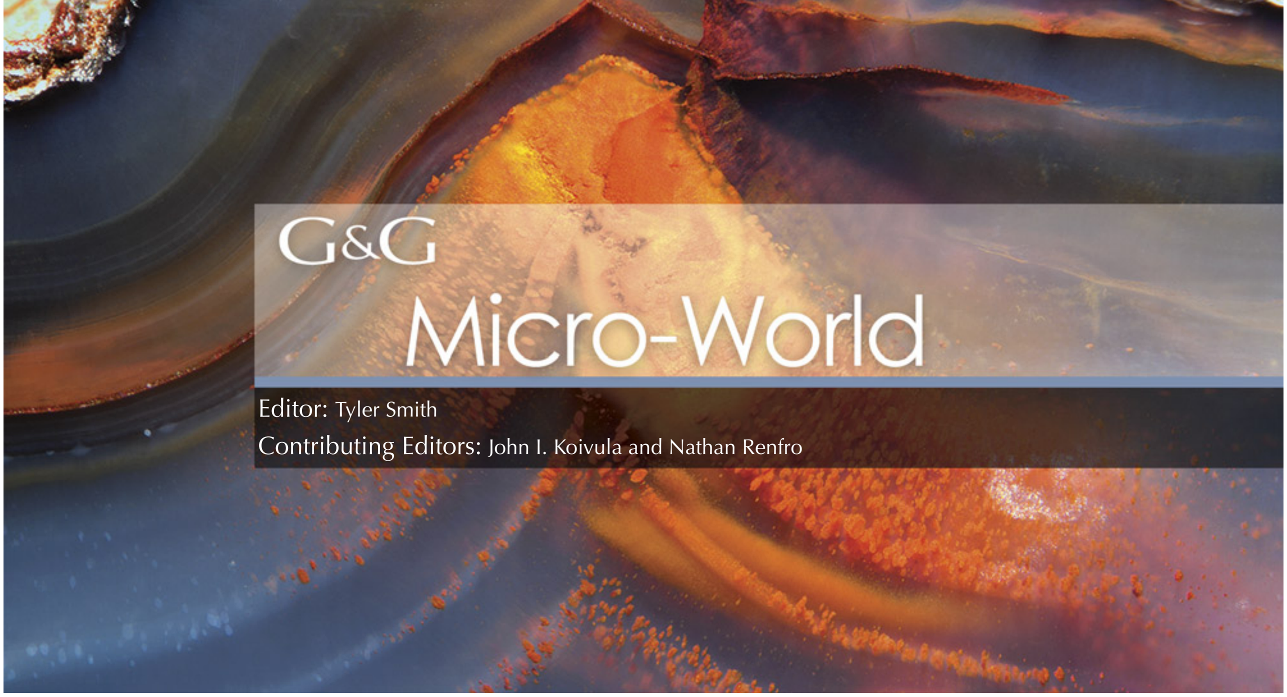


Anatase "Dandelion" in Agate

Rutile is a common inclusion in quartz, but its polymorphs, such as anatase and brookite, are much rarer to find. Recently, a spherical conglomeration of acicular anatase crystals (identified by Raman spectroscopy) resembling the seed-head phase of a dandelion was seen as an inclusion within an agate slice (figure 1). Nearby, orangy yellow iron staining was also observed in a dendritic growth pattern.

Anatase and rutile are both tetragonal crystallizations of titanium dioxide (TiO_2). Rutile, with its more compact crystal structure, is more stable and therefore more common. Brookite and anatase will convert to rutile under specific heat and pressure conditions. Anatase typically manifests as reddish brown to brownish yellow tabular or pyramidal crystals. Anatase inclusions are rare, but this inclusion with an acicular crystal habit is an exceptionally unusual occurrence.

Britni LeCroy
GIA, Carlsbad

Diamond Within a Diamond Within a Diamond

Recently, the authors examined a 2.57 ct natural type Ia diamond with some interesting inclusion features. This

Figure 1. An acicular cluster of anatase crystals within agate resembling a dandelion seed head. Photomicrograph by Britni LeCroy; field of view 4.79 mm.

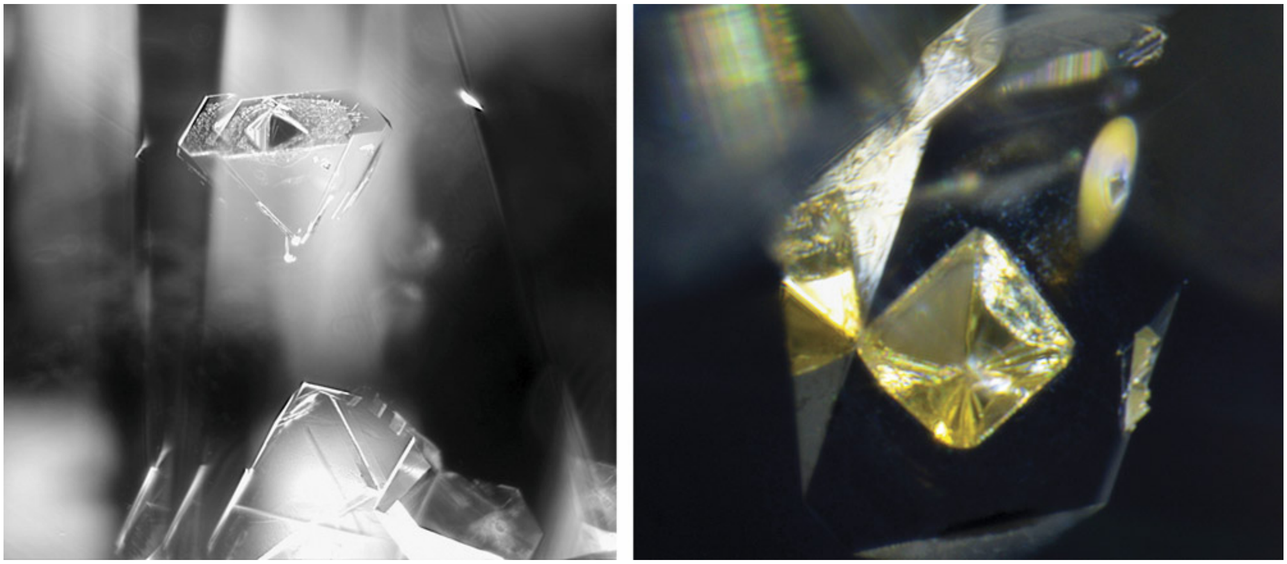


Figure 2. Left: Viewed from the pavilion of the 2.57 ct diamond, this transparent crystal inclusion with mirror image reflection resembles the profile of a faceted diamond under darkfield lighting. Image captured in monochrome; field of view 0.88 mm. Right: Using fiber-optic lighting, the crystal inclusion that appears opaque in the left image is displayed as a yellow octahedron; field of view 0.40 mm. Photomicrographs by Yagnesh Vyas (left) and Hemal Trivedi (right).

round brilliant stone with I-color and I_1 clarity contained interesting transparent and yellow crystal inclusions (figure 2). The transparent crystal resembled the profile view of a faceted round brilliant diamond. Within the "crown" of this ghostly faceted transparent crystal, a yellow crystal was also observed. Although the crystal's identity was unconfirmed, it showed a morphology resembling that of an octahedral rough diamond. Similar inclusions have been documented previously (Summer 2022 *G&G* Micro-World, pp. 227–228; Spring 2024 *G&G* Micro-World, pp. 81–82). No obvious strain was observed when the diamond was examined through crossed polarizing filters. These unusual inclusions—resembling a miniature faceted diamond and a yellow octahedral rough diamond—are "knot" commonly observed in the laboratory.

Ravikumar Sharma and Krishna Sagar
GIA, Mumbai

Sally Eaton-Magaña
GIA, Carlsbad

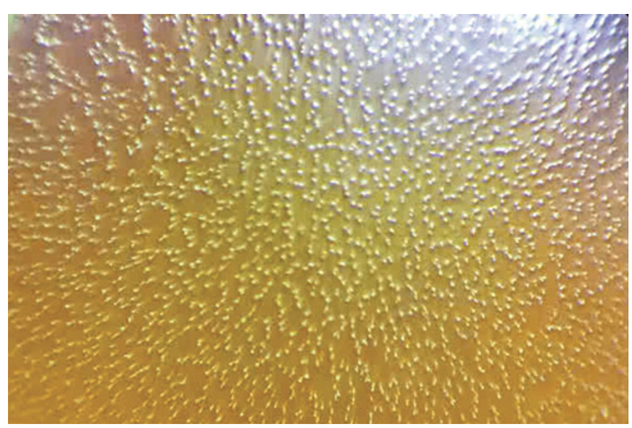
About the banner: This laguna agate from Chihuahua, Mexico, shows peaked bands of orange iron oxide concretions. The shape of these bands is dictated by the morphology of the vug within which the agate formed. Photomicrograph by Tyler Smith; field of view 4.79 mm.

Gems & Gemology, Vol. 61, No. 2, pp. 184–191.

"Goose Bumps" on South Sea Pearl

Pearls occasionally develop marks on their surface during formation. Recently, when examining a strand of cultured golden South Sea pearls approximately 12 mm in diameter, we discovered a pearl covered with innumerable pinpoints resembling a dotted pattern similar to that of goose bumps when viewed under the gemological microscope (figure 3). When present, pinpoints such as these usually only occur sporadically on the surface of South Sea and Tahitian pearls, but the densely covered surface in this pearl is

Figure 3. "Goose bumps" on the surface of a 12 mm golden South Sea pearl. Photomicrograph by Le Ngoc Nang; field of view 5 mm.



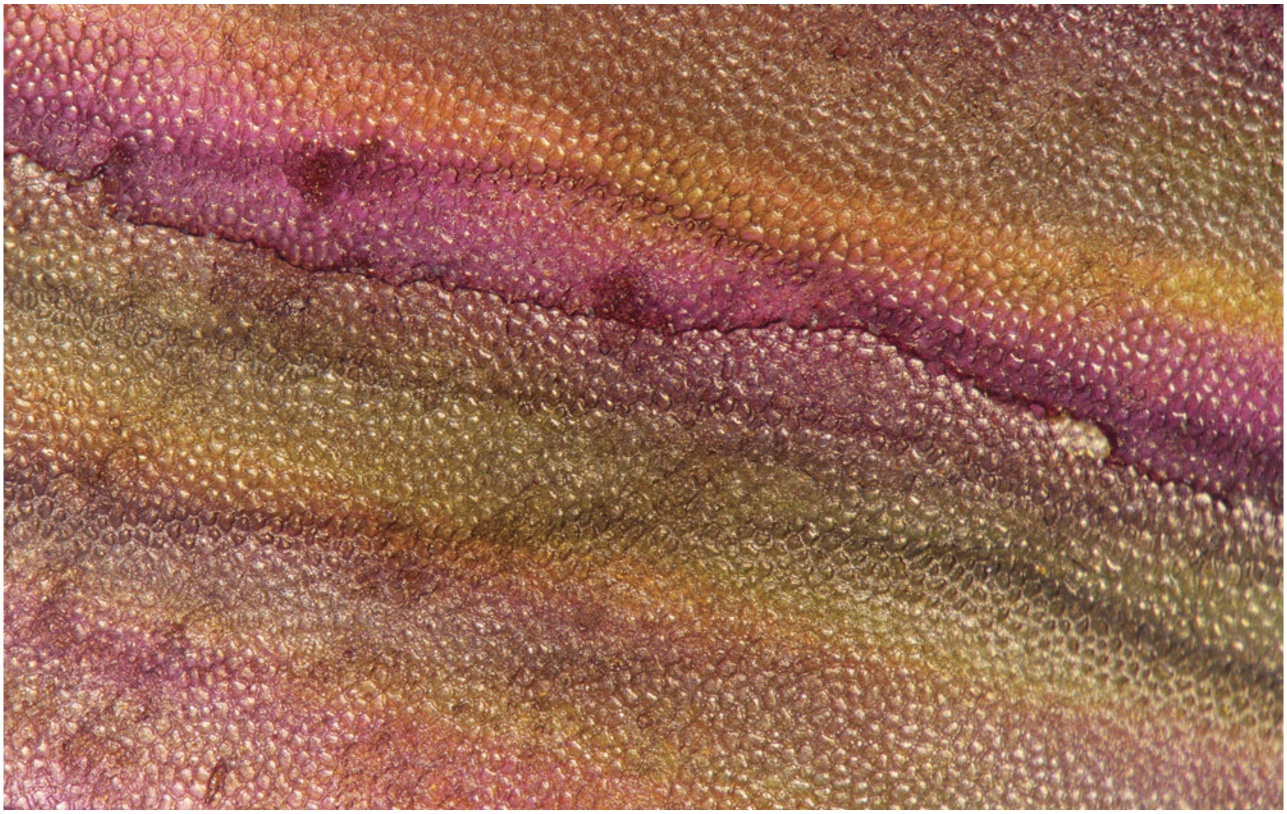


Figure 4. A thin layer of iridescent aragonite overlays the prismatic calcite of a Pinnidae shell, creating a captivating iridescent effect. Photomicrograph by Ravenya Atchalak; field of view 2.88 mm.

extremely rare. Interestingly, despite their high density, these inclusions had little effect on the luster and quality of the pearl when viewed without magnification, allowing the pearl to maintain its beauty and high value.

Le Ngoc Nang
Liu Gemological Research and Application Center
Ho Chi Minh City

Iridescent Pen Shell

The thin, wedge-shaped shell of the Pinnidae family (pen) mollusk is made of calcium carbonate in the forms of calcite and aragonite. The outer (posterior) surface is composed of non-nacreous calcite prisms covering the entire shell, while the inner (anterior) surface is composed of both calcite and aragonite. The nacreous aragonite

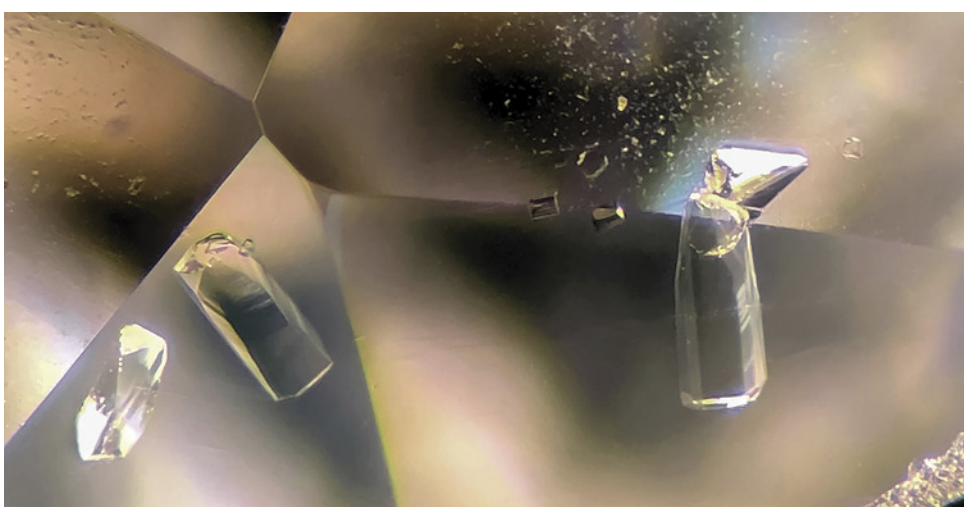


Figure 5. Transparent danburite crystals in phenakite from Momeik, Myanmar, shown in a combination of darkfield and oblique illumination. Photomicrograph by Kyaw Thu; field of view 2 mm.

Figure 6. This orange inclusion in quartz (left) with a striated bipyramidal structure was identified as lithiophilite (right). Photos by Wingtak Lui (left) and Liyan He; field of view 13.0 mm (right).

tablets are deposited over the calcite and restricted to a section of the shell at the tapered end. Figure 4 shows the calcite covered by a thin, iridescent layer of aragonite. The interplay between the two crystalline forms highlights the intricate structural complexity of the shell.

Ravenya Atchalak
GIA, Bangkok

Colorless Danburite Crystals in Phenakite from Myanmar

Phenakite (Be_2SiO_4), also known as phenacite, is a rare beryllium silicate mineral characterized primarily by its colorless appearance, although it may also exhibit shades of yellow, pink, or brown. Phenakite is typically found in granitic pegmatite deposits and is recognized from many localities worldwide.

A 4.68 ct colorless faceted oval specimen measuring 10.37 × 9.25 × 7.52 mm sourced from Khetchel, near Momeik in Myanmar, was recently examined by the authors. Based on its physical and optical properties, such as a refractive index of 1.653–1.670 and a specific gravity of 2.97, the mineral was identified as phenakite. Microscopic observation revealed the presence of well-formed prismatic crystal inclusions (figure 5). These transparent crystals were identified through Raman microanalysis as danburite ($CaB_2(SiO_4)_2$). Unusual inclusions, such as perettiite-(Y) and tusionite, have been documented in phenakite from Khetchel (Summer 2018 *G&G* Micro-World, p. 228). To the authors' knowledge, however, this is the first documented case of danburite inclusions in phenakite.

Sai Gon Khay and Kyaw Thu
S Gemmological Institute (SGI)
Yangon, Myanmar

Lithiophilite in Quartz

The 52.52 ct transparent colorless quartz in figure 6 displayed a large orange crystal near the surface with a well-formed bipyramidal habit. The crystal surface showed growth features and had weak pleochroism.

Raman microanalysis identified the inclusion as lithiophilite. Lithiophilite ($LiMn^{2+}PO_4$) is a member of the triphylite group and quite rare as an inclusion in quartz, especially in such a well-crystallized form. Lithiophilite generally forms in granitic pegmatites, mostly in environments rich in lithium and phosphorus. This unique inclusion in quartz is one of the best well-crystallized examples of lithiophilite that the authors have observed.

Liyan He
Guangdong Gemstones & Precious Metals Testing Center
Guangzhou, China

Wingtak Lui and Wang Zhang
Min De Minerals & Gem Research Co., Ltd.
Nanjing, China

Monazite in Quartz

Recently, several platy orange-yellow inclusions were observed within a highly transparent colorless quartz crystal

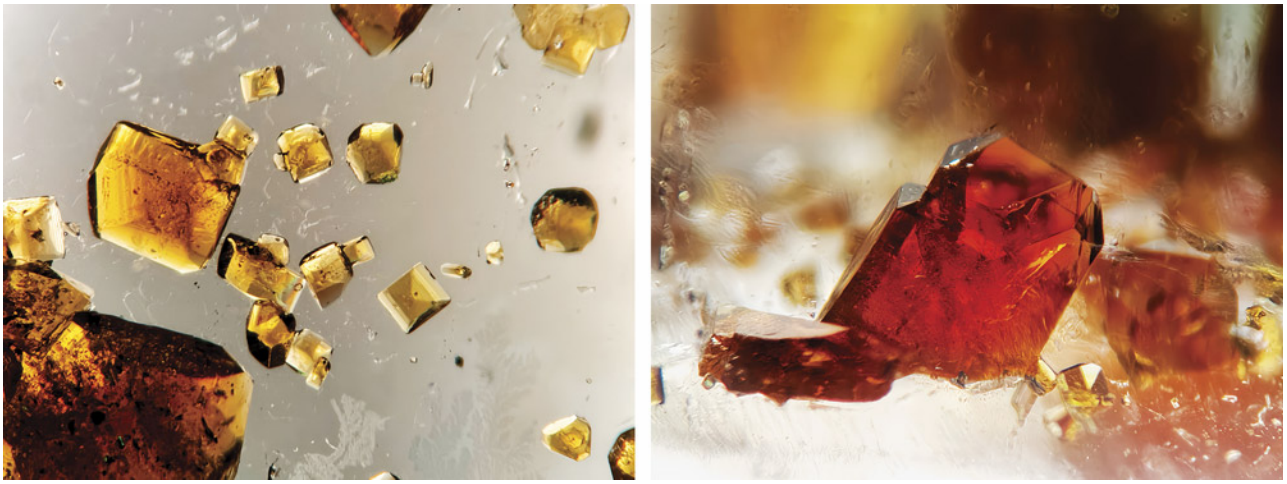


Figure 7. Left: Numerous orange-yellow to orange solid inclusions are visible within the transparent colorless quartz. Right: Closer observation reveals bright orange wedge-shaped crystals. Photomicrographs by Wingtak Lui; fields of view 5.1 mm (left) and 3.2 mm (right).

(figure 7, left). These inclusions exhibited an orange-yellow to orange color, a smooth surface, and a glassy luster, with a euhedral or subhedral appearance. Closer inspection revealed that some crystals displayed the typical wedge shape of monoclinic crystals (figure 7, right). This distinct crystal morphology and vibrant color prompted further investigation into their composition.

Raman spectroscopy identified the inclusions as monazite, a phosphate mineral ((Ce,La,Nd,Th)PO_4). Further analysis using X-ray fluorescence confirmed a high concentration of cerium, classifying the inclusions specifically as monazite-(Ce).

Rui Rui Xing, Wingtak Lui, and Tsu Wei Chang
Min De Minerals & Gem Research Co., Ltd.
Nanjing, China

Mystery Pebbles in Quartz

Sometimes strange specimens come to us for examination and publication in the *Micro-World* column. The transparent to opaque, partially polished crystal of doubly terminated rock crystal quartz shown in figure 8 is one such example.

The crystal weighed 150.97 ct and measured 55.52 × 24.59 × 19.13 mm. Raman analysis revealed that the pebbles embedded in the quartz were composed of a mineral in the amphibole supergroup, though the exact type of amphibole remains unknown.

Thought to have come from the Fengjiashan mine in Daye County, Hubei Province, China, the crystal contained numerous opaque light gray to white and yellowish fibrous rounded pebbles with a felted texture, in various

Figure 8. This 150.97 ct quartz crystal hosts pebbles of an amphibole, stacked like rocks in a stone wall. Photo by Annie Haynes.

Figure 9. The fibrous felted texture of the amphibole pebbles was revealed under magnification. Photomicrograph by Nathan Renfro; field of view 20.57 mm.

sizes up to 12 mm, as shown in figure 9. Overall, the inclusion scene had the appearance of rocks stacked in a stone wall. How the inclusions formed in this way is a gemological mystery, but they certainly provided us with a very photogenic specimen.

John I. Koivula, Nathan Renfro, and Maxwell Hain
GIA, Carlsbad

Well-Formed Rutile Star in Quartz

Rutile, one of the five forms of titanium dioxide, can be found in many gemstones as inclusions. In this colorless cabochon, acicular crystals of rutile formed around a hematite core as a protogenetic mineral to the quartz host. A large quantity of rutile needles intersects and radiates outward to form a six-rayed "star" inclusion (figure 10). While rutilated quartz is not uncommon, this attractive inclusion provided a striking contrast to the colorless quartz backdrop.

Isabelle Corvin
Olympia, Washington

"Sugar Plum" in Titanium-Diffused Blue Sapphire

A recently examined 4.20 ct blue sapphire included a frosted cluster surrounded by a rimmed bubbly discoidal

Figure 10. Intersecting needles of rutile form a "star" inclusion in this colorless quartz. Photomicrograph by Isabelle Corvin; field of view 2.2 mm.

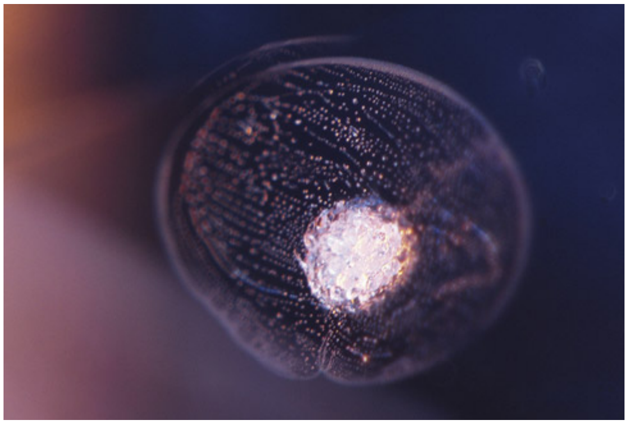


Figure 11. A sugar plum–like frosted zircon cluster in blue sapphire. Photomicrograph by Taku Okada; field of view 1.05 mm.

Figure 12. A 6.28 ct faceted yellow sphene exhibited interference "soap bubbles." Photomicrograph by Ungkhana Atikarnsakul; field of view 3.6 mm.

fingerprint, resembling a sugar plum, Portuguese *confeito*, or Japanese *konpeito* (figure 11). The inclusion appeared to be a former zircon ($ZrSiO_4$) cluster, which is a common inclusion in sapphire and decomposes after heat treatment above about 1400°C (W. Wang et al., "The effects of heat treatment on zircon inclusions in Madagascar sapphires," Summer 2006 *G&G*, pp. 134–150). When viewed with diffused white light, the stone displayed concentrations of blue color at the facet edges of the pavilion, indicating titanium diffusion treatment, which usually happens around 1675–1750°C for 96–150 hours (R.W. Hughes et al., *Ruby & Sapphire: A Gemologist's Guide*, RWH Publishing/Lotus Publishing, Bangkok, 2017). At such high temperatures, the aluminum oxide (Al_2O_3) component of the surrounding corundum decreases the melting point of the decomposing zircon and causes partial melting, especially through interaction with the SiO_2 component of the zircon inclusion (W. Wang et al., 2006). High-temperature heat treatment sometimes creates such sugar plum–like frosted zircon inclusions as seen in this sapphire.

Taku Okada
GIA, Tokyo

"Soap Bubbles" in Yellow Sphene

Sphene, better known to mineralogists as titanite ($CaTiSiO_5$), is typically yellow, green, orange, or brown in color and is known for its incredible fire resulting from high dispersion. Recently, the author examined a 6.28 ct yellow cushion-cut stone displaying fire and strong eye-visible doubling. Its over-the-limit refractive index reading and visual appearance, as well as Raman spectroscopy, identified the specimen as sphene. Internal growth features, healed fissures, and a cloud of reflective particles were observed. Interestingly, the reflection of light from minute particles within the doubly-refractive sphene resulted in the appearance of a cloud of soap bubble–like inclusions, displaying interference colors in some crown facets (figure 12). The inclusions were best viewed with oblique fiber-optic lighting, creating a fantastic scene in this yellow sphene.

Ungkhana Atikarnsakul
GIA, Bangkok

Figure 13. Weighing 2.22 ct and measuring 8.26 mm in the largest dimension, this unique diamond octahedron contains a high-relief, three-dimensional phantom visible through all eight octahedral faces. Photo by Diego Sanchez.

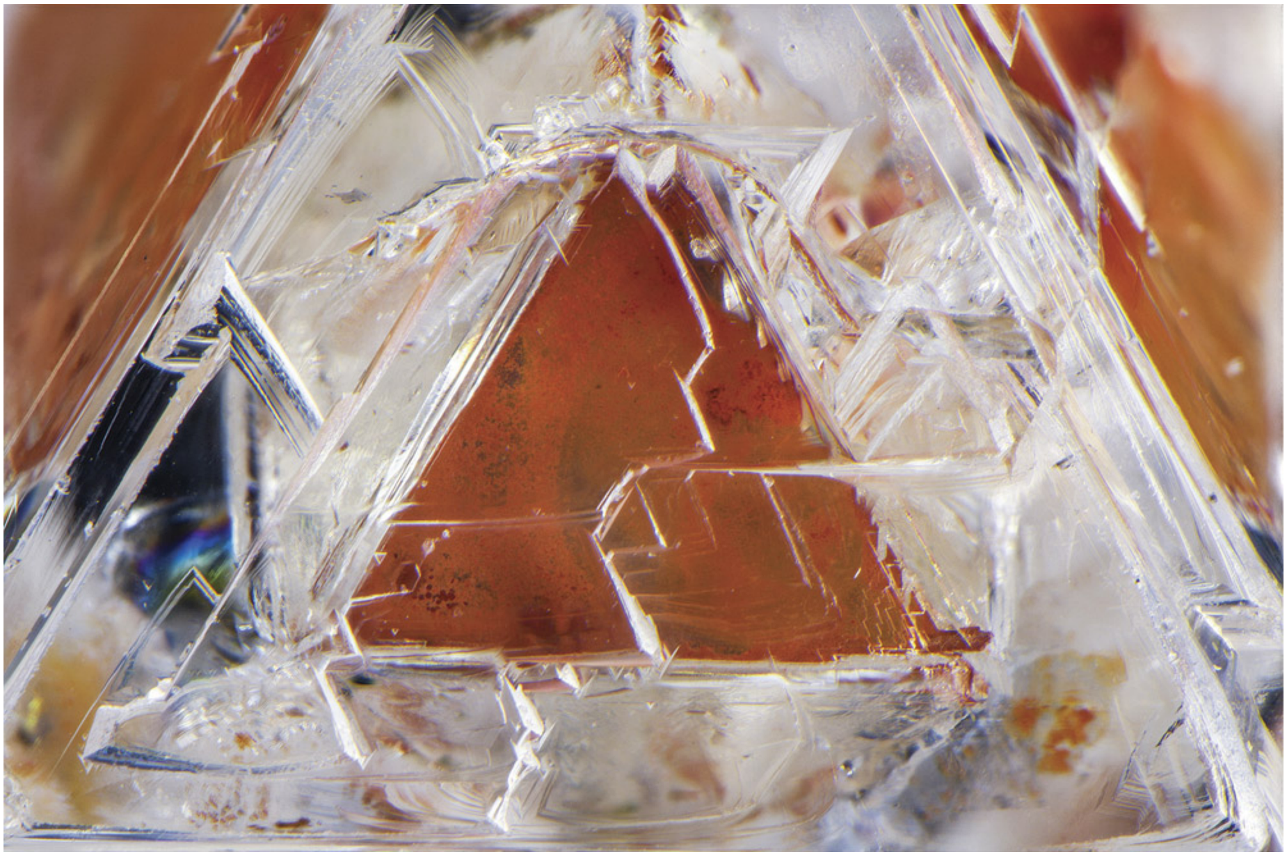


Figure 14. One of eight triangular limonitic faces in the 2.22 ct diamond crystal containing a phantom. Photomicrograph by Nathan Renfro; field of view 4.78 mm.

Quarterly Crystal: Unique Phantom in Diamond

When we think about phantoms as inclusions, quartz typically comes to mind. However, this Quarterly Crystal is a bit different, in that the phantom examined resides in a well-formed, transparent octahedral diamond crystal reportedly from the De Beers mine in the Republic of South Africa (figure 13). The colorless diamond host measures 8.26 × 6.20 × 5.37 mm, weighs 2.22 ct, and was purchased from David New in 1989 in Tucson, Arizona.

As shown in figure 14, the phantom is a most unusual octahedral orangy red-brown limonitic crystal formation showing trigons and dark green radiation stains on its inner surfaces. The triangular faces of the phantom were likely once composed of an iron sulfide, such as pyrrhotite, which was subsequently altered epigenetically to limonite, a rusty mixture of hematite and goethite.

The complete phantom is visible through each of the eight octahedral faces of the diamond host. We have never encountered anything like this unique diamond crystal, nor does the literature on diamonds contain any such descriptions of similar phantoms.

John I. Koivula and Nathan Renfro
GIA, Carlsbad