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COLORED STONES AND ORGANIC MATERIALS

Naturally healed fractures in Ethiopian opal. During the examination of opals from Shewa, Ethiopia, we encountered several samples showing fractures filled with a translucent material that appeared to be different from the opal. The fractures were about 50 µm wide and distributed over the whole stone. The stones looked as if they had been broken and then glued back together (figure 1). We investigated these samples to verify if this fracture filling was a natural phenomenon or the result of a treatment.

During polishing, we noted that the filling substance was harder than opal (figure 2). With magnification, we observed minute black, opaque octahedral inclusions in both the filling substance and the host opal (again, see figure 2). This suggested that both were opal. We measured the Raman spectrum of the host opal and the filling substance using a Bruker FT Raman equipped with a Nd:YAG laser emitting at 266 nm quadrupled to 1064 nm and coupled to an optical microscope, allowing the measurement of volumes smaller than 100 µm^3. We measured each material several times and obtained Raman spectra with nearly identical features in both zones. a major broad at about 320 cm^{-1}, weaker peaks at 780 and 1057 cm^{-1}, and a broad, intense band centered at about 2900 cm^{-1}. These spectral features are typical for opal. We observed no additional peak in the fracture's spectrum. The difference in visual appearance and hardness between the host and the filler opal may be explained by their different porosity and water contents, for example.

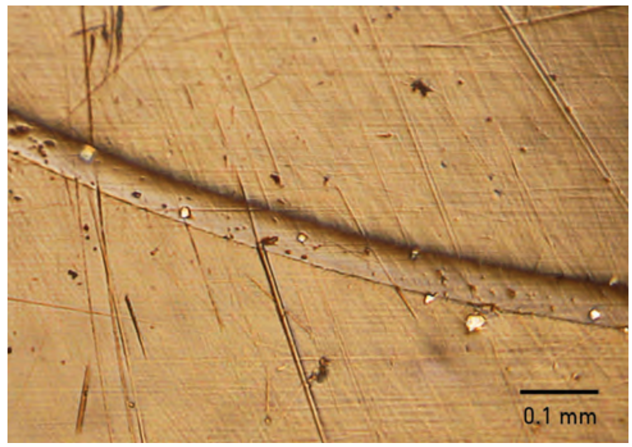
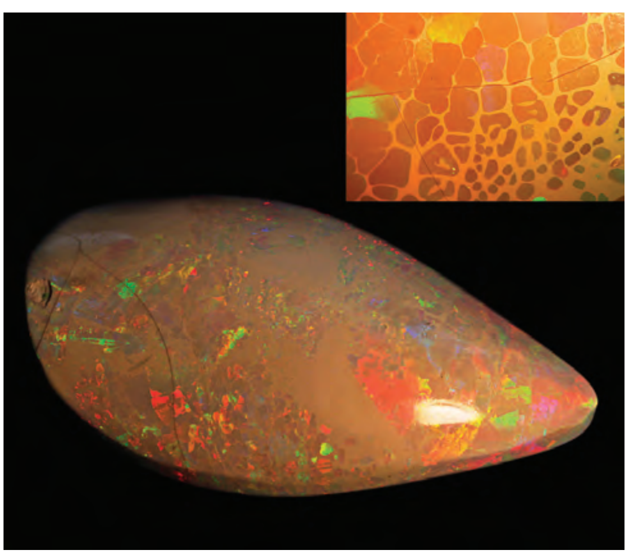


Figure 2. Reflected light on the surface shows that the filling substance is slightly harder than the host opal. The shiny dots are opaque inclusions observed in both the host opal and the filling substance. Photo by Jean-Pierre Gauthier.

Figure 1. This 29.68 ct play-of-color opal from Shewa, Ethiopia, shows thin fractures filled with a colorless substance. Photo by B. Rondeau.



Editor's note: Interested contributors should send information and illustrations to Justin Hunter at justin.hunter@gia.edu or GIA, The Robert Mouawad Campus, 5345 Armada Drive, Carlsbad, CA 92008.

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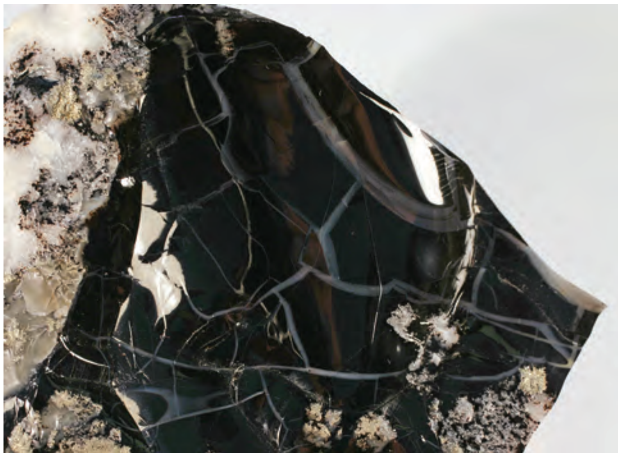

Figure 3. Black common opal from Brittany, France, also shows fractures that developed after the opal formation. They were naturally healed by gray common opal. Photo by B. Rondeau; image width 6 cm.

From these observations, we deduce that the filling of these fractures is a natural phenomenon: The fractures first developed in a well-formed opal, and then a second stage of opal precipitation naturally healed them. From our experience, the fracturing does not hinder the toughness of these opals.

We have encountered such a fracture filling in other opals, such as black common opal (without play-of-color) from Brittany, France. In this case, a network of fractures developed and was naturally healed by a later stage of gray common opal (figure 3). The resulting opal is homogeneous, as shown by the regular propagation of the conchoidal fracture that developed when the stone was extracted.

Gemological labs should note that correct identification requires careful examination to differentiate between naturally healed opals, as described here, and opals with fractures filled with an artificial substance. To our knowledge, this last case has not been documented in the gemological literature, though it is possible in theory.

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New supplier of Montana sapphires. In March 2012, Lisa Brooks-Pike and Margo Bedman formed Sapphires of Montana, a new wholesale and retail outlet for heat-only sapphires originating from the United States. The company's focus is calibrated stones ranging from 2 to 6 mm, with the majority in the 4–4.5 mm range. Stones larger than 6 mm are occasionally offered. Colors available are primarily blue and greenish blue, as well as limited quantities of yellow, orange, and pink stones (figure 4).

Brooks-Pike and Bedman initially acquired about 65 kg of rough from existing stock mined at the Rock Creek deposit in Montana. The rough was then heat treated by Crystal Chemistry (Brush Prairie, Washington) without the addition of color-modifying chemicals (see J. L. Emmett and T. R. Douthit, "Heat treating the sapphires of Rock Creek, Montana," Winter 1993 *G&G*, pp. 250–272). Pike and Bedman have also collaborated with Colombia Gem House (Portland, Oregon) to oversee cutting operations, with the emphasis on optical performance rather than yield. This carefully controlled production is capable of manufacturing high-quality, well-matched suites of sapphire suitable for a number of jewelry designs.

While Montana sapphires have been available for some time, new sources of quality material are always a welcome addition to the trade.

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Figure 4. Sapphires of Montana offers heat-only material in a variety of colors. The faceted stones pictured here range from 3 to 7 mm in diameter. Courtesy of Sapphires of Montana; photo by Sherman Pike.

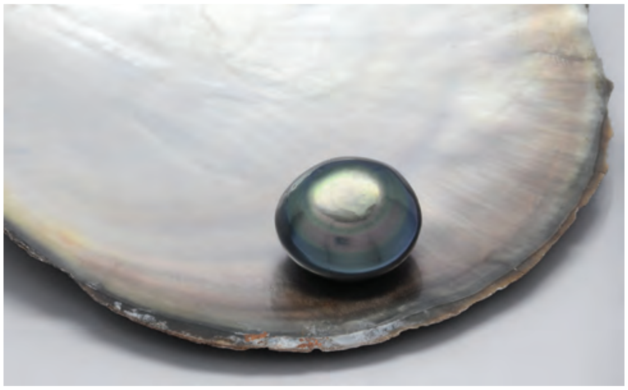

Figure 5. This was one of the large Tahitian black cultured pearls with a baroque-shaped nucleus. Photo by O. Segura.

Figure 6. The cultured pearl shown in figure 5 was cut in half, revealing a white, baroque-shaped nucleus. Photo by O. Segura.

***Pinctada margaritifera* cultured pearl with baroque-shaped nucleus.** The French Gemological Laboratory (Laboratoire Français de Gemmologie, or LFG) recently analyzed 110 Tahitian black cultured pearls presented as keshi (cultured pearls without a nucleus). They were large, up to 25.5 mm in the longest dimension, and slightly baroque, with a very good nacre quality (figure 5). Overtones ranged from green ("peacock") to purple ("aubergine").

Their UV-Vis-NIR spectrometry features were consistent with cultured pearls from *Pinctada margaritifera*, particularly the presence of the 700 nm band (S. Karampelas, "UV-Vis-NIR reflectance spectroscopy of natural-color saltwater cultured pearls from *Pinctada margaritifera*," Spring 2011 *G&G*, pp. 31–35). But microradiography did not reveal the expected structures of keshi (N. Sturman, "The microradiographic structures of non-bead cultured pearls," August 20, 2009, http://www.giathai.net/lab.php). A strong, easily visible delineation ran roughly parallel to the external shape, 0.8–2.8 mm below the surface. That line was similar to the structure encountered in cultured pearls at the boundary between nacre and nucleus, but here it had a "baroque" shape. The shape of the cultured pearl generally followed the shape of the nucleus. In many cases there were one or more cavities related to this structure. In several instances, this delineation opened into cavities, with a very similar appearance to that seen in keshis. X-ray opacity, which appeared as shades of gray in radiography, was very similar between the nucleus and the periphery, which is usually the case for cultured pearls.

We obtained permission to cut one of the submitted pieces in half to directly observe the type of core used for nucleation (figure 6). The material forming the nucleus is similar to that normally seen in cultured pearls, but the shape was different. Raman analysis indicated that the nucleus was indeed composed of calcium carbonate (aragonite). The yellow X-ray luminescence and the Sr/Mn ratio determined by EDXRF chemical analysis (Rigaku NexCG) confirmed that it was produced by a freshwater mollusk, not *Pinctada margaritifera*. When one of the two halves was cut again, the core and black nacre separated immediately, revealing another human intervention: a polished surface on the nucleus.

This appears to be a new type of core carved from a piece of shell from a freshwater mussel (e.g., *Megalonaias sp.*, *Fusconaia sp.*, or *Quadrula sp.*) conventionally used to create spherical nuclei but here carved with a baroque shape. The quality of the nacre used for the baroque nuclei seems lower than that used for spherical beads, however. Indeed, this lower quality induces many structures such as cracks, fissures, and areas of variable X-ray opacity that are visible in radiographs. These structures may lead one to believe that this is not a nucleus, as it looks more natural (figure 7).

Cultured pearls with spherical pieces of shell as nuclei have been long known, and nucleation with freshwater cultured pearls has appeared more recently. But this new baroque variety of nucleus may be difficult to properly identify using X-radiography because the features produced sometimes resemble those observed in keshis or baroque-shaped natural pearls.

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Figure 7. The sawed parts of the specimen are shown next to a classic round nucleus (far right). Both nuclei are similar except for their shape. Photo by O. Segura.

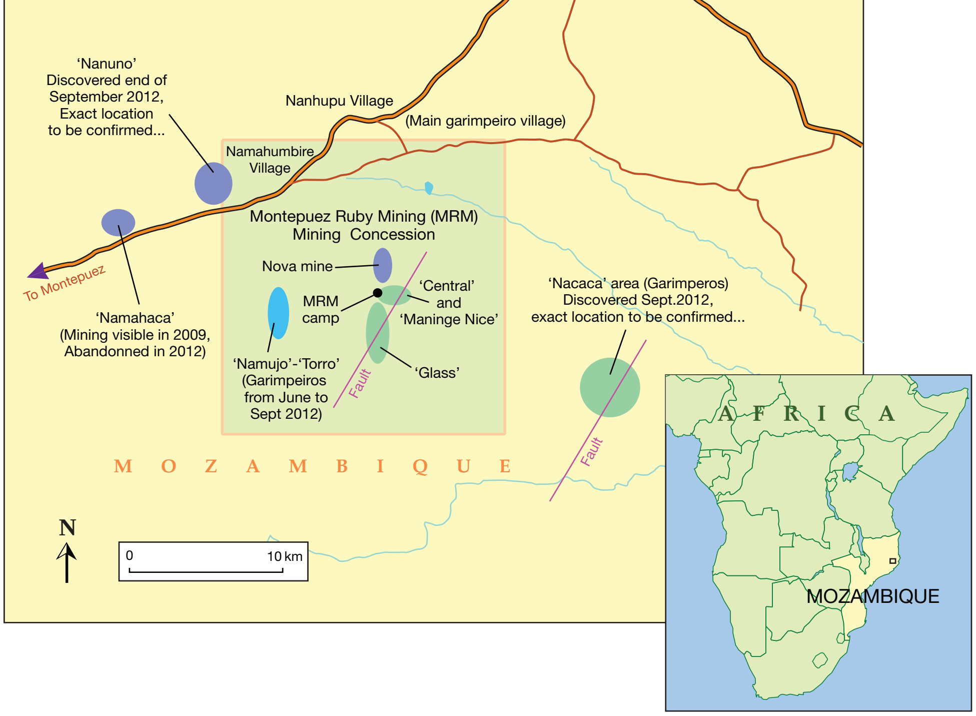

Figure 8. This map shows the different ruby mining areas around Montepuez, as of September 2012.

Update on ruby mining and trading in northern Mozambique. A few months after the gem rush in Winza, Tanzania, that brought many Thai and Sri Lankan ruby buyers to East Africa, two new ruby deposits were discovered in northern Mozambique in the Niassa and Cabo Delgado provinces (see Winter 2009 GNI, pp. 302–303).

In Niassa, the deposit was worked illegally by *garimpeiros* (the name used in Mozambique, a Portuguese-speaking country, for illegal miners) until the summer of 2009, when it was closed by law enforcement. But according to Niassa officials contacted in 2012, the *garimpeiros* have returned every year during the rainy season, when the area is too muddy for vehicles.

Near Montepuez, in the Cabo Delgado province, law enforcement was not as successful, and *garimpeiros* have been mining illegally the new deposit since its discovery in May 2009 (again, see Winter 2009 GNI). It is believed that they have mined most if not all of the stones currently in the market from that new deposit.

The new deposit is located on a private hunting reserve belonging to Mwiriti Ltd., a Mozambican company owned by a retired general. A few weeks after the discovery, the company was granted several mining licenses for an area that is approximately 20 km by 20 km. Mwiriti initially signed an agreement with a Thai company to mine the site.

More details on M'sawize, Montepuez rubies, and the GIA expedition in 2009 can be found on GIA's website at www.giathai.net/Mozambique_Ruby_Special_Issue.php.

The partnership did not last long, and in 2011 Mwiriti signed on with Gemfields, a British company involved in Zambian emerald and amethyst mining. The new company was called Montepuez Ruby Mining, or MRM. Like the previous partnership, MRM has had difficulty controlling the wide area. Since its discovery in 2009, the deposit has been worked by thousands of *garimpeiros* who have sold their stones to buyers from Africa, Thailand, and Sri Lanka. In 2010, Mozambique became the main source of rubies in the Bangkok and Chanthaburi markets. Since the site was not officially in production, the stones presumably were mined by *garimpeiros*.

During a visit to northern Mozambique in September 2012, we continued the work started by contributor VP during his previous three expeditions in 2009. After visiting the MRM ruby mine September 9–12, we stayed to visit the areas currently being mined by the *garimpeiros*.

Between March and June 2012, after the rainy season, MRM had been building infrastructure and securing the area. MRM security personnel said they spent a month trying to peacefully expel the *garimpeiros* from four areas inside the concession: "Central," "Maninge Nice" (meaning "very nice" in local languages and referring to the quality of the rubies), "Nova Mina," and "Glass" (because of the rubies' clarity). After a three-month battle, MRM finally regained control of the areas, apparently because the *garimpeiros* heard that good rubies could be found near Namujo village at a place called "Torro."

While MRM was securing the core of its concession, including Maninge Nice and Glass, the *garimpeiros* were busy at Namujo/Torro, which is also inside the concession (figure 8). According to an MRM manager and some independent miners we met, over 4,000 of them were at Namujo/Torro on a 5 km area along a stream. MRM first tried to persuade them to leave, with little success—in fact, the *garimpeiros* at Namujo/Torro threw stones at their cars. The situation was tense, but compared to the three-month guerilla-like conflict for control of the MRM core area, it represented a de facto cease-fire.

Between March and September 2012, MRM built a fortified camp near Maninge Nice and prepared for the arrival of a large washing plant, reportedly on its way by boat. Near Namahumbire village, a large camp is also being constructed to accommodate hundreds of employees. All over the middle of the concession, including Maninge Nice and Glass, there are prospecting pits, security posts, roads, and boreholes.

Figure 9. Rubies were found in situ with amphibole (dark green), mica (yellowish), and feldspar (white) on the wall of the test pit. Note the white feldspar rim surrounding most of the rubies. Photo by Vincent Pardieu.

Garimpeiros informed us that a few days earlier, there was a rumor in Namahumbire of fine rubies found by gold miners working on a stream at Nacaca, a new area in the southeast of the MRM concession. We also learned that the area near Namahaca village (about 5 km west of Namahumbire, outside the concession), where contributor VP found some ruby diggings and low-quality samples in December 2009, is now nearly abandoned, as the stones there were inferior.

At MRM, the authors were able to collect samples for the GIA reference collection from all the areas except Namujo/Torro. It soon became clear that visiting Namujo/Torro with MRM would not be possible due to their fierce struggle with the *garimpeiros* for control of Central, Maninge Nice, and Glass.

Contributor VP had in fact already visited Maninge Nice in December 2009 with the support of Mwiriti Ltd. This gave us an opportunity to complete the field study started in 2009. An extensive report with our recent findings, including a study of the samples collected, will be published in *Gems & Gemology* and on GIA's website. What we can confirm is that rubies around Maninge Nice and Central are found within two types of deposits: (1) an alluvial ruby-rich soil corresponding to the weathering of the *in situ* ruby deposit, and (2) a primary deposit where rubies are found in veins associated with amphibole, feldspar, and mica (figure 9).

Samples collected from Maninge Nice and Central ranged from pink to deep red and up to about 20 ct. Most were very included and fractured, but a few small clean, beautiful gems were also collected. The deposit seems incredibly rich: After carefully mining and documenting less than one cubic meter of ruby-rich rock, we were able to collect more than 20 grams of rubies. By comparison, the authors could not find any rubies in matrix in the Glass and Nova Mina areas, where the *garimpeiros* were mining a secondary deposit along a stream.

After leaving the MRM mine, we started negotiating with *garimpeiros* and village elders to find a way to visit Namujo/Torro. Nearly a week later, while discussions were still in progress, our hopes of witnessing the *garimpeiros* vanished. That day, the police launched a major security operation with the support of special forces from Maputo, the capital of Mozambique. Within a day, the government forces expelled thousands from Namujo/Torro. One Tanzanian miner died after falling into a pit. On our way back to Montepuez, we saw hundreds walking along the road toward Montepuez, having escaped from Namujo/Torro.

Following the security operation, our local *garimpeiro* contacts were on the run, waiting for the situation to ease. The more adventurous attempted to collect their belongings left behind in haste. During the nights, after the operation, there were reportedly problems in the nearby village of Namahumbire, where *garimpeiros* damaged a school building and the house of a local government official. But overall the situation quieted within about three days.

Upon meeting with *garimpeiros* again on September 22, we learned that many of them were moving to Nacaca (again, see figure 8), the new ruby mining area about 35 km south of Mesa village and about 10 km southeast of the MRM concession. That was confirmed by other sources.

On September 24, we finally spent a full day at Namujo/Torro, where we confirmed that it is indeed a secondary deposit. The *garimpeiro* workings covered an area approximately one kilometer wide and two kilometers long. Judging from the area and the number of pits, it is likely that more than 4,000 people had been working there. Throughout the day, while a bulldozer refilled thousands of pits, we witnessed the cat-and-mouse game between the police and the *garimpeiros* returning to collect the gravels left behind (figure 10). Finally, after washing some of these gravels, we could see what all the excitement was about: small rubies of very fine color and high quality, rounded in form, as expected from secondary deposits (figure 11). Looking at the stones that day, we understood why some in Bangkok have claimed that the quality of Mozambique rubies is improving.

It is still too early to know if MRM can bring its mining concession under control. The key might be Nacaca: If good stones are found, it will likely draw *garimpeiros* there, and MRM will have an easier time securing its concession.

The success of any gem mining operation depends on three factors: (1) understanding the geology, to know where the stones are located; (2) understanding the mining technology, to find the most cost-efficient way to mine the deposit; and (3) management and security. The ruby deposit near Montepuez seems very rich and technically easy to mine. The most pressing issue facing MRM is security—many gem

Figure 10. Garimpeiros *collect ruby-rich gravels in Namujo/Torro a few days after the security operation. Photo by Vincent Pardieu.*

mining operations would love to have this as their problem.

Looking ahead, the Montepuez area seems very likely to remain the world's main ruby producer. The question that many ponder—particularly in Thailand, the main market for these rubies—is how and where MRM will commercialize its production. Currently, Gemfields seems to favor the auction system they already have in Singapore for their Zambian emerald production. According to MRM and Gemfields officials, the first auction including rubies from Montepuez is expected to take place in 2013.

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Figure 11. These small rubies, weighing up to 3 ct, were the result of washing a few bags of ruby-rich gravels left behind by the garimpeiros*. The stones show a very fine color, good clarity, and the weathering typical of rubies from secondary deposits. Photo by Vincent Pardieu.*

CONFERENCE REPORT

2012 NAG Institute of Registered Valuers Conference. The National Association of Goldsmiths 24th annual Institute of Registered Valuers Conference took place September 22–24 at Loughborough University in Leicestershire, UK. A record 198 delegates attended the various presentations and hands-on workshop sessions. This year the Institute marked its 25th anniversary, and silver was the theme of the event.

The history of silver penny and the use of silver coins were reviewed by former Senior Master of the Supreme Court and Queen's Remembrancer **Robert Turner**. Besides discussing his judicial functions at the Royal Courts of Justice, Prof. Turner explained some of the diverse duties of the Queen's Remembrancer, such as presiding over the ancient Pyx Trial, which ensures that newly minted coins conform to required standards. **David Evans** (a former assay master of the London Assay Office) explained how hallmarking began in the UK and focused mainly on silver.

Grant Macdonald (Grant Macdonald Silversmiths, London) described how he expanded his business into different markets. He also illustrated many of his silver masterpieces and explained the use of technology in silver craftsmanship. **Alastair Dickenson** (Alastair Dickenson Ltd., London) described the challenges of buying silverware from the Internet and what to consider when buying from eBay. He provided guidelines on how to assess the item, showing some of the silverware live on the website and reviewing the descriptions.

Eric Knowles described his journey to become an antiquarian and how he got into this business working as an expert in ceramics and porcelains. **Stephen Kennedy** (The Gem and Peal Laboratory Ltd., London) reviewed the use of technology in his lab and provided tips on how to identify treatments in corundum. He also explained the common treatments he is seeing in the market and the challenges to detecting some of them.

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