show attractive chatoyancy; they are courtesy of Mark Kaufman (1.84 ct) and Herb Obodda (4.11 ct). Photos by Maha Tannous.



Six samples were gemologically characterized by contributors SFM and EPQ: two faceted stones (0.89 and 1.02 ct), two cat's-eye cabochons (1.84 and 4.11 ct), one crystal specimen (7.5 grams), and one partially polished crystal fragment (1.64 ct). The properties are reported in table 1. The R.I. and S.G. values are significantly higher than those reported for morganite (e.g., n_o=1.578–1.600, n_e=1.572–1.592, and S.G.= 2.80–2.90; R. Webster, *Gems*, 5th ed., revised by P. Read, Butterworth-Heinemann, Oxford, England, 1994, p. 128), as well as other beryl varieties. In addition, morganite has no characteristic absorption spectrum (Webster, 1994). Although the dealers who supplied the samples were not aware of any clarity enhancement, all samples showed fractures of low relief, some of which contained air bubbles that contracted when exposed to a thermal reaction tester, indicating the presence of a filling substance. Subsequently we learned from Dudley Blauwet (Dudley Blauwet Gems, Louisville, Colorado) that all of the purplish pink "beryl" rough he had purchased was oiled by the local Madagascar dealers. He reported that the oiling enables them to see into the rough more easily (because of the slight etching on most of the crystal surfaces), and it appears to be done with mineral oil that is manually applied rather than pressure injected.

On a separate crystal (5 mm in diameter; figure 10) that was donated by Mr. Thomas to the University of New Orleans, WBS obtained refractive indices of n_o=1.616 and n_e=1.608 by immersion in Cargille oils (in white light, Na corrected). A measured density of 2.97 was obtained with a Berman density balance, and a calculated density of 3.012 was obtained using unit-cell dimensions (from powder X-ray diffraction analysis) and the average chemical composition of the core (from electron microprobe analysis; see below). The relatively low density of this sample, compared to those examined above, is probably due to the presence of numerous fluid inclusions.

Preliminary chemical analyses of two samples with energy-dispersive spectrometry (performed by Dr. Alessandro Guastoni of the Natural History Museum, Milan) revealed high concentrations of Cs, with the strongest enrichment in the rims of the crystals. Quantitative chemical analysis with an electron microprobe at the University of New Orleans was performed by WBS and AUF on the 5-mm-diameter crystal mentioned above. This sample had a purplish pink core and a pale pinkish orange rim that were separated by a sharp boundary (again, see figure 10). Several point analyses of a slice taken perpendicular to the c-axis revealed an average of 13.57 wt.% Cs_2O in the core and 15.33 wt.% Cs_2O in the rim (table 2). This is significantly more Cs than previously reported in beryl (11.3 wt.% Cs_2O in morganite from Antsirabe, Madagascar; see H. T. Evans and M. E. Mrose, "Crystal chemical studies of cesium beryl," *Program & Abstracts*, Geological Society of America Annual Meeting, San Francisco, 1966, p. 63). Minor amounts of Rb, Na, and K also were detected. Inductively coupled plasma (ICP) analysis of a portion of the crystal showed 2.16 wt.% Li_2O. The water content, obtained by the LOI (loss on ignition) method, is 1.72 wt.%. Some of the water, as well as the 0.30 wt.% B_2O_3 measured by ICP, is attributed to the presence of abundant fluid inclusions.

Structural refinement of four samples by FCH showed that the Cs resides (and is dominant) in the 2a site in the channel of the mineral's structure. Cs substitutes for a vacancy in the channel, and electroneutrality is maintained by an accompanying substitution of Li for Be at the tetrahedrally coordinated beryllium site. Minor Na occupies the 2b channel site. The end-member composition could therefore be represented as $Cs[Be_2Li]Al_2Si_6O_{18}$. As such, this interesting gem material has been submitted to the International Mineralogical Association as a new mineral of the beryl group (along with beryl, bazzite, and stoppaniite).

Vis-NIR spectroscopy by GRR showed bands centered at 494 and 563 nm when the beam was polarized perpendicular to the c-axis (figure 11). The maximum transmission was seen near 630 nm (orangy red) and 400 nm (deep violet), which provided the pink-orange color in this direction. When the polarization was parallel to the c-axis, the spectrum was dominated by a band centered at 572 nm. Transmissions in the red and blue-to-violet regions of the spectrum combined to produce the purplish pink color for light polarized in this direction. These absorption characteristics are consistent with Mn^{3+} and are similar to the spectra of pink beryls that have been interpreted in terms of Mn^{3+} (see A. N. Platonov et al., "On two colour types of Mn^{3+}-bearing beryls," *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, Vol. 38, 1989, pp. 147–154).

TABLE 1. Properties of six samples of purplish pink Cs-"beryl" from Madagascar.

Property	Description
Color	Purplish pink with moderate dichroism: pink-orange (ω ray) and purplish pink to pinkish purple (ε ray)
R.I.	n_o=1.616–1.617, n_e=1.608; spot reading = 1.61 (cabochons)
Birefringence	0.008–0.009
Optic character	Uniaxial negative, with two samples showing anomalous biaxial optics, possibly due to strain
S.G.	3.04–3.14, with most values near 3.10
Chelsea filter reaction	Orangy pink to pink
UV fluorescence	Inert to long- and short-wave UV radiation
Absorption spectra	With the desk-model spectroscope, all samples showed an absorption band at approximately 485–500 nm, and five samples showed weak lines at 465 and 477 nm and a weak band at 550–580 nm
Internal features	Growth tubes, fractures, "fingerprints," and fluid inclusions; two samples contained low-relief, birefringent inclusions

In heating experiments by GRR, crystal fragments heated at 250°C and 350°C for two hours maintained their color. A fragment heated at 450°C for 2 hours suffered near total loss of color. The sample regained nearly all its pink color upon irradiation with 6 megarads of Cs-137 gamma rays. This sensitivity to heating and irradiation suggests that the color is caused by radiation-induced color centers involving Mn^{3+}. However, the color and optical spectrum of the new Cs-"beryl" are different from those of the red beryl from Utah, which is also colored by Mn^{3+} (Platonov et al., 1989).

Raman spectrometry of the Cs-"beryl" showed shifts in some peak positions and intensities when compared to morganite and near-colorless beryl from Brazil. Likewise, some of the bands in the infrared spectrum were shifted in comparison to morganite and near-colorless beryl. The powder X-ray diffraction pattern was unique, with missing peaks and slight shifts in peak positions, as compared to the beryl pattern. Evans and Mrose (1966) also documented intensity differences in the X-ray diffraction patterns of Cs-rich beryl. Likewise, Cs has been shown to increase R.I. values (P. Černý and F. C. Hawthorne, "Refractive indices versus alkali contents in beryl: General limitations and applications to some pegmatitic types," *Canadian Mineralogist*, Vol. 14, 1976, pp. 491–497). Since Cs is a relatively heavy element, high concentrations of it would also be expected to increase S.G. values, as recorded in the samples we examined. Further information on this Cs-"beryl" is being prepared by these researchers for publication in the mineralogical and gemological literature.

TABLE 2. Chemical analyses of a Cs-"beryl" from Mandrosonoro, Madagascar, with a purplish pink core and a pale pinkish orange rim.[a]

Chemical composition	Core	Rim
Oxide (wt.%)		
SiO_2	56.52	55.99
Al_2O_3	15.60	15.68
Sc_2O_3	0.03	0.03
BeO calc	8.05	7.99
MnO	0.09	0.06
Li_2O[a]	*2.16*	*2.16*
Na_2O	0.52	0.46
K_2O	0.15	0.03
Rb_2O	0.76	0.68
Cs_2O	13.57	15.33
H_2O[a]	*1.72*	*1.72*
Total	99.17	100.13
Ions[b]		
Si	6.050	6.024
Al	1.968	1.988
Sc	0.003	0.003
Be	2.070	2.065
Mn	0.008	0.006
Li	0.930	0.935
Na	0.107	0.097
K	0.021	0.004
Rb	0.052	0.047
Cs	0.619	0.703

[a] *Except for Li and H_2O (one bulk analysis each, by ICP and LOI, respectively), data represent averages of nine analyses of the core and eight analyses of the rim, by electron microprobe. Below detection limits (in wt.%) were TiO_2 (0.002), FeO (0.02), MgO (0.01), and CaO (0.07).*

[b] *Calculated per 18 oxygens (water excluded, Be+Li=3).*

Figure 10. This crystal of Cs-"beryl" displays a pale pinkish orange overgrowth over a purplish pink core. Electron-microprobe analyses showed slightly more Cs in the rim. Courtesy of Laurent Thomas; photo by W. Simmons.

Figure 11. Vis-NIR spectra of a 5.08-mm-thick slice of Cs-"beryl" were dominated by bands centered at 494 and 563 nm when polarized perpendicular (⊥) to the c-axis, and a band centered at 572 nm when polarized parallel (∥) to c. The difference in these absorptions accounts for the moderate dichroism in purplish pink (ε ray) and pink-orange (ω ray).

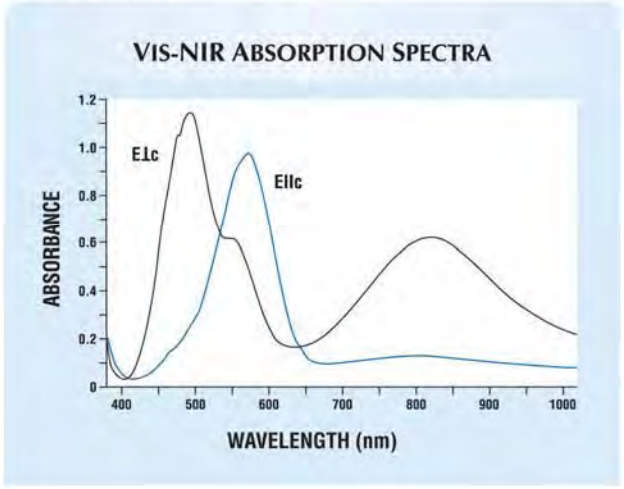


Figure 12. Bill Larson (left) and Nicolai Kuznetsov examine some of the demantoid rough that was recently recovered from the Kladovka mine in Russia's Ural Mountains. Photo © Jeff Scovil.

Figure 13. These rough nodules (up to 4+ grams) and faceted stones (3.31 and 4.21 ct) show the range of color of demantoid from the Kladovka mine. Photo © Jeff Scovil.

Acknowledgments: The contributors thank the following for loaning and/or donating research specimens: Mark Kaufman, Kaufman Enterprises, San Diego; Dudley Blauwet; Laurent Thomas; Denis Gravier and Fabrice Danet; Tom Cushman; Alain Andrianjafy, Antananarivo, Madagascar; Marc Jobin; Herb Obodda, H. Obodda, Short Hills, New Jersey; Stuart Wilensky, Stuart and Donna Wilensky Fine Minerals, Wurtsboro, New York; and Irv Brown, Irv Brown Fine Minerals, Fallbrook, California.

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BML

A new find of demantoid at a historic site in Kladovka, Russia. At the AGTA show, Bill Larson of Pala International, Fallbrook, California, had large quantities of rough and fine cut demantoid garnets from a recently rediscovered primary deposit in the historic Sissertsk district in the Ural Mountains (figure 12). The Kladovka mine is located about 10 km from the city of Kladovka, which is a two-hour drive south of Ekaterinburg. In the past, primary deposits in this area produced mostly mineral specimens, while nearby placers yielded significant amounts of gem rough (W. R. Phillips and A. S. Talantsev, "Russian demantoid, czar of the garnet family," Summer 1996 *Gems & Gemology*, pp. 100–111).

Mr. Larson and his partner, Nicolai Kuznetsov of Moscow-based Stone Flower Co., helped fund an Ekaterinburg team of prospectors who began exploring the area in May 2002 after researching the historic localities of this czarist gem, first discovered in Russia in the mid-19th century. By July 2002, the prospectors were on the verge of abandoning their search in the heavily forested area when they rediscovered an old mining pit and exposed a "vein" containing demantoid. The garnets formed rounded nodules and aggregates along this vertical horizon in the sheared serpentinite host rock, which varied from a few centimeters up to 50 cm wide.

According to Mr. Larson, Pala International has obtained 8.3 kg of rough of variable color, from yellowish or brownish green to bright green. Approximately 600 grams is of top cutting grade. A significant portion will cut stones exceeding 1 ct each; however, gems over three carats (see, e.g., figure 13) are very rare. The largest gem faceted so far weighed 6.71 ct. "Horsetail" inclusions are present in some of the material.