



Figure 9. This necklace is set with two bicolored beryls (38 ct total weight) from the Erongo Mountains. Courtesy of Gudrun Bellwinkel, African Art Jewellers, Swakopmund, Namibia.

rescence—green portion = inert, and blue portion = inert to short-wave and very weak green to long-wave UV radiation. A weak line at 427 nm was seen in both color portions with the desk-model spectroscope. These properties are consistent with those reported for aquamarine by M. O'Donoghue (*Gems*, 6th ed., Butterworth-Heinemann, Oxford, England, 2006, pp. 162–164), except that the refractive index values in that publication are slightly higher (1.572–1.590) than those recorded for the blue portion of

Figure 10. This bicolored beryl (2.9 cm tall) from the Erongo Mountains shows bluish green and brownish orange coloration. Juergen Tron collection; photo © Jeff Scovil.



this sample. Microscopic examination revealed numerous fractures and two-phase (fluid-gas) inclusions in the blue part of the stone. The green portion was more heavily included and showed parallel growth structures, opaque inclusions, and densely spaced clusters of growth tubes.

In addition to the light greenish blue and yellowish green colors described here, the bicolored beryl may also be composed of bluish green and brownish orange portions (see figure 10 and the photo on p. 393 of Cairncross and Barhmann, 2006).

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Diopside from Afghanistan. “Olive” green and “chrome” green diopside reportedly from Badakhshan, Afghanistan, were brought to our attention by Farooq Hashmi (Intimate Gems, Jamaica, New York), who obtained the gem-quality rough while on a buying trip to Peshawar in January 2006. The two diopside varieties come from separate deposits that have been worked on an irregular basis for at least two years.

Mr. Hashmi obtained 3–4 kg of the “olive” green diopside from various parcels that totaled about 15 kg. The cobbled rough typically contained abundant inclusions, and the limited quantities of clean transparent pieces mostly weighed <3 grams each. The “chrome” diopside was available in larger quantities (i.e., parcels weighing up to 30–40 kg), and was reportedly cobbled from pods of material measuring up to several centimeters in diameter that were hosted by black mica schist. Extracting the gem-quality pieces was challenging due to the cleavage of the diopside.

Mr. Hashmi had a few stones faceted from each diopside variety, and loaned/donated them to GIA for examination by one of us (EPQ). Gemological testing of three “olive” diopsides (1.33–2.75 ct; figure 11) showed the following properties: color—medium to medium-dark yellow-green; pleochroism—very weak, brownish yellow and gray-green; R.I.— $n_{\alpha}=1.674\text{--}1.675$ and $n_{\gamma}=1.701\text{--}1.703$; birefringence—0.027–0.028; and hydrostatic S.G.—3.29–3.30. These properties are consistent with those reported for diopside by W. A. Deer et al. (*An Introduction to Rock-forming Minerals*, 2nd ed., Longman Scientific and Technical, Essex, England, 1992, pp. 170–176). There was no Chelsea filter reaction, and the stones were inert to both long- and short-wave UV radiation. Absorption features at approximately 450, 505, and 550 nm were visible with the desk-model spectroscope. Microscopic observation revealed moderate doubling of the facet junctions, small transparent low-relief doubly refractive crystals and needles in stringers and planes, and small dark crystals. The stones also contained clouds and stringers of minute particles (which appeared dark in diffused light but white or gray in darkfield illumination); some of the clouds were planar. One of the stones displayed twinning, while another sample had partially healed fractures. EDXRF spectroscopy of two of the samples indicated the presence of



Figure 11. These yellow-green diopside samples (1.33–2.75 ct) reportedly came from Badakhshan, Afghanistan. The stone in the center (GIA Collection no. 36612) is a gift of Intimate Gems. Photo by C. D. Mengason.



Figure 12. Badakhshan, Afghanistan, was also given as the source of these “chrome” diopsides (0.57–0.77 ct). Courtesy of Intimate Gems; photo by C. D. Mengason.

major amounts of Si, Ca, and Mg; minor Fe; traces of Mn and Sr; and possibly Y and Zn.

Gemological testing of four faceted “chrome” diopsides (0.57–0.77 ct; figure 12) showed the following properties: color—medium-dark to dark green; diaphaneity—transparent; pleochroism—moderate, brownish yellow and green; R.I.— $n_o=1.678$ and $n_r=1.705$; birefringence—0.027; S.G.—3.30–3.32; Chelsea filter reaction—none; and fluorescence—inert to both long- and short-wave UV radiation. Again, these properties were consistent with those of diopside reported by Deer et al. (1992). Absorption features at approximately 505, 550, 640, 660, and 690 nm were visible with the desk-model spectroscope; the lines in the red end of the spectrum are consistent with the presence of Cr, while the other features are probably due to iron. Microscopic examination revealed moderate doubling of the facet junctions, small low-relief doubly refractive transparent crystals and needles, and small dark crystals. The stones also contained clouds and stringers of particles and needles (which appeared dark in diffused light but white or gray in darkfield illumination); some of the clouds were planar, and the stringers had a wavy stair-step-like configuration. Two of the stones had partially healed fractures and two contained larger, doubly refractive, low-relief acicular crystals. EDXRF spectroscopy of three of the samples indicated the presence of major amounts of Si, Ca, and Mg; minor Fe; traces of Cr, Ti, Mn, and Sr; and possibly V. The absorption spectra and the detection of Cr in these samples by EDXRF indicate that the intense green color of this diopside is likely due to chromium.

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California jadeite with copper inclusions. The Spring 1996 Lab Notes section (pp. 46–47) reported on jadeite beads from Guatemala with inclusions of native copper. Recently, a slab of mottled gray-green jadeite containing metallic inclusions was brought to our attention by Steve Perry (Steve Perry Gems, Davis, California). The sample was sliced from a boulder that was recovered by Nancy Stinnett and Michael Humenik of Watsonville, California, from the well-known jadeite locality of Clear Creek, San Benito County, California.

The optical and physical properties of the sample were consistent with jadeite, as was the Raman spectrum obtained in the GIA Laboratory. A few “copper”-colored metallic flakes (e.g., figure 13) were the only inclusions visible at 10× magnification. Using a four-probe high-impedance conductance test on the largest inclusion (employing an ohm meter with separate probes to measure the voltage drop and current across the inclusion, and incorporating its measurements into a simple calculation), one of us (RM) determined that the electrical properties were consistent with native copper. A review of the literature found that copper was previously documented in Clear Creek jadeite by R. C. Coleman (“Jadeite deposits of the Clear Creek area, New Idria District, San Benito County,” *Journal of Petrology*, Vol. 2, 1961, pp. 209–247). His description, “Native copper is present as small isolated blebs (less than 1 mm) within the jadeite . . .,” is consistent with the appearance of the inclusions in the slab we examined.

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Figure 13. The metallic inclusions in this jadeite from Clear Creek, California, consist of native copper. The largest copper inclusion measures approximately 2 mm in longest dimension. Courtesy of S. Perry; photomicrograph by R. Merk, magnified 10×.

