

Figure 3: A phantom layer of what appear to be hematite particles is shown here in 'Passion Amethyst' from Brazil. Photomicrograph by N. D. Renfro; image width 5.6 mm.

they appeared typical for quartz, most probably consisting of orangey red to yellow brown iron oxides/hydroxides (i.e. hematite and goethite) and dark greenish grey chlorite. During crystallization of the amethyst, the typical sequence of the phantoms started with particles of hematite (Figure 3) followed by particles of chlorite and finally by local brush-like bundles of hematite/goethite that were oriented perpendicular to the crystal faces. Cutting and polishing brought out various inclusion-related patterns and colours that were superimposed over the pale purple body colour of the host amethyst, creating an unusual appearance.

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Beryllonite from Pakistan

Beryllonite (NaBePO_4) is an uncommon mineral that is more typically seen as a mineral specimen than as a faceted gemstone. Nevertheless, its hardness of $5\frac{1}{2}$ –6 on the Mohs scale makes it suitable for faceting and use in gently worn



Figure 4: Pakistan is the source of this beryllonite, which weighs 14.79 ct and is completely colourless. Photo by Dean Brennan.

jewellery. Both chatoyant cabochons and transparent faceted gems are sold as collector's stones, but they have seldom been documented in the gemmological literature (e.g. Koivula and Kammerling, 1991; Muylar and Sun, 2016).

During the February 2017 Tucson gem shows, Dudley Blauwet (Dudley Blauwet Gems, Louisville, Colorado, USA) showed one of the authors (BML) a faceted 14.79 ct beryllonite from northern Pakistan (Figure 4). He purchased the rough material 15–20 years ago in Chhappu village in Pakistan's Braldu Valley. The crystal was large (338.1 g), but Blauwet hesitated to send it to his cutting factory because he could not determine how much gem material was inside. In March 2016 he finally sent it for cutting, and the factory returned 102 pieces weighing 176.94 carats. The largest gem weighed ~28 ct, while the two largest clean stones were between approximately 9.7 and 8.6 ct, with the majority less than 3 ct including numerous melee-sized stones.

Blauwet loaned the 14.79 ct beryllonite to authors CW and BW for examination. It measured $17.81 \times 14.56 \times 10.28$ mm and was so colourless that it appeared silver-white. The RIs were 1.551–1.560 (birefringence 0.009) and the hydrostatic SG was 2.81. It was inert to UV radiation. These properties are consistent with those reported for beryllonite, and the identification was confirmed by Raman analysis with a GemmoRaman-532SG instrument. Energy-dispersive X-ray fluorescence (EDXRF) chemical analysis with an Amptek X123-SDD instrument revealed only the expected major amount of P and no significant trace elements.

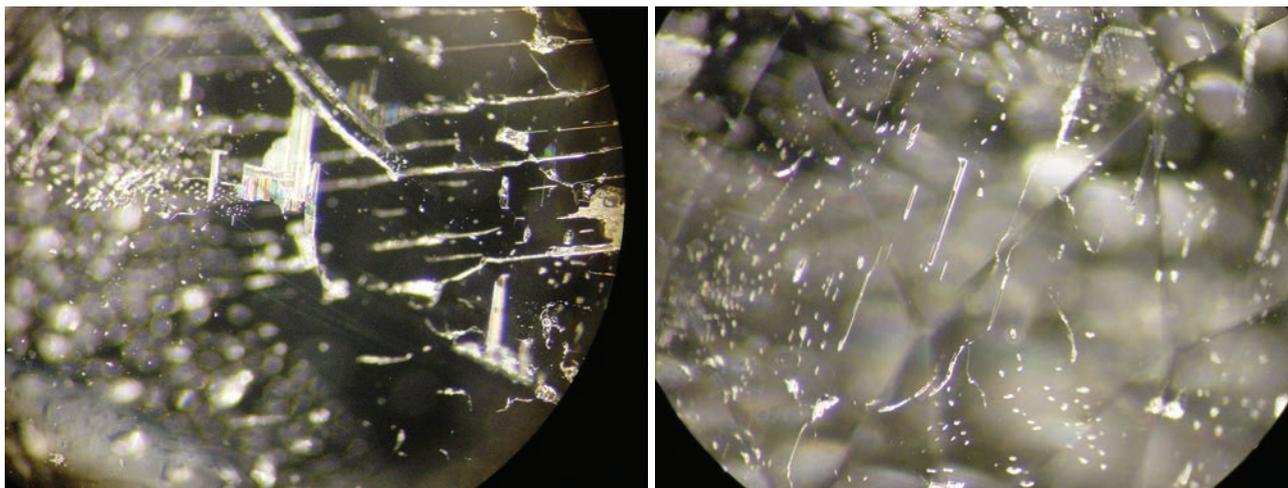


Figure 5: Internal features in the beryllonite consisted of iridescent planar fluid inclusions (left) and variably shaped two-phase inclusions (right). Photomicrographs by C. Williams; magnified 40×.

Numerous small inclusions were evident upon close examination of the stone without magnification. Microscopic observation with darkfield illumination revealed fluid-filled partially healed fissures, including one geometric-shaped iridescent inclusion that appeared to follow a cleavage plane (Figure 5, left). Also present were two-phase (fluid-gas) inclusions containing tiny bubbles (Figure 5, right).

Gem-quality beryllonite is known mainly from Afghanistan and Brazil, although Pakistan is also an occasional source of this rare gem material, as seen in this report.

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References

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Apache Blue Stone (Chrysocolla) from Arizona, USA

The south-western USA is a well-known source of colourful secondary copper minerals such as malachite, azurite, chrysocolla, turquoise, etc. In 2013, a temporary partnership between a copper-mining company and Apache Way LLC (Chiricahua Apache Nde Nation, San Carlos Apache Reservation, Arizona) produced several tonnes of bright blue rough material from a large open pit located approximately 1 km from the now-inactive Sleeping Beauty turquoise mine. The appearance of the material varies from uniformly coloured to showing substantial amounts of matrix. Approximately 225 kg have been stabilized by polymer impregnation, and this material is being sold as Apache Blue Stone. More than 400 gems of various sizes and shapes have been cut and polished on the San

Carlos Apache Reservation, with some contract cutting also being done overseas. In addition, silver- and gold-mounted jewellery and *objets d'art* are being manufactured and sold with Apache Blue Stone in indigenous and American heritage-inspired designs.

During the February 2017 Tucson gem shows, three pieces of rough were donated to Gem-A, and five cut-and-polished pieces were loaned for examination, by Charles Vargas and Warren Boyd (Apache Gems, San Carlos, Arizona). The rough material (Figure 6) was untreated, while the polished stones (Figure 7) had been stabilized by different polymer impregnation processes.

The samples were characterized by authors CW and BW. The rough stones were vibrant blue