Cat's-eye Tremolite from Badakhshan, Afghanistan

In recent years there have been descriptions of transparent gem-quality tremolite from apparently two different locations in Tanzania (Zwaan and Hawthorne, 2015; Williams et al., 2017), and now this report covers tremolite that is from a different locality—Afghanistan—which also displays chatoyancy. Gem dealer Dudley Blauwet (Dudley Blauwet Gems, Louisville, Colorado, USA) first encountered this material in 2015, and obtained a total of four parcels during various visits to the gem and mineral bazaar in Peshawar, Pakistan. According to his Afghan supplier, the specimens originated from the Dar-e-Zu mine, Sar-e-Sang, Kokcha Valley, Badakhshan Province, Afghanistan. The material in the parcels ranged from pale greyish green or brownish green to black, and Blauwet was particularly interested in selling any unbroken well-formed crystals as mineral specimens. Since much of the rough material was opaque and lacked strong schiller, only a small proportion of the parcels were suitable for cutting cat's-eye gemstones. Furthermore, the narrow cross-section of those crystals showing the most desirable coloration restricted the size of any cut stones. Nevertheless, after initial efforts to cut a 4.1 g piece yielded a 4.70 ct cat's-eye cabochon, Blauwet then sent 16 pieces weighing 96.5 g to his cutting factory in July 2017, and they successfully produced six cabochons with a total weight of 33.58 carats. The largest was a translucent black gem weighing 11.26 ct, and the smallest was a pale greyish green stone that was ~0.90 ct.

Figure 16: A prismatic crystal (1.4 g) and an oval cat's-eye (2.09 ct) tremolite from the Dar-e-Zu Mine, Afghanistan, were gemmologically characterized for this report. Photo by Orasa Weldon.

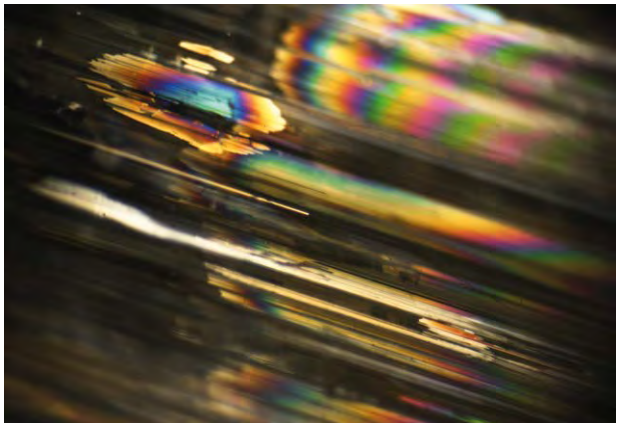

Figure 17: The Afghan cat's-eye tremolite contains growth tubes, incipient cleavage planes and fissures showing bright rainbow colours when viewed with magnification and oblique illumination. Photomicrograph by J. C. Zwaan; image width 5.0 mm.

During the February 2017 Tucson gem shows, Blauwet supplied some rough and cut samples of the chatoyant tremolite to the authors for examination.

A gemmological characterization was performed by author JCZ of the samples in Figure 16. The prismatic crystal and the oval cabochon were transparent to translucent and were light greyish green to greyish brown; in addition, a dark brown zone was present at one end of the crystal. The specimens respectively weighed 1.4 g and 2.09 ct and measured 20.53 × 9.40 × 3.83 mm and 12.71 × 6.68 × 2.88 mm.

The crystal had broken terminations, and on one side there was a small piece of matrix. Parallel to the longitudinal direction, striations were visible on the crystal faces and ran parallel to many straight fibres present inside the crystal. Incipient cleavage planes additionally ran parallel to the length of the crystal, which also contained small partially healed fissures. The oval cabochon essentially showed the same inclusions, with parallel fibres along its length being responsible for the cat's-eye. Viewed with magnification, some fissures in the cabochon showed bright iridescence with oblique illumination (Figure 17). Some slightly thicker fibres in the stone appeared to be lined with limonite or filled with diamond polishing residues where they reached the surface (confirmed by Raman analysis), which indicates that the parallel fibres consist of hollow growth tubes.

Clear RI readings were obtained from the flat base of the cabochon: 1.610–1.638, yielding a birefringence of 0.028. The hydrostatic SG was 3.01. The dichroscope revealed weak-to-distinct trichroism in greenish yellow, pale grey-green and greyish green. Both specimens were inert to long- and short-wave UV radiation.

Comparing these properties with those of amphiboles in the tremolite-actinolite-ferroactinolite series (Deer et al., 1997), the relatively low SG corresponds to tremolite, although distinct trichroism indicates the presence of some iron. Raman spectra most closely matched the spectra of tremolite recorded in the RRUFF database. Furthermore, electron microprobe analysis of another sample by authors FCH and MD confirmed that the material is indeed tremolite, with the formula: $(Na_{0.14}K_{0.01})_{0.15}(Ca_{1.95}Fe^{2+}_{0.03}Na_{0.02})_2(Mg_{4.68}Fe^{2+}_{0.20}Al_{0.10}Ti_{0.01}Mn_{0.01})_{5.00}(Si_{7.70}Al_{0.30})_8O_{22}(OH_{1.91}F_{0.09})_2$. This is well within the compositional range of tremolite, which extends from $\square Ca_2Mg_5Si_8O_{22}(OH)_2$ to $\square Ca_2Mg_{4.5}Fe^{2+}_{0.5}Si_8O_{22}(OH)_2$ (with $\square$ = A-site vacancy; Hawthorne et al., 2012).

In conclusion, the Dar-e-Zu mine in Afghanistan is one of the few known occurrences of gem-quality tremolite, apart from localities in Tanzania (see references above and also Fritz et al., 2007).

Dr J. C. (Hanco) Zwaan FGA
(hanco.zwaan@naturalis.nl)
Netherlands Gemmological Laboratory
National Museum of Natural History 'Naturalis'
Leiden, The Netherlands

Dr Frank C. Hawthorne and Maxwell Day
Geological Sciences, University of Manitoba
Winnipeg, Manitoba, Canada

Brendan M. Laurs FGA

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Wavellite and Drusy Variscite from Arkansas

Wavellite and variscite are both aluminium phosphate minerals with a Mohs hardness of approximately 3½–4 (up to 4½ for variscite). Although variscite is commonly slabbed to show its attractive coloration and patterns, wavellite is typically appreciated for its botryoidal formations and radiating textures.

Since at least 1870, wavellite has been collected near the town of Avant in Garland County, Arkansas, USA (Smith, 2010). The area also is a source of drusy variscite, and both minerals are hosted by brecciated sedimentary rock of the Big Fork Chert Formation (Barwood and de Linde, 1989). The wavellite occurs in a range of colours (blue, blue-green, green, greenish yellow and yellow), which have been attributed to variations in the amounts and valence states of vanadium (Foster and Schaller, 1966).

One of the most important sources of wavellite and variscite in Arkansas is the de Linde mine (also known as the H. de Linde No. 3 or the Stuart Schmidt deposit), and many specimens from this claim have been cut for use in jewellery over the past decade. In 2009 the property was purchased by Avant Mining LLC (Paramus, New Jersey, USA), and they started extracting rough material in early 2010. According to owner James Zigras, the company recently expanded its production of jewellery material, and at the February 2018 Tucson gem shows they had multiple booths that displayed cut stones ranging from 10 to 500 ct each.

Both the wavellite and variscite are cut into various freeform shapes. While the variscite consists of pure drusy green coatings (Figure 18), the wavellite is

Figure 18: Various pieces of drusy variscite (up to 68 × 45 mm) from the de Linde mine are displayed on a background of Arkansas quartz. Photo by Jeff Fuller.