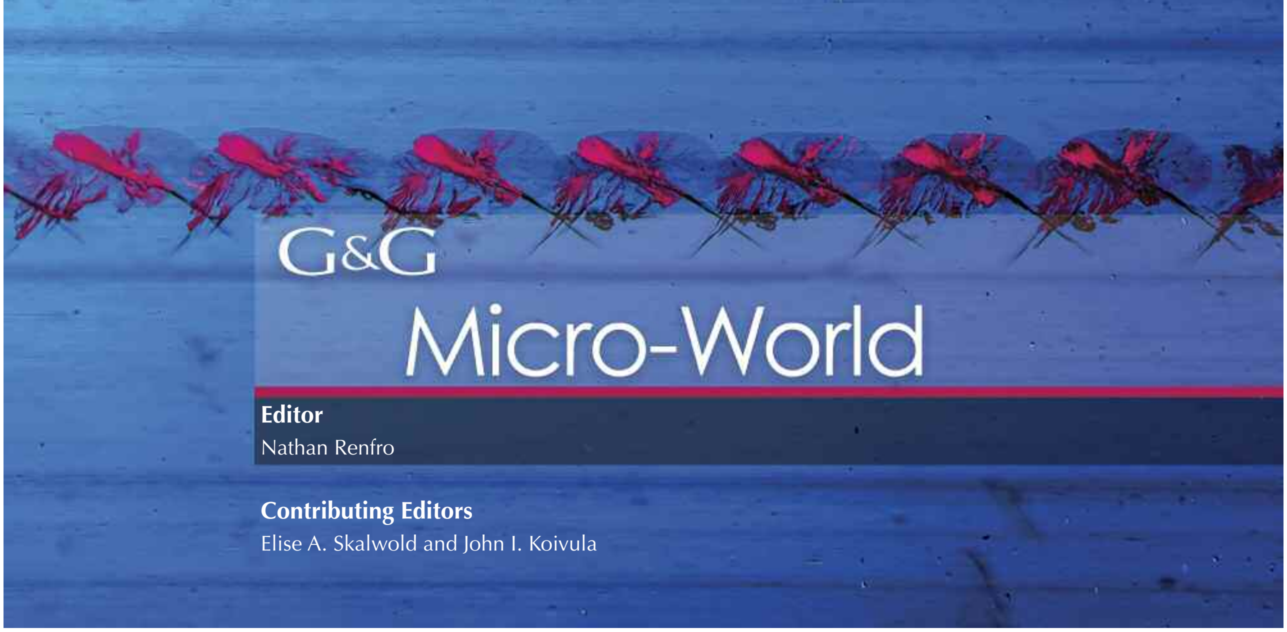

G&G Micro-World

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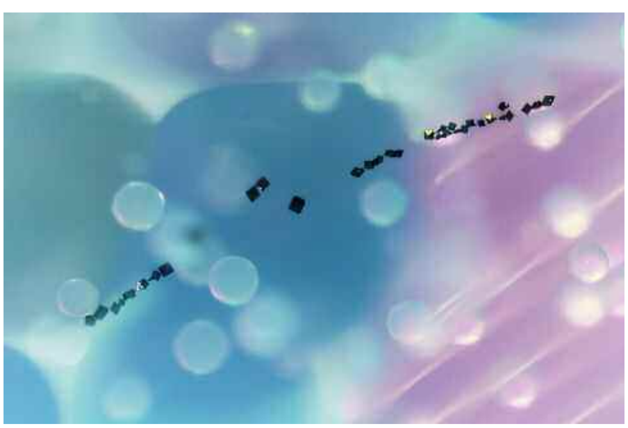
Aragonite Spheres in Ethiopian Opal

Recently, the authors examined an 88.51 ct pear-shaped white precious opal that displayed typical digit patterns and hydrophane behavior (see Fall 2013 Lab Notes, pp. 175–176). These properties were consistent with opal from the Wollo mining area in Ethiopia (see B. Rondeau et al., "Play-of-color opal from Wegel Tena, Wollo Province, Ethiopia," Summer 2010 *G&G*, pp. 90–105). The stone also showed weak whitish blue fluorescence in long-wave UV and was inert to short-wave UV. No phosphorescence was observed.

In addition to its attractive digit pattern with spectral play-of-color, this opal hosted a number of unusual inclusions: opaque black octahedrons and translucent spheres. When viewed with a fiber-optic light, the opaque black octahedrons appeared a dark brassy metallic yellow (figure 1). Raman analysis identified them as pyrite, which has been previously reported in Ethiopian opal (N. Renfro and S.F. McClure, "Dyed purple hydrophane opal," Winter 2011 *G&G*, pp. 260–270). Of particular interest is that the translucent spherical inclusions (figure 2), which formed as isolated spheres and clusters, were identified by Raman

Figure 1. This Ethiopian opal contained an interesting inclusion scene consisting of a string of octahedral pyrite crystals and aragonite spheres. Photomicrograph by Charuwan Khowpong; field of view 1.40 mm.



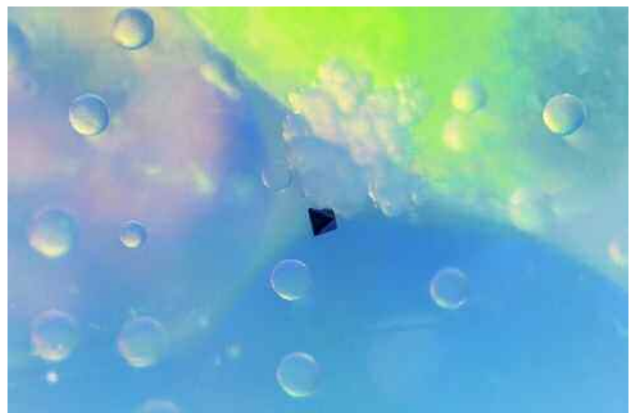


Figure 2. A single pyrite crystal is seen among spheres and clusters of translucent aragonite inclusions, both of which were identified by Raman spectroscopy. Oblique fiber-optic illumination. Photomicrograph by Charuwan Khowpong; field of view 1.05 mm.

About the banner: Modified Rheinberg illumination highlights the crystallographically aligned tension cracks in this topaz crystal. Photomicrograph by Nathan Renfro; field of view 10.29 mm. Specimen courtesy of John S. White.

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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analysis as aragonite. The presence of aragonite spheres in opal is quite uncommon and has not been previously reported in precious opal from Ethiopia.

Ratima Suthiyuth and Charuwan Khowpong
GIA, Bangkok

Remarkable Twinned Calcite Inclusion in Mogok Ruby

The Mogok Stone Tract in Myanmar (formerly Burma) is one of the world's most famous sources of ruby, which often forms there in a calcite-marble host. Calcite may occur as an inclusion inside the ruby, as in the example in figure 3. In this stone, the calcite is easy to spot between crossed polarizers, which reveal polysynthetic twinning planes that "crisscross" the crystal. While calcite is a common inclusion in ruby, this is the clearest example of calcite twinning this author has seen. Surrounding the calcite crystal is a dense, angular nest of exsolved rutile silk as short needles, a typical scene in rubies from this locality.

E. Billie Hughes
Lotus Gemology, Bangkok

Figure 3. Viewed between crossed polarizers, an included calcite crystal within an unheated Burmese ruby displays dramatic twinning planes. Photomicrograph by E. Billie Hughes; field of view 3.90 mm.

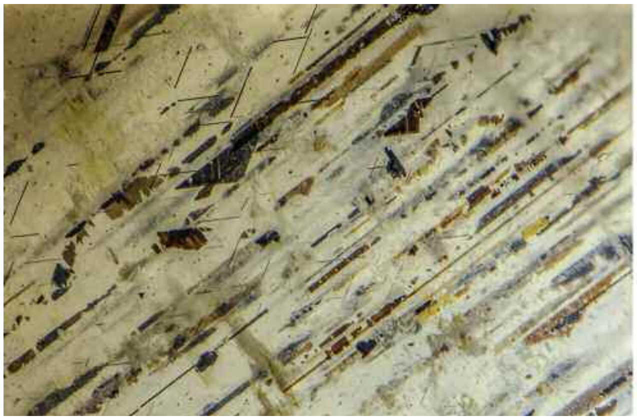
New Phenomenal Feldspar from North Carolina With Iridescent Inclusions

Several varieties of aventurescent feldspar are well known in the gem trade. Of these, one of the most remarkable is orthoclase from the Hart's Range area in Australia. This unique material showcases exsolution platelets of hematite and ilmenite that display thin-film interference colors along the interface between the exsolution product and the feldspar host. Because of its array of colors and the crosshatch pattern of exsolution platelets, the material's trade name is "rainbow lattice sunstone."

The authors recently examined samples of potassium feldspar from a relatively obscure source (figure 4) that displayed a phenomenon remarkably similar to Australian rainbow lattice sunstone. This new material is reported to be from the Statesville area of North Carolina and contains brown and black exsolution platelets of hematite and ilmenite showing thin-film interference colors along the interface with the host feldspar. This deposit was first reported by George Frederick Kunz (*Gems and Precious Stones of North America*, The Scientific Publishing Co., New York, 1890, p. 164). Chemical analysis of the feldspar was performed using laser ablation–inductively coupled plasma–mass spectrometry (LA-ICP-MS), and the results were consistent with potassium feldspar.

Local prospector Ryan Underwood first found samples of this material as loose crystal fragments and traced them back to their source rock, a metamorphic biotite gneiss. The crystals are brittle, apparently as a result of metamorphic stresses, and tend to cleave during cutting. As such, material suitable for cutting is rare and finished stones tend

Figure 4. Brown and black exsolution platelets of hematite and ilmenite in feldspar (left) show colorful thin-film interference colors in oblique fiber-optic illumination (right). Photomicrographs by Nathan Renfro; fields of view 3.55 mm.



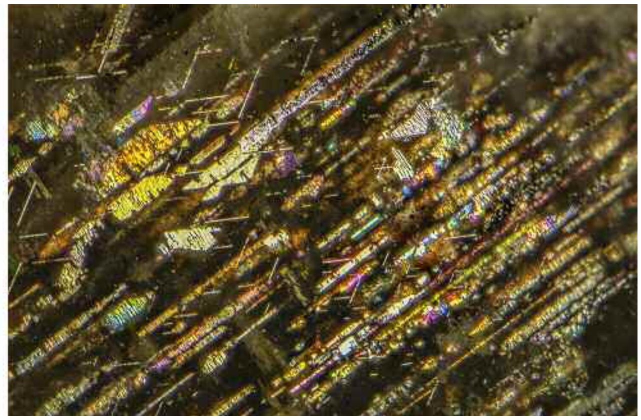


Figure 5. This octahedral-shaped negative crystal in a Burmese red spinel is filled with colorless carbonate crystals, yellow sulfur-rich liquid, opaque sulfide crystals, and diaspore fibers. Photomicrograph by Victoria Raynaud; field of view 1.20 mm.

to be small (though some large multicrystalline specimens up to 30 cm in diameter have been recovered). Base colors include blue-gray, tan, and a pink color apparently induced by additional fine hematite inclusions.

Stephen Challener
Raleigh, North Carolina

Nathan Renfro and Ziyin Sun
GIA, Carlsbad

Complex Yellow Fluid Inclusions in Red Burmese Spinel

Spinel has found new popularity and is now recognized as a birthstone for August. Some of the most desirable stones come from Myanmar, as they exhibit a pure red color with a light tone, accompanied by extremely high fluorescence under long-wave UV. Red Burmese spinel can also be found with a dark tone and much weaker fluorescence. The main localities that produce the highly fluorescent spinel are Namya in northern Myanmar and Man Sin in the Mogok Valley (V. Pardieu, "Hunting for 'Jedi' spinels in Mogok," Spring 2014 *G&G*, pp. 46–57). Clean stones are rare, as the majority have inclusions consisting of colorless carbonate crystals and complex multiphase negative crystals. These complex negative crystals contain a sulfur-rich yellow liquid, opaque metal sulfides, transparent carbonate daughter crystals, diaspore fibers, and a gas bubble. This unique yellow complex fluid inclusion (figure 5) is only known to occur in Burmese spinel and therefore serves as a good indicator of this origin.

Wim Vertriest
GIA, Bangkok

Victoria Raynaud
DANAT, Manama, Bahrain

Tourmaline Crystals on Burmese Ruby

During a GIA field expedition to Mogok, Myanmar, a tiny but interesting sample was acquired. This 0.552 ct ruby was purchased from local Kanase miners who process the tailings of the larger mines in the Kyatpyin Valley, just west of the town of Mogok. The ruby is associated with pure white calcite and bluish green tourmaline (figure 6).

Many rubies form in marble, especially in the deposits related to the Himalayan orogeny (Afghanistan, Tajikistan, Myanmar, and Vietnam), so calcite as an inclusion or associated mineral with these gems is common. While tourmaline in combination with ruby is not unheard of, it is a relatively unusual combination. LA-ICP-MS chemical analysis showed that the tourmaline was a Na-Mg-rich dravite. Tourmalines are of great interest to geologists be-

Figure 6. Bluish green tourmaline crystals and white calcite on a Burmese ruby. Photo by Charuwan Khowpong; field of view 2.48 mm.

Figure 7. This vibrant yellowish green crystal in a faceted ruby from Myanmar was identified as vesuvianite. Photomicrograph by Nathan Renfro; field of view 1.20 mm.

cause their isotopic and trace element composition are potentially strong indicators of the formation environment of the tourmaline and the associated minerals, in this case ruby.

Wim Vertriest and Charuwan Khowpong
GIA, Bangkok

Vesuvianite in Burmese Ruby

It is a pleasant surprise when a gemologist encounters a vibrantly colored crystal in a gemstone, as most gems are either inclusion free or contain inclusions that are weakly colored due to their small size. When the authors discovered a vibrant yellowish green crystal in a Burmese ruby (figure 7), it was a very welcome sight. Green crystals in corundum are not common but do occur occasionally. Green spinel and pargasite both occur in gem corundum. The former, a singly refractive mineral, was ruled out immediately because this inclusion behaved as a doubly refractive mineral when examined between crossed polarizers. Doubly refractive pargasite remained a possibility. The surprise came when Raman microspectrometry identified the yellowish green crystal as vesuvianite, also known as idocrase. To the authors' knowledge, this is the first time vesuvianite has been reported as an inclusion in ruby.

Nathan Renfro and John Koivula
GIA, Carlsbad

Wollastonite Blizzard Within Glass

A collection of lovely faceted blue beads was presented to author EAS during an annual meeting of inclusion specialists at the 2017 Tucson shows. While most specimens of interest highlighted in these meetings are of extraordinary naturally occurring minerals and gem materials—some of which have appeared in this column—these rather ordinary beads were intriguing for the veritable blizzard of translucent colorless needles and short euhedral crystals that filled each one. They created a beautiful optical effect, especially when illuminated from below (figure 8). Upon acquisition, the original owner had been told these were Russian synthetic quartz, and indeed their age and azure color suggested such an origin. It came as a surprise when standard gemological testing (RI of 1.518, SG of 2.47, and the absence of birefringence) identified the beads as glass, making the internal scene even more intriguing for its natural appearance. Raman spectroscopy at GIA's Carlsbad laboratory identified the beads as manufactured glass, and the majority of the nee-

Figure 8. Faceted manufactured glass beads measuring approximately 8 mm in diameter. Photo by Robison McMurtry.

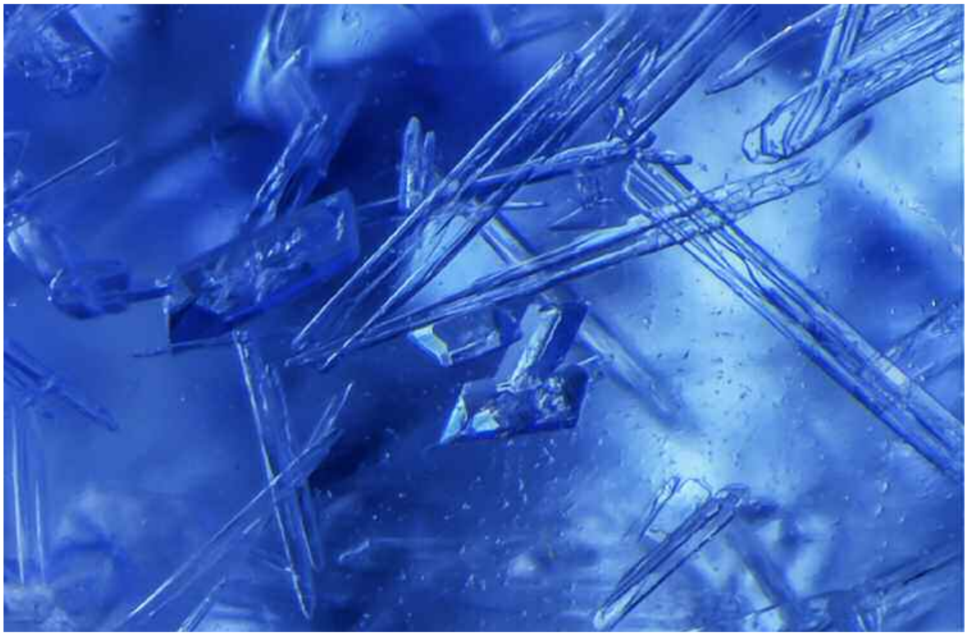


Figure 9. Transmitted light reveals a blizzard of transparent wollastonite needles within the glass host, an indication of devitrification. Interspersed among the needles are blocky crystals of diopside. Photomicrograph by Nathan Renfro; field of view 2.03 mm.

dles as the calcium silicate mineral wollastonite (figure 9). Additionally, relatively small blocky crystals scattered among the needles were conclusively identified as diopside (see Summer 2010 Lab Notes, p. 144).

Inclusions in glass such as wollastonite and diopside are indicators of devitrification, a process by which various components of the glass's composition crystallize out when subjected to high temperatures and/or changes in temperature. The process varies according to the type of glass. This may also happen in natural glasses, as with obsidian, resulting in the attractive lapidary material known as snowflake obsidian, which sports white blooms of cristobalite crystals on a black background. Devitrified glass is also sometimes used to imitate natural gems, as seen in manufactured "meta-jade." The beautiful blue inner world of these beads makes them a welcome addition to one's library of inclusions.

Elise A. Skalwold
Ithaca, New York

Nathan Renfro

Quarterly Crystal: Shattuckite in Quartz

For our "Quarterly Crystal" in the Micro-World column, we are always searching for unusual crystal specimens that contain interesting mineral inclusions and other micro-features worthy of description. This quarter's offering is an intergrown cluster of quartz crystals that play host to a rich blue deposition of the orthorhombic copper silicate mineral shattuckite, which typically forms aggregates of spherulitic to circular masses composed of acicular crystals (figure 10). The 41.27 mm long quartz crystal grouping (figure 11) came from the Kandesei mine in the Kunene region of Namibia and was acquired from Jordi Fabre (Fabre Minerals, Barcelona).

The inclusions were situated in the quartz crystals in the form of phantoms that developed through the deposition of the shattuckite on the surface. Laser Raman microspectrometry identified the phantom layers as shattuckite. As the quartz continued to grow, the shattuckite was captured as inclusion phantom planes tracing the form of the original quartz host.

Named for the type locality—the Shattuck mine in Bisbee, Arizona—shattuckite is a medium to deep blue mineral with a silky luster. A secondary mineral in oxidized copper deposits, shattuckite is often found together with ajoite, chrysocolla, and malachite, in addition to quartz.

John Koivula

Figure 10. As an inclusion in quartz, shattuckite typically forms aggregates of circular to spherulitic masses composed of acicular crystals. Photomicrograph by Nathan Renfro; field of view 3.55 mm.

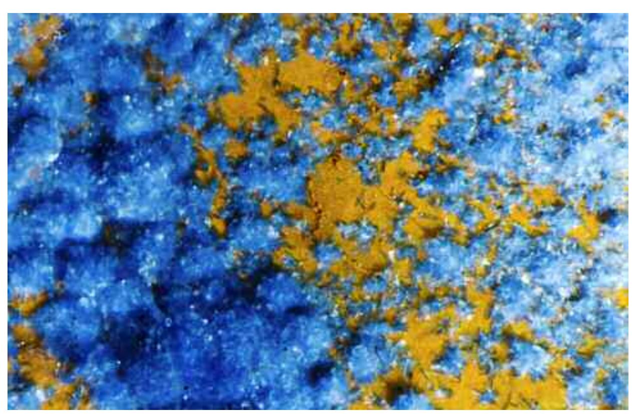


Figure 11. Measuring 41.27 mm and weighing 164.63 ct, this quartz crystal cluster contains a phantom composed of an abundance of deep blue radial concretions of shattuckite, forming a rich blue felted mat. Photo by Kevin Schumacher.