G&G Micro-World

Unusual Cloud in Diamond

GIA's laboratories issue clarity grades for many diamonds for the gem trade. So when we observe a diamond with clarity characteristics we have not encountered before, we generally consider those features to be rather rare and worth documenting for future reference.

Recently, just such a diamond was examined in the Carlsbad lab. It was a 0.62 ct round brilliant with very good polish and symmetry and a very light brown bodycolor. The diamond exhibited a faint light blue fluorescence to long-wave radiation and an inert reaction upon exposure to short-wave UV.

The gem's I_1 clarity grade resulted from a delicate cloud of cruciform dislocations (figure 1), forming numerous small interlinked cross-like patterns in the diamond host, which were visible face-up through the table facet. The shape and orientation of the overall cloud suggests that the cube face of the original diamond crystal was parallel to the table facet of the faceted diamond.

We regularly encounter cloud clarity features in diamonds, but this fascinating geometric network was a "first encounter" for us.

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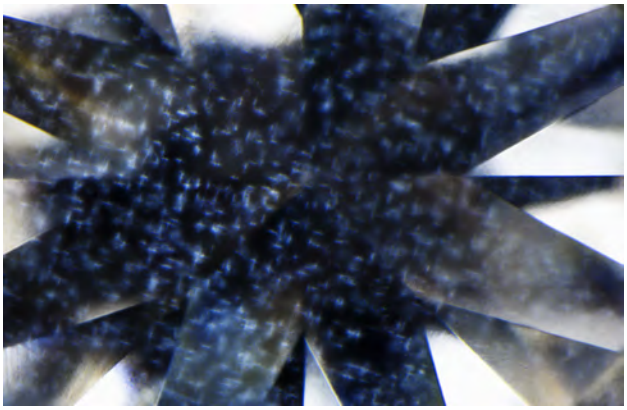

Figure 1. This delicate interlinked cross-like cloud pattern found in a 0.62 ct diamond has never been encountered in GIA's laboratories. Photomicrograph by Nathan Renfro; field of view 2.40 mm.

Hematite in Quartz: "A Rose by Any Other Name"

Careful exploration of the micro-world can often reveal extraordinary crystal formations, even in relatively inexpensive, somewhat ordinary jewelry. The silver pendant shown in figure 2, measuring 31.50 × 17.00 × 10.00 mm, was purchased by author CF in 1996 from a Brazilian dealer at the

Figure 2. A plain quartz silver pendant measuring 31.50 × 17.00 × 10.00 mm encapsulates extraordinary inclusions of complex hematite crystals. Photo by Conny Forsberg.

About the banner: Lattice-like exsolution products of hematite and ilmenite show iridescent colors with oblique fiber-optic lighting in an Australian orthoclase feldspar known in the trade as "rainbow lattice sunstone." Photomicrograph by Nathan Renfro; field of view 7.20 mm.
Editors' note: Interested contributors should contact Nathan Renfro at nrenfro@gia.edu and Jennifer-Lynn Archuleta at jennifer.archuleta@gia.edu for submission information.

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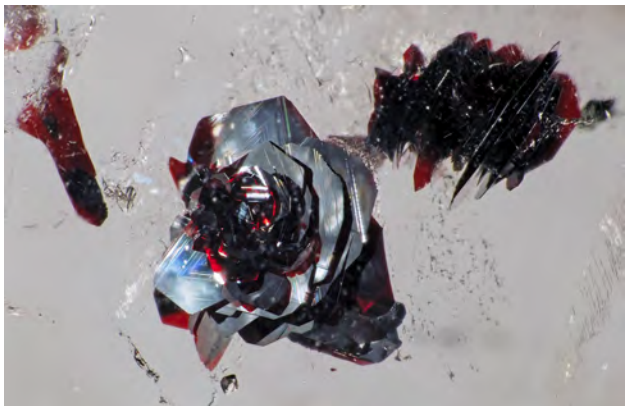

Figure 3. One of the quartz cabochon's perfect "rose" habit inclusions exhibits fine, well-crystallized thin platelets of hematite. Transmitted and oblique halogen fiber-optic lighting. Photomicrograph by Conny Forsberg; field of view 5.00 mm.

Pueblo Show in Tucson, Arizona. It stood out among many others for its aesthetic swarm of crystal inclusions (later identified by their color and morphology as hematite), while their host was confirmed to be quartz using standard gemological techniques, including refractive index and optical testing. Several of the included crystals exhibited a complex habit known to mineral collectors as a "hematite rose"—an aggregate of crystal platelets arranged very much like the blooms of its botanical namesake. One of these inclusions was oriented in such a way that it lent itself to easy observation and photomicrography; this is not always the case with jewelry pieces whose construction may obscure the internal view or make lighting the inclusions tricky. A halogen light source with dual fiber-optic wands was used to successfully illuminate the rose from an oblique angle and to bounce light off the microscope plate in order to provide transmitted lighting (figure 3).

While quartz is a silicate, hematite is an iron oxide; both crystalize in the trigonal system. The surfaces of the fine, well-crystallized platelets of hematite exhibit triangular growth steps revealing this mineral's underlying symmetry. These very thin plates reveal a deep red color in transmitted light. Quartz has a large thermal expansion coefficient, larger than that of hematite. Therefore, we would not expect cooling from the formation conditions to create a thin gap between the quartz and the hematite capable of producing thin-film interference colors, which are indeed absent here. Freely grown macro-specimens command hefty prices in the mineral-collecting world; however, an observant inclusionist may obtain one very frugally. This hematite crystal formation is as lovely as any rose and a fitting bloom for any gemologist's micro-world garden.

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Silvery Rutile "Tufts" in Quartz

Recently, author JG discovered a deposit of rock crystal quartz in El Dorado County in east-central California. To date, more than 1,000 quartz crystals have been recovered from a single pocket in this deposit. Almost 50 percent of those crystals contained interesting silvery gray tufts of the titanium dioxide mineral rutile (figure 4), which was identified using Raman spectroscopy. Rutile in quartz typically occurs as golden needles, but it can occasionally be found as reddish brown, green, or silvery gray needles.

While the cause of the star-like needle arrangement in these particular clusters is not known, it is possible that the gray rutile is overgrown on a core crystal of anatase, which is a polymorph of rutile and might influence the morphology of the cluster. Tufts of golden rutile with a similar morphology have been observed overgrown on blue core crystals of anatase by author NR, which may explain the morphology in this sample; however, it was not possible to confirm this. A similar occurrence of gray rutile overgrowth is known to occur in the material sold as "platinum quartz" from Currelo in Minas Gerais, Brazil, where it is overgrown on the other rutile polymorph, brookite (see E.J. Gübelin and J.I. Koivula, *Photoatlas of Inclusions in Gemstones*, Vol. 2, Opinio Verlag, Basel, Switzerland, 2005, p. 588).

While production volume of quartz with these silvery rutile inclusions remains uncertain, this deposit has already provided interesting and beautiful additions to the micro-world.

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Figure 4. Quartz crystals containing stellate tufts of silvery gray rutile were recently discovered in east-central California. Photomicrograph by Nathan Renfro; field of view 9.48 mm.

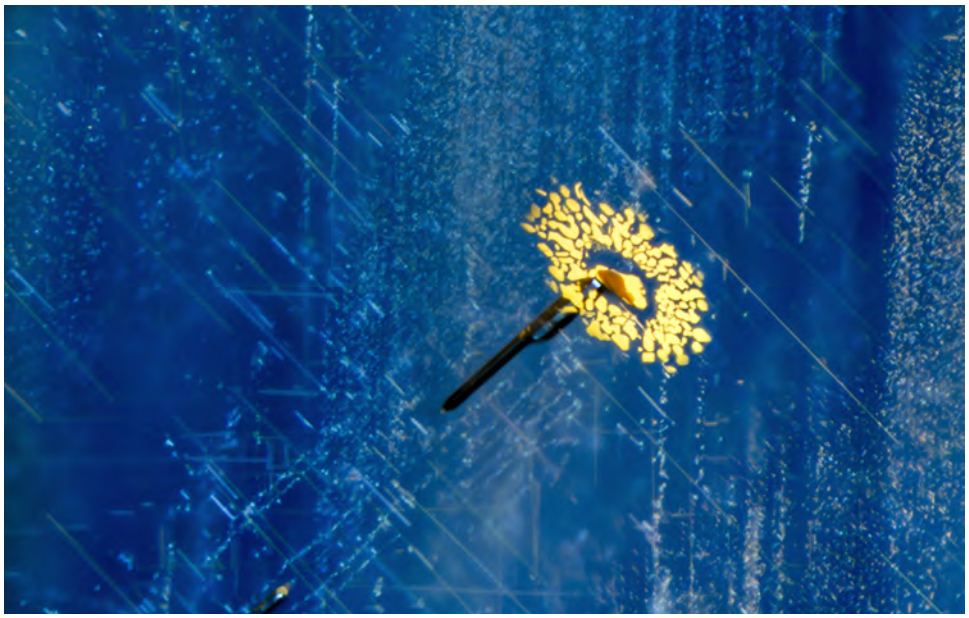

Figure 5. Reminiscent of a flower in a rainstorm, this inclusion scene has been dramatically enhanced using modified Rheinberg illumination to accentuate a growth blockage and thin-film rosette within a sapphire from Elahera, Sri Lanka. Photomicrograph by Jonathan Muyal; field of view 1.34 mm.

"Flower in the Rain" Inclusion in Sri Lankan Sapphire

The island of Sri Lanka is famous for gems but is also notable for its enormous biodiversity. It therefore seemed fitting that when these authors encountered a fascinating inclusion reminiscent of a beautiful flower within a Sri Lankan sapphire, it would embody these themes.

This 3.64 ct blue sapphire specimen from Elahera exhibited an interesting growth blockage resulting in an elongate tube capped by a rosette-like thin-film fluid inclusion. To further enhance the inclusion scene, Rheinberg illumination (Fall 2015 Micro-World, pp. 328–329) using blue and yellow filters provided additional contrast. This lighting technique transformed the inclusion scene into an easily imagined, vibrantly colored flower caught in a rainstorm, something one might encounter while visiting the tropical island nation (figure 5).

Growth blockages occur when a foreign mineral grain or particle interrupts the growth of a crystal (Spring 2010 Lab Notes, pp. 55–56). As the crystal continues to grow, an elongate void is typically produced, which may extend to the surface or be capped off, as seen in this sapphire. Even though a growth blockage is not diagnostic of Sri Lankan origin in sapphire, this inclusion scene is an appropriate symbolic representation of the "resplendent isle."

Jonathan Muyal and Nathan Renfro
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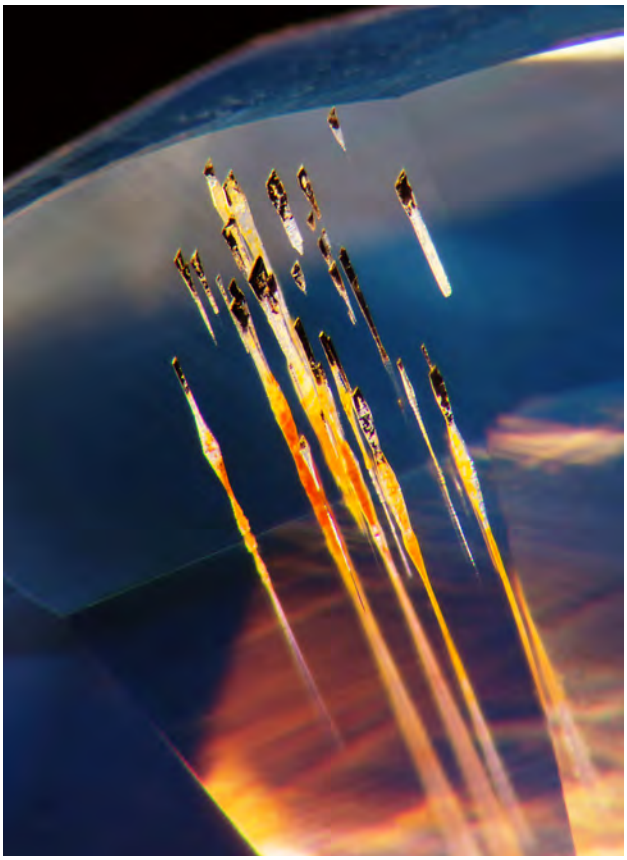
Growth Tube Cluster in Sapphire

Growth tubes are a typical inclusion in corundum and often seen during examination in the laboratory. While commonplace, a stunning cluster such as the one seen in figure 6 calls out to the photomicrographer. At the surface these tubes are cut through and some black debris has be-

Figure 6. Surface-reaching growth tubes within a sapphire exhibit unaltered yellowish staining, an indication that the stone has probably not been heated. Combined with other observations, this suggests a possible Madagascar origin. Photomicrograph by E. Billie Hughes; horizontal field of view 1.4 mm.



come lodged inside the ends, while deeper within the stone they still display a fiery glow, reminiscent of rockets launching into the sky.

Not only do these tubes spark the imagination, but they can actually tell us a lot about the identity of their sapphire host. The limonitic staining found deeper in the tubes is a yellowish orange, suggesting that they have not been altered by heat treatment. These stains often turn a darker reddish or brownish color in heat-treated stones (J.I. Koivula, "Useful visual clue indicating corundum heat treatment," Fall 2013 *G&G*, pp. 160–161).

Furthermore, we have observed in the past several months that these prominent growth tubes are a common feature in Madagascar sapphire. While the tubes can be found in corundum from other origins, they seem particularly common in the Madagascar material that has been entering the Bangkok market in greater numbers recently. When taken into account along with other features, they provide a clue to the origin of these sapphires. Thus, what initially appeared to be a mundane inclusion is both visually impressive and gemologically significant, as it provides hints to the origins and treatments of corundum.

Figure 7. This 247.02 ct bright yellow fluorite partial crystal, which measures 40.04 mm tall, hosts two large concretions of bone-white barite. Photo by Kevin Schumacher.

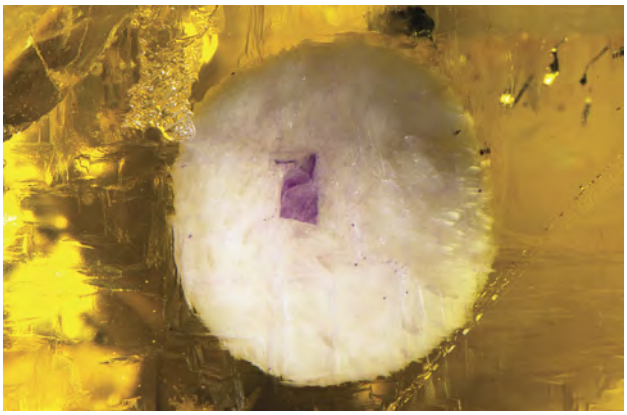


Figure 8. The largest of the two barite inclusions has a prominent purple spot on the top of its dome, which is easily seen against the white background provided by the inclusion. Photomicrograph by Nathan Renfro; field of view 13.71 mm.

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Quarterly Crystal: Barite in Fluorite

Although gemologists deal primarily with fashioned gemstones, some crystal specimens are far too attractive as intact objects to be used as cutting rough. This is particularly true if they contain eye-visible inclusions like those seen in the 247.02 ct transparent yellow fluorite partial crystal shown in figure 7.

At 40.04 mm in its longest dimension, this specimen invites exploration of its inclusions, which were identified as barite using laser Raman microspectrometry. The larger of the two barites measures 7.0 mm in diameter and has a microscopically prominent rectangular purple spot on the apex of its dome (figure 8), which clearly stands out against the stark white background provided by the barite inclusion. Although the cause of the spot is unclear, the contrasting assemblage of colors adds to this specimen's value as an aesthetic collector piece.

John I. Koivula