Colour-zoned Green Beryl from Pakistan

During a buying trip to Pakistan in June 2016, gem dealer Dudley Blauwet obtained ~500 g of colourless beryl that showed distinctive green banding from a local miner/dealer. The beryl reportedly came from the Shandu Fangma mine, located on the ridge between Haiderabad and Baha, east of the Braldu River, in the Shigar Valley area of northern Pakistan. The crystals were hosted by a friable mica schist that fell apart when handled. Blauwet retained 25 of the best crystals to sell to mineral collectors, and assembled five parcels of rough material (totalling 297 pieces and weighing 199.5 g) to send to his cutting factory. He instructed the lapidaries to cut the various lots in different styles, including step cuts and elongate matched pairs to accentuate the colour zoning. He also had them facet some radiant emerald cuts to blend the colour zones into a more uniform pale emerald-green colour, and some cabochons to obtain cat's-eye gems from somewhat silky pieces. These latter two efforts did not prove successful, however, since the radiant cuts turned out pale blue with only slight green coloration, and the cabochons did not show chatoyancy. In total, the gems that were returned from the cutting factory totalled 434 pieces weighing 247.18 carats, and ranged from approximately 0.10 to 4.97 ct.

Blauwet loaned three faceted samples (0.83–4.97 ct) to authors CW and BW for examination (Figure 3). All of them were near-colourless with bluish green banding perpendicular to the length of the stones. The RIs were 1.572–1.579 (birefringence 0.007) and the SG was 2.68 (measured on the 4.97 ct stone), consistent with beryl. The samples were inert to standard long- and short-wave UV lamps (i.e. 365 and 254 nm, respectively); however, the bluish green bands did fluoresce moderate pink to 375 nm LED illumination (Figure 4). No reaction was observed with the Chelsea colour filter. The polariscope revealed that the optic axis of all the stones was oriented parallel to their length, and therefore the colour banding was parallel to the basal pinacoid. Viewed with the dichroscope, the green bands showed bluish green and yellowish green pleochroism, while the near-colourless areas appeared very pale blue and yellow.

Microscopic examination revealed growth tubes oriented parallel to the c-axis in all three stones (Figure 5). Some of the tubes appeared flattened with a feathery texture (Figure 5, left). While some tubes were colourless, others were filled with a dark substance; those that were open to the surface of the stones contained polishing residues with a different appearance than the dark matter mentioned above. Most of the growth tubes had abrupt terminations, in some instances where they encountered minute colourless mineral inclusions (Figure 5, right).

Figure 3: These beryls from Pakistan (0.83–4.97 ct) show distinct colour bands oriented parallel to the basal pinacoid. Photo by C. Williams.

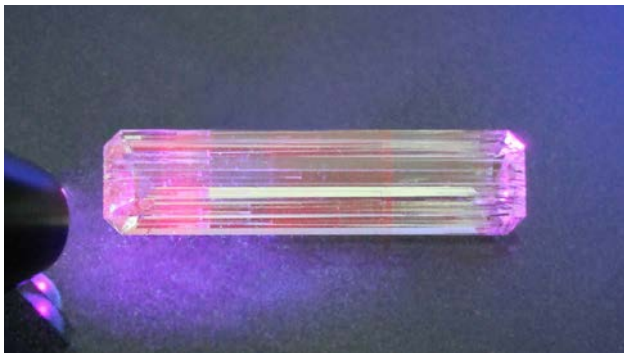

Figure 4: Moderate pink fluorescence is displayed by the bluish green colour bands in the 4.97 ct beryl when illuminated with a 375 nm LED torch. Photo by Dean Brennan.

Energy-dispersive X-ray fluorescence (EDXRF) spectroscopy with an Amptek X123-SDD instrument showed significant Fe, minor Cr and Cs, and a trace of V; relatively higher amounts of these elements were found in the bluish green bands as compared to the near-colourless areas. In addition, standard-based chemical analysis done with scanning electron microscopy-energy dispersive spectroscopy of another sample of this beryl was performed by authors AUF and WBS using a JEOL JSM-6400 instrument with the Iridium Ultra software package by IXRF Systems Inc. The rough sample was ground down slightly and

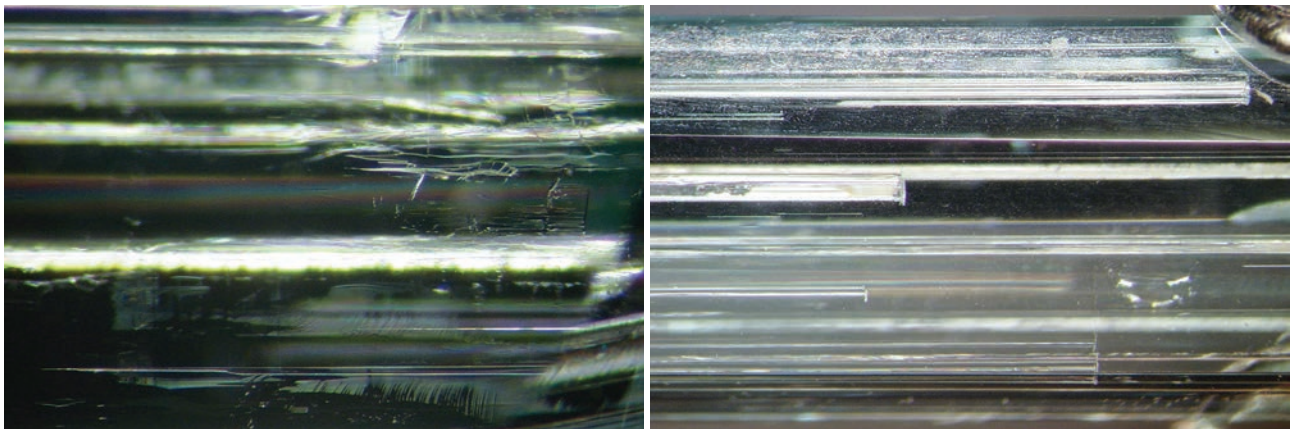

Figure 5: Growth tubes form conspicuous inclusions in the Pakistan beryls. Some of them show a feathery appearance (left, magnified 20×), and the tubes commonly terminate at colourless mineral inclusions (right, magnified 35×). Photomicrographs by C. Williams.

then polished before the analysis. Overall, it contained 0.3–0.6 wt.% FeO, 0.22–0.31 wt.% MgO and 0.14–0.20 wt.% Na_2O. In addition, contents of V_2O_5 ranged from below the detection limit up to 0.02 wt.%, with no relation to colour, whereas Cr_2O_3 was undetectable in the near-colourless areas and up to 0.05 wt.% in the darker green zones.

Blauwet has occasionally encountered limited quantities of this beryl in Pakistan since approximately mid-2011, and it was commonly offered to him as 'emerald'. Its colour banding and growth tubes are similar to those shown by colour-zoned beryl from Torrington and Emmaville in eastern Australia (e.g. Brown, 1998). However, the Australian beryls contained less Fe, and more Cr and V, than the Pakistan stones documented here.

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Reference

Brown G., 1998. Les gisements d'émeraudes en Australie. In D. Giard, Ed., *L'émeraude—Connaissances Actuelles et Prospectives*. Association Française de Gemmologie, Paris, France, 201–204.

Coloration of Green Dravite from the Commander Mine, Tanzania

A recent Gem Note by Williams et al. (2017) documented green/brown dravite from the Commander mine, Simanjiro District, north-eastern Tanzania. A crystal fragment that was studied for that report was subsequently analysed further by the present author to investigate the nature of its green coloration.

The green portion of the sample was sliced into a piece measuring 3 mm thick that was slightly darker at the rim and lighter in the interior. The dichroic colours of the rim were very light bluish green (E∥c) and greenish yellow (E⊥c), while the inner region was pale yellow (E∥c) to light yellow (E⊥c).

Visible-near infrared (Vis-NIR) spectroscopy with a silicon-diode array microspectrometer showed absorption bands at ~444 nm (more intense in the E∥c direction) and at ~606 nm (more intense in the E⊥c direction; Figure 6). An overtone of the OH bands occurred at 979 nm in the E∥c direction. These spectra are very similar to those of the V-Cr tourmalines (olenite, uvite and dravite) reported by Ertl et al. (2008). In addition, there is a close resemblance to the spectrum of green dravite from Tanzania (GRR 1719 with V>Cr) available at http://minerals.gps.caltech.edu/manuscripts/2008/V_Olenite/Index.html. The primary difference is the lack of a spin-forbidden