G&G Micro-World

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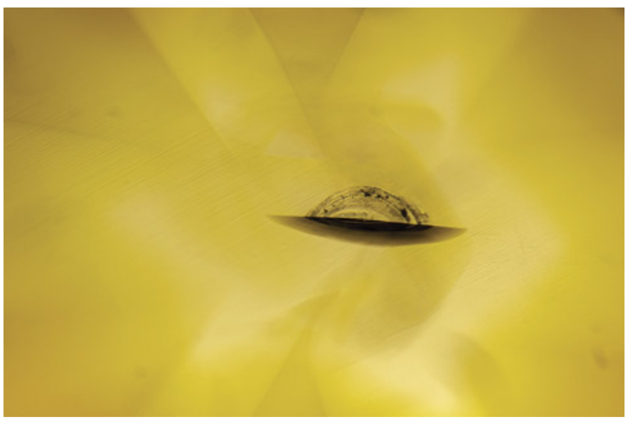

Figure 1. This diamond feather and its reflection resemble a UFO flying across the sun. Photomicrograph by Michaela Damba; field of view 3.57 mm.

"UFO" in Diamond

The author recently examined a 3.03 ct Fancy Deep brownish orangy yellow diamond featuring a small feather on the table and very strong yellow color zoning in a stellate pattern. When held table to culet, the diamond displayed a feather that, with its reflection, appeared as a caricature of an unidentified flying object soaring across the sun (figure 1).

Feathers are common inclusions that impact the clarity grade of a diamond. This diamond received a clarity grade of SI_1 based on its etch channels and several feathers. Color zoning does not impact the clarity grade, but it can affect the overall color grade of a diamond.

Michaela Damba
GIA, Carlsbad

Cristobalite Stars and Snowflakes in Devitrified Glass

Recently, the authors examined a 3.04 ct transparent green oval mixed cut stone. Basic gemological testing suggested this stone was glass, which was further supported with Fourier-transform infrared and Raman spectroscopy showing characteristic features of artificial glass.

Although artificial glass is one of the most common gem simulants, microscopic observation revealed a unique inclusion scene. In addition to gas bubbles, many six-pointed star-shaped platelets were observed (figure 2). These star-shaped platelets exhibited a dendritic pattern, which could be seen clearly when observed in brightfield illumination (figure 3). In this lighting environment, the stars more closely resembled snowflakes. Additional inclusions were also observed, taking the form of three-dimensional lattices with spikes at each tip (figure 3). All inclusions were identified as cristobalite by Raman spectroscopy.

Cristobalite, a crystallized form of silica, is a common inclusion in artificial glass formed by devitrification (e.g., E.J. Gübelin and J.I. Koivula, *Photoatlas of Inclusions in Gemstones, Volume 1*, ABC Edition, Zurich, 1986, p. 430; G. Bosshart, "Cobalt glass as a lapis lazuli imitation" Winter 1983 *G&G*, pp. 228–231). Devitrification is the process by which an amorphous material changes to a crystalline state. Crystalline inclusions produced by this

About the banner: Prismatic tourmaline crystals intersect in this goshenite beryl from Governador Valadares, Minas Gerais, Brazil. Photomicrograph by Nathan Renfro; field of view 11.28 mm.

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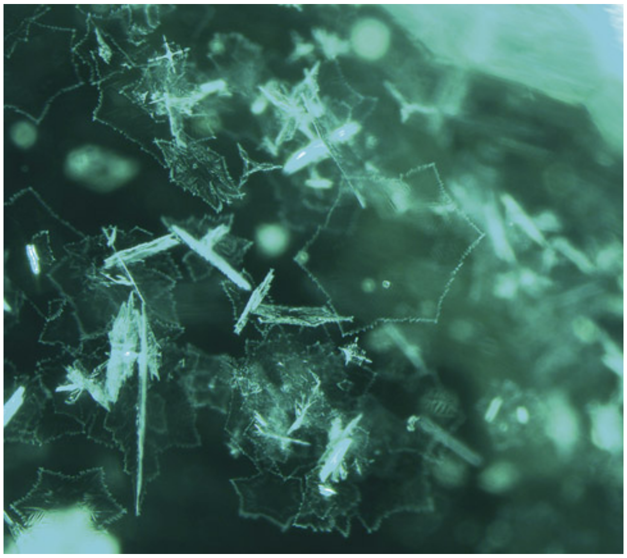

Figure 2. Many six-pointed star-shaped platelets and round gas bubbles are observed in this artificial glass. Photomicrograph by Kanako Otsuka; field of view 2.51 mm.

process can give a natural appearance to glass simulants (e.g., Summer 2018 *G&G* Micro-World, pp. 230–231). However, this artificial glass, which was likely made to imitate emerald, has a unique beauty that would not exist in natural gemstones.

Kanako Otsuka and Kazuko Saruwatari
GIA, Tokyo

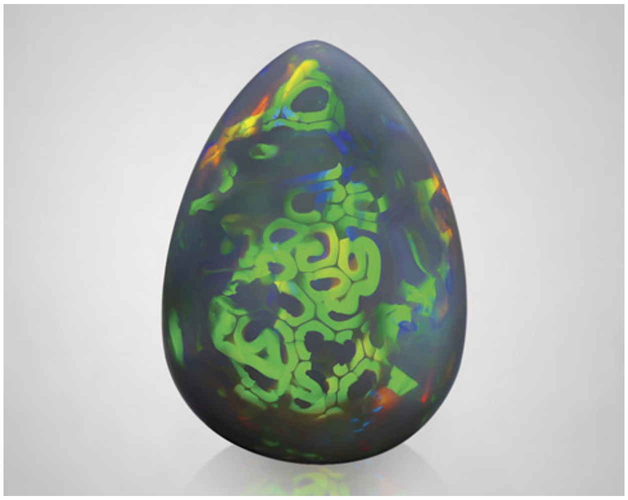

Figure 4. A natural 47.77 ct Ethiopian opal with an unusual play-of-color pattern. Photo by Nuttapol Kitdee.

Natural Opal with Unusual Play-of-Color Pattern

Ethiopian opal was first discovered in the early 1990s and is capable of producing spectacular play-of-color in a variety of patterns and bodycolors. Some Ethiopian opals exhibit macroscopic finger-like structures called digit patterns: columnar zones of interpenetrating play-of-color within a network of common opal (B. Rondeau et al., "Play-of-color opal from Wegel Tena, Wollo Province, Ethiopia," Summer 2010 *G&G*, pp. 90–105).

Recently, the author encountered a 47.77 ct gray Ethiopian opal displaying attractive play-of-color in an unusual pattern (figure 4). Basic gemological observation and properties confirmed that the stone was a natural non-

Figure 3. Brightfield illumination reveals a dendritic pattern in the star-shaped platelets, which bear a striking resemblance to snowflakes. Smaller three-dimensional crystal inclusions are also observed in the artificial glass. Photomicrograph by Kanako Otsuka; field of view 1.58 mm.

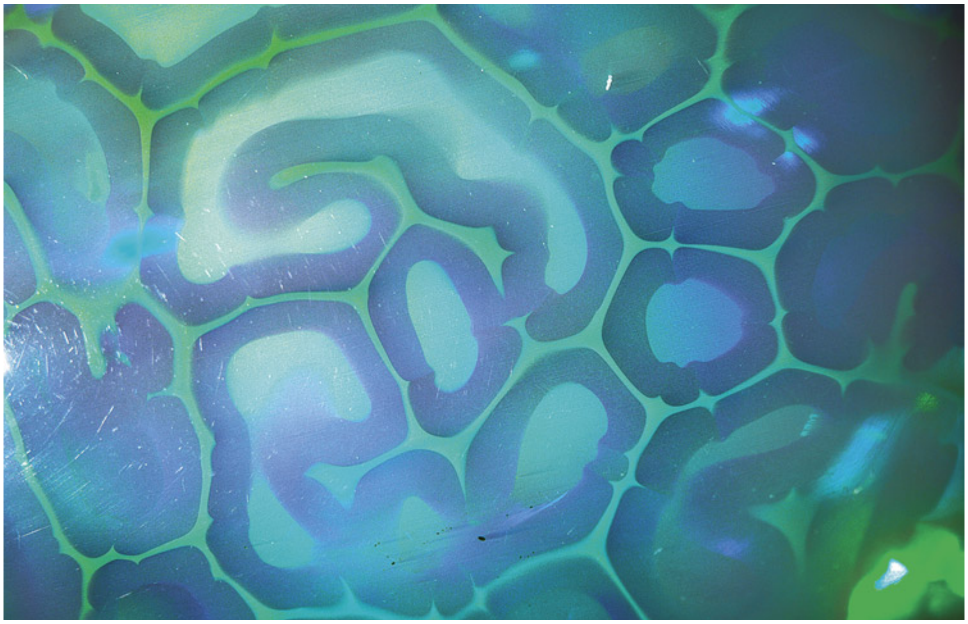

Figure 5. The turtle shell–like pattern of the natural opal as seen in oblique reflected light. Photomicrograph by Ungkhana Atikarnsakul; field of view 14.4 mm.

hydrophane opal. Interestingly, the play-of-color pattern in this specimen was confined to distinct "cells" separated by greenish-colored opal, resembling a turtle-shell structure on the top of the cabochon (figure 5). This is one of the most extraordinary patterns in natural opal that the author has examined.

Ungkhana Atikarnsakul
GIA, Bangkok

"Melon" Pearl

Non-nacreous pearls are characterized by the absence of iridescent layers of nacre and are recognized for their distinctive surface characteristics. For some non-nacreous pearls, their unique look is attributed to the calcite structure's patterning on the surface. Such structures can result in a wide range of surface appearances, predominantly featuring a cellular pattern, in contrast to nacreous pearls, which typically display overlapping aragonite platelets.

Recently, the authors examined a parcel of non-nacreous yellow, gray, brown, and black pearls of various shapes reportedly sourced from *Pinctada radiata* mollusks fished from Bahrain. Among the samples, an oval non-nacreous black pearl with grayish yellow areas at its center, weighing 0.085 ct and measuring 2.46 × 2.25 mm, stood out for its fascinating surface appearance (figure 6, left). When viewed under magnification, its subsurface revealed a reticular netted structure characterized by a spiky veined cellular pattern (figure 6, right). Although the authors have previously encountered similar surface textures, this particular pattern was intriguing, as it closely resembled the netted tissue found on the surface of a melon.

Pfokreni Nipuni and Abeer Al-Alawi
GIA, Mumbai

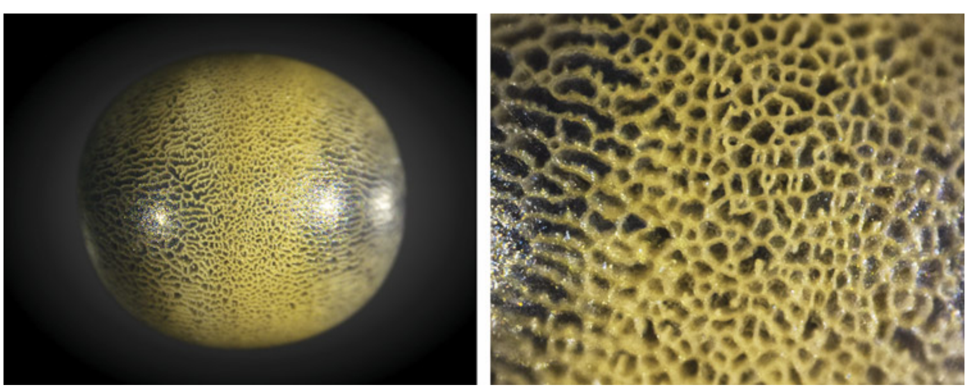

Figure 6. Left: A non-nacreous 0.085 ct pearl with a unique netted surface resembling the exterior of a melon. Right: The reticular netted cellular structure on the pearl's surface. Photomicrographs by Pfokreni Nipuni; fields of view 4.0 mm (left) and 1.0 mm (right).

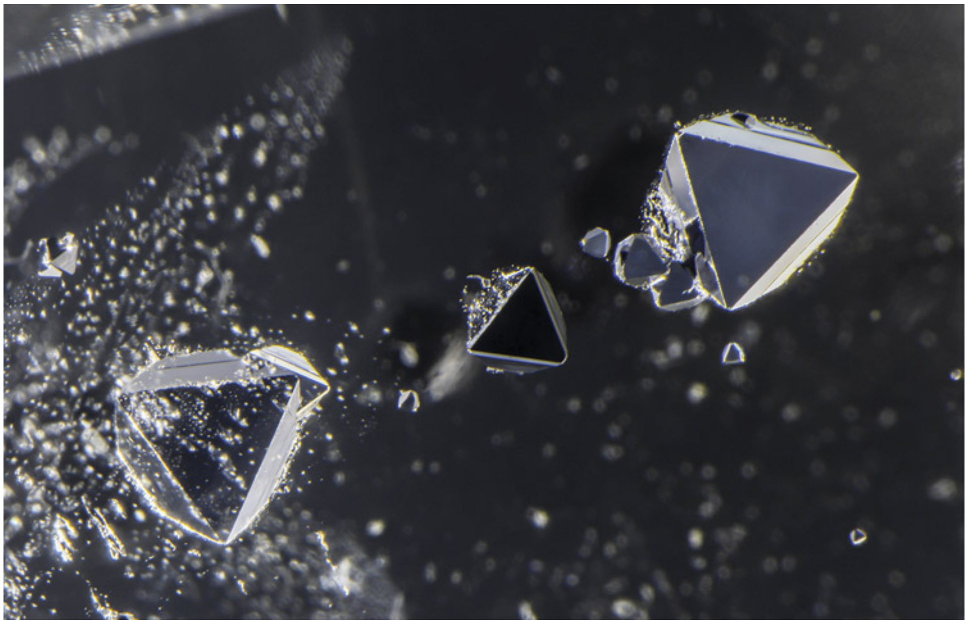

Figure 7. Octahedral gersdorffite inclusions in quartz appearing as triangles. Photomicrograph by Nathan Renfro; field of view 8.16 mm.

Gersdorffite in Quartz

While examining a 59.32 ct transparent colorless freeform shield-shaped step cut from Kara-Oba in the Karagandy Province of Kazakhstan, we noticed something curious. Using optical microscopy, X-ray powder diffraction, and standard gemological testing, we identified the sample as transparent rock crystal quartz and its eye-visible inclusions as the isometric nickel arsenic sulfide, gersdorffite.

What made this quartz subject particularly interesting to study was the euhedral morphology of the opaque, silvery gray, highly reflective, cubically modified octahedral crystals of gersdorffite. From one side of the quartz host, the inclusions with octahedral faces reflected as triangles (figure 7). Through the opposite side of the host, the faces of the very same inclusions appeared as hexagons (figure 8). In this sample, the perceived shape of the inclusions—triangles or hexagons—depends entirely on viewing direction.

John I. Koivula and Nathan Renfro
GIA, Carlsbad

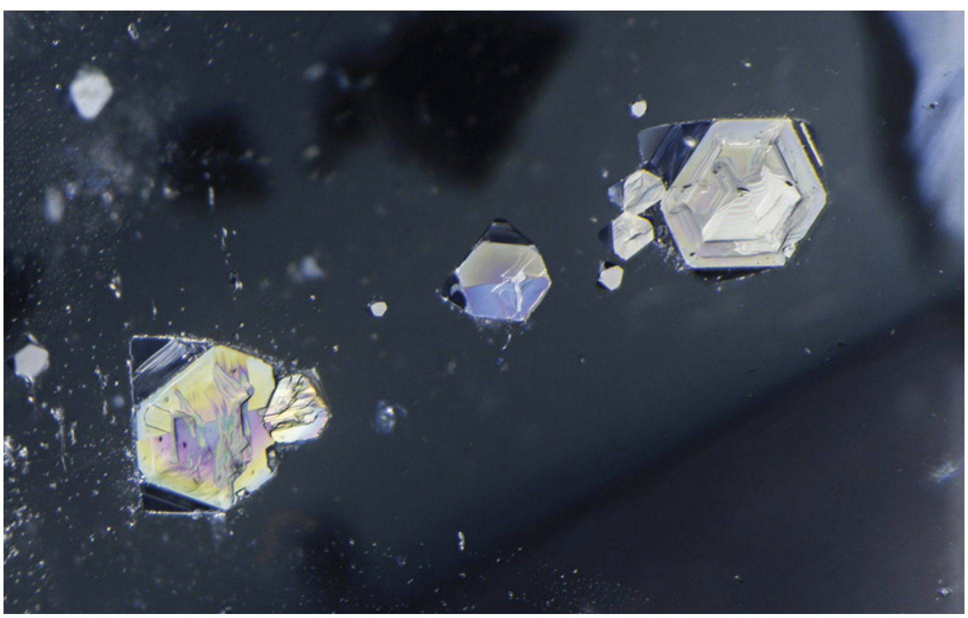

Figure 8. When viewed from the opposite side of the quartz host, the same gersdorffite inclusions display as hexagons. Photomicrograph by Nathan Renfro; field of view 8.11 mm.

Figure 9. Sea urchin–like 3D radial fissures in a heated Mong Hsu ruby. Photomicrograph by Taku Okada; field of view 1.70 mm.

Sea Urchin–Like 3D Radial Fissures in a Heated Mong Hsu Ruby

The author recently examined a 1.34 ct red stone with a three-dimensional radial inclusion resembling a sea urchin, or *uni* in Japanese (figure 9). The stone was identified as a heated ruby from Mong Hsu, Myanmar, based on trace element chemistry, chalky fluorescence under short-wave (254 nm) UV radiation, and the altered state of diagnostic inclusions (A.C. Palke et al., "Geographic origin determination of ruby," Winter 2019 *G&G*, pp. 580–613). Mong Hsu rubies rarely contain such large crystals, indicating that this was an aggregate of tension fissures and not a crystal at all. These fissures likely formed when an isolated, relatively small inclusion expanded during heating. If an inclusion has a thermal expansion coefficient greater than that of corundum, fissures may form around the inclusion during heating, such as common discoidal decrepitation fissures. The fissures usually develop in the direction of maximum compression stress of the residual strain inside the ruby (e.g., T.L. Anderson, *Fracture Mechanics: Fundamentals and Applications*, Third Edition, CRC Press, 2005). In this case, the radial fissures developed almost isotropically in three dimensions, suggesting that the surroundings of the inclusion were in a quasi-hydrostatic pressure state with almost no differential stress. The unexpected local stress state in the ruby formed the fissure aggregates in this exciting and unusual shape.

Taku Okada
GIA, Tokyo

Suspended Pargasite Crystal in Pink Spinel

A 1.33 ct pink spinel containing a distinct mineral inclusion located near the stone's surface was recently examined by the author. Raman analysis identified the inclusion as a pargasite ($NaCa_2(Mg_4Al)(Si_6Al_2)O_{22}(OH)_2$) crystal. This euhedral prismatic crystal displayed chamfered terminations, rhombohedral pinacoids, and a near-colorless bodycolor (figure 10). Reflected light highlighted a central feature, possibly a growth hillock, which gave the appearance of two connected pargasite crystals. While pargasite inclusions are more commonly found in corundum than in spinel, few have been documented exhibiting such remarkable morphology.

Hannah Wiggins
GIA, New York

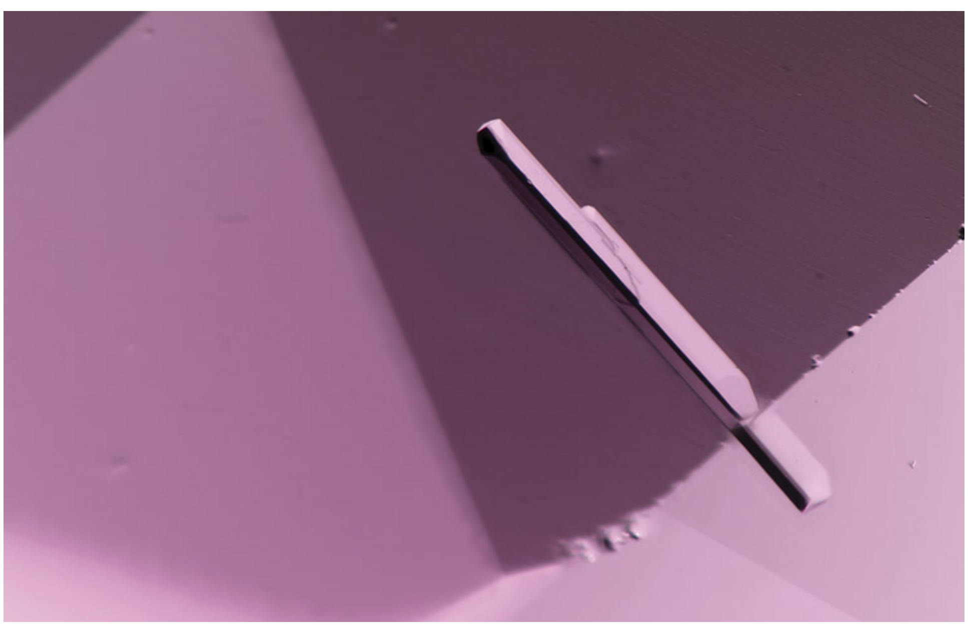

Figure 10. A prismatic pargasite crystal against the pink faceted background of its spinel host. Photomicrograph by Tyler Smith; field of view 1.76 mm.

Figure 11. Weighing 2.34 ct and measuring 7.71 mm in the largest dimension, this partially etched diamond octahedron hosts a yellow-orange almandine-pyrope garnet crystal. Photo by Diego Sanchez.

Quarterly Crystal: Almandine-Pyrope Garnet in Diamond

The authors recently examined a collection of African diamond crystals that hosted various mineral inclusions. This Quarterly Crystal, chosen from that collection, is a 2.34 ct transparent near-colorless partially etched diamond octahedron measuring 7.71 × 7.39 × 4.92 mm, which came from the Republic of South Africa (figure 11). During routine testing, the near-colorless octahedron fluoresced a strong blue when exposed to long-wave (365 nm) ultraviolet radiation.

The diamond crystal hosts a transparent yellow-orange inclusion situated near its center. Laser Raman microspectroscopy identified this included crystal as an almandine-pyrope garnet. The yellow-orange color is typical of this type of inclusion. In addition to the garnet, light grayish green transparent birefringent omphacite crystals and opaque black sulfide and graphite crystals (some forming rosettes) were also present.

As inclusions in diamonds, transparent almandine-pyrope crystals are generally a medium to deep yellow-orange color with a vitreous luster. As shown in figure 12, such inclusions typically form as somewhat rounded protogenetic mineral crystals. Geologically, the presence of an almandine-pyrope garnet inclusion is an indicator that the host diamond formed in a rock type known as eclogite.

John I. Koivula and Nathan Renfro

Figure 12. This yellow-orange transparent crystal of almandine-pyrope garnet is a very rare inclusion in diamond. The example shown here has a typical somewhat rounded habit. Photomicrograph by Nathan Renfro; field of view 3.84 mm.