The Journal of Gemmology

2014 / Volume 34 / No. 2

The Gemmological Association of Great Britain

Gem-A

THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

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- Alan Hart FGA DGA
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- Richard Hughes FGA
- Craig Lynch GG
- Dr Menahem Sevdermish FGA
- Chris Smith FGA

MONDAY 3 NOVEMBER

Seminars

Gem-A Headquarters, 21 Ely Place, London EC1N 6TD

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- Mikko Åström FGA and Alberto Scarani GG, GemmoRaman

MONDAY 3 NOVEMBER (EVENING)

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Goldsmiths' Hall, London

Guest speaker:

Tim Matthews FGA DGA, CEO of Jewelry Television (JTV)

TUESDAY 4 NOVEMBER

Private visit to the mineral collection at the Natural History Museum

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COLUMNS


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ARTICLES

Feature Articles

Gemmological Briefs

Cover Photo: These two historic Portuguese jewels feature different diamond cutting styles: the gold stomacher (15.7 × 6.5 × 3.0 cm) from the late 17th to early 18th century is set with rose cuts, and the gold and silver ring (2.8 × 1.7 × 1.2 cm) from the late 18th century is set with brilliant-cut diamonds. For more on historic diamond cutting styles in Portugal, see the article by R. Galopim de Carvalho on pp. 114–128. Photos by Carlos Pombo Monteiro; © Fundação Eugénio de Almeida / Arquidiocese de Évora, Portugal; composite image by Orasa Weldon.

The Journal of Gemmology

Content Submission
The Editor-in-Chief is glad to consider original articles, news items, conference/excursion reports, announcements and calendar entries on subjects of gemmological interest for publication in *The Journal of Gemmology*. A guide to the preparation of manuscripts is given at www.gem-a.com/publications/journal-of-gemmology.aspx, or contact the Production Editor.

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What's New

INSTRUMENTS AND TECHNIQUES

GIA DiamondCheck

The Gemological Institute of America (GIA) recently unveiled the DiamondCheck device for screening unmounted faceted colourless to near-colourless stones (D-to-N range). The instrument is designed to accurately separate natural and untreated diamonds from non-diamond simulants (e.g. cubic zirconia) and from diamonds that need to be referred to a gemmological laboratory for further testing, as they are potentially treated natural or synthetic diamonds. The DiamondCheck consists of a commercially available infrared spectrometer coupled with GIA-developed software for automatic data interpretation. It does not require any technical training to operate. The system can rapidly analyse individual stones ranging from 0.01 to 10 ct, providing one of three results in a matter of seconds: *natural diamond; non-diamond;* or *diamond, refer for further testing.* When used as indicated, the DiamondCheck will correctly refer all colourless and near-colourless synthetic diamonds.


Photo © GIA

GIA is leasing these devices at no cost to major diamond bourses around the world. The DiamondCheck is available for purchase from GIA for US$23,900. For more information, visit www.gia.edu/instruments.

HRD Alpha Diamond Analyzer

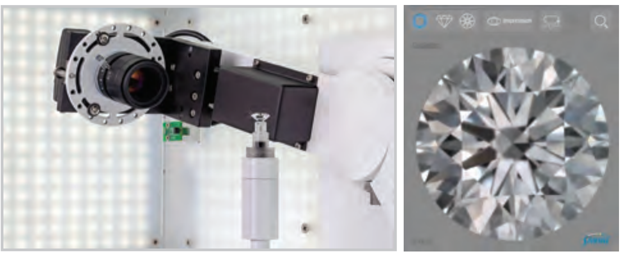
In August 2012, HRD Antwerp released the Alpha Diamond Analyzer, which is a diamond detection and type screening instrument. Using the FTIR diffuse reflectance method, it distinguishes diamonds from imitations, and through its determination of diamond type, it allows the user to select potentially HPHT-treated or synthetic colourless diamonds for further testing in a gem laboratory. Also, by knowing the specific diamond type, the user can more effectively sort and value their diamonds. The software instructs the user how to bring the stone into position for analysis, and the measurement is performed within one minute. The gem's infrared spectrum is saved as a report file in PDF format. The minimum sample size that can be tested is 2–3 points (~0.03 ct) and the maximum size is approximately 70 ct. The current system can only accommodate unmounted diamonds, but in the future it will be possible to test gems mounted in jewellery using a separate module that will fit on the same instrument.


Photo © HRD Antwerp

The Alpha Diamond Analyzer weighs 7 kg and may be operated using a battery pack, making it quite portable. It costs €21,700, and further information can be found at www.hrdantwerp.be/equipment/ada.html.

Sarine Loupe

Launched in July 2014, the Sarine Loupe is a comprehensive imagery solution for viewing diamonds online. The system takes 360° scans of a diamond, and creates a shareable digital file that allows a user to see details of the stone as if holding it in their hand and viewing it through a loupe. The user may rotate the virtual diamond, both horizontally and vertically, and features such



as inclusions, reflections, and workmanship are perceptible from any direction. A magnifier allows closer examination of minute details.

The Sarine Loupe device consists of advanced optics and mechanics with a controlled illumination environment, creating an accurate virtual representation without any image manipulation. The resulting images are digitally combined, allowing the creation of a fully 'floating' virtual diamond without any concealments. Images show high consistency and fidelity, and cutting-edge technology is used to handle the large video files online to provide a user interface with a rapid response time.

The imagery generated with the Sarine Loupe may be embedded into any online platform, attached to an email or examined through an intuitive viewer online. The system currently supports viewing of faceted round diamonds weighing 0.5 to 3 ct, but the capabilities will soon be expanded to other shapes and larger stones. A demonstration of the imaging capability of the Sarine Loupe is available at www.sarine.com/m2.php, for a 2.5 ct round brilliant diamond with H colour, VS_1 clarity and Excellent cut.

Tamar Brosh (tamar.brosh@sarine.com)
Sarine Technologies Ltd., Kfar Saba, Israel

NEWS AND PUBLICATIONS

2014 CIBJO Congress Reports

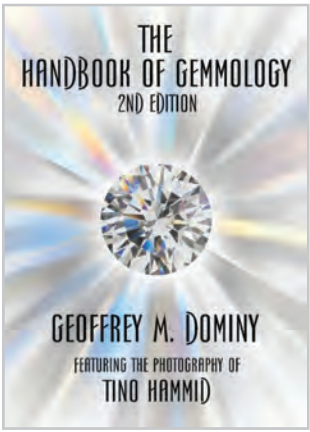
The 2014 CIBJO Congress took place on 19–21 May in Moscow, Russia. On the Congress website, http://congress2014.cibjo.org, a series of reports are available that were posted before the conference to review issues for discussion by the various commissions (click the Special Reports button). In addition, several news entries review the outcome of the conference sessions (click the News button).

Gem Testing Laboratory (Jaipur, India) Newsletter

The latest Lab Information Circular (Vol. 69, March 2014), available at www.gtljaipur.info/Lab%20Information%20Circular.asp, describes emeralds (and their simulants) from East Singhbhum District, southern Jharkhand State, India; composites consisting of pieces of multi-coloured tourmaline that are cemented together with a colourless polymer; and a report written in Hindi on a dyed bone imitation of coral.

The Handbook of Gemmology, 2nd Edition

The 2nd edition of *The Handbook of Gemmology* by Geoffrey M. Dominy (with photos by Tino Hammid) was released in June 2014 as individual digital downloads for US$39.95 each, via http://handbookofgemmology.com. The following formats are available: .exe for Windows, .app for Mac, ePUB/PDF for iPhones and iPads and a PDF format for androids and most e-readers. Users can also purchase all of these formats by downloading the 'deluxe' version for $49.95.

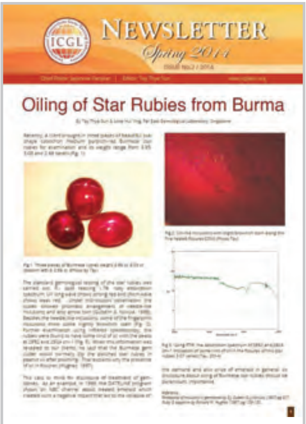


The 2nd edition contains 206 more pages and 200 additional photographs, for a total of 860 pages. Chapters on *Diamond Grading* and *Coloured Gemstone Grading* have been added, and updated information is provided on gem magnetism, electrical properties, synthetic gemstones, treatments and more.

A print version of *The Handbook of Gemmology* is planned for release in 2015.

International Consortium of Gem-Testing Laboratories Newsletter

The International Consortium of Gem-Testing Laboratories has released Newsletter No. 2, 2014, available at http://icglabs.org. It includes brief reports on the oiling of Burmese star rubies; ancient Roman bead-makers of Arikamedu, South India; black synthetic moissanite sold as black diamond; the use of QR (quick response) codes in gemmological coursework in Korea; and a book review of *Colour of Paradise—The Emerald in the Age of Gunpowder Empires* (by Kris Lane, 2010).



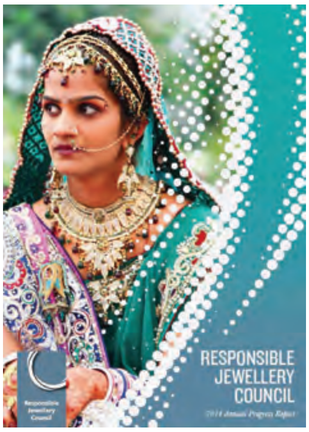
Responsible Jewellery Council Reports and Presentations

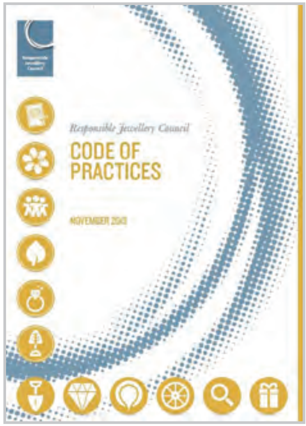
In May 2014, RJC released its Annual Progress Report (www.responsiblejewellery.com/annual-progress-report), in which they focus on conveying the benefits of RJC certification and supporting responsible business practices.

At www.responsiblejewellery.com/monitoring-and-evaluation, users can download two documents that were posted in June 2014: (1) RJC's first *Impacts Report*, which reviews the first four years of RJC's certification programs during 2010 to 2013 (including a focus on the diamond cutting sector in India), and (2) RJC's *Monitoring & Evaluation System Report*, which provides an overview of the design and operation of this program.

RJC's updated Code of Practices was launched in November 2013 and is being implemented in 2014. Several documents pertaining to this Code can be downloaded at www.responsiblejewellery.com/code-of-practices-2013-english.

Presentations from RJC sessions at several recent trade shows can be downloaded at www.responsiblejewellery.com/recent-events.





OTHER RESOURCES

Help With Hallmarks App

In October 2013, the Birmingham Assay Office released the *Help With Hallmarks* app for both iPhone and iPad as well as Android devices. The app enables users to quickly research and identify the date letter on precious metal jewellery and silverware, and includes date letters from the 11 key assay offices in the UK, going back to 1544. An updated version (1.3) of the app was released in January 2014, and it is available from iTunes or the Google Play store for £9.99 or US$13.99.

What's New provides announcements of new instruments/technology, publications, online resources and more. Inclusion in What's New does not imply recommendation or endorsement by Gem-A. Entries are prepared by Brendan Laurs unless otherwise noted.

Spinel Masquerading as Taaffeite or Sapphirine: A Clever Scam

Alan Hodgkinson

Several years ago, an 'enterprising' gem cutter in Sri Lanka capitalized on the similar appearance between spinel and two much rarer, more valuable gems: taaffeite (Figure 1) and sapphirine. The typical RI of violet spinel (1.72) is quite close to that of taaffeite of a similar colour (1.719–1.723), although taaffeite is doubly refractive with a birefringence of 0.004. In a similar fashion, the darker blue tones of spinel resemble those of sapphirine (1.706–1.712, birefringence = 0.006). The anisotropic RI readings of taaffeite or sapphirine do of course change as the stones are rotated on the refractometer, but their low biaxial birefringence is not easy to observe in full.

Probably by accident originally, it was found that polishing a spinel with two slightly angled planes on the table (Figure 2a) results in two simultaneous shadows on the refractometer (Figure 2b). This deception enables such a spinel to be passed off as taaffeite or sapphirine.

How does this deception work? When the refractive indices of a gemstone are recorded on a refractometer, the table facet should lie flat on the hemicylinder, with a thin layer of contact liquid between the two surfaces. In these contrived table facets, the two facet planes are at an angle of only about 1–2° from one another.

Figure 1: The 1.47 ct spinel on the left has a violet colour that strongly resembles the 1.49 ct taaffeite on the right. Photo by A. Hodgkinson.

The contact liquid makes optical contact with both of the contrived planes, and each of the two table surfaces registers its own shadow edge simultaneously on the refractometer.

Just how much can a refractometer measurement be distorted by the hemicylinder/gemstone contact angle? As an experiment, a small piece of Blu-Tack was used to position a large 37.99 ct orange synthetic spinel (RI = 1.727) so that its table was tilted on the refractometer's

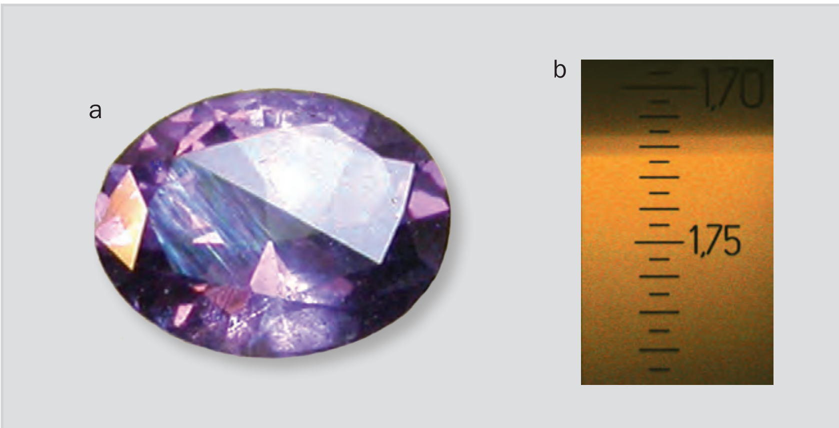


Figure 2: (a) This 1.89 ct spinel has two contrived table facets. (b) Two shadow edges are seen when this spinel is placed on the refractometer. Photos by A. Hodgkinson.

prism. When the far end of the stone was raised, the shadow edge lowered to 1.710. When the front end of the stone was raised in the same fashion, the shadow edge rose to 1.750. This created an error span of 0.040. This distortion is far more than that of the natural spinel described above, but this is due to the exaggerated angles that this large gem was tilted on the refractometer. Such false RI readings only occur when a stone is inadvertently tilted in the north-south direction (along the length of the hemicylinder); no errors are produced when it is tilted in the east-west direction (across the refractometer prism from left to right). A discussion of the erratic readings that can result from such tilting of a stone is provided by Koivula (1985).

The use of a large drop of contact liquid will show such rogue readings more readily than a small drop, since a greater volume of liquid is available to fill the two spaces between the stone and the refractometer. Therefore only the smallest amount of fluid necessary for a reading should be used, and it is essential that a facet makes flat optical contact with the prism. This may require the help of a fingertip or back end of a pencil.

To avoid being deceived by such scams, the gemmologist must be forever vigilant when examining gemstones. By first using a 10× loupe, the keen observer should see a discrepancy in the light reflected from contrived table facets, as shown in Figure 2a. Since light will not reflect simultaneously across the entire table facet, the two contrived table facets will be revealed.

Reference

Koivula J., 1985. Errors in refractive index. *Canadian Gemmologist*, **6**(3), 86–87.

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Acknowledgement: The author thanks the late H. Karunananayaka of Sri Lanka for custom cutting two spinels with 'contrived' tables.

Gem Notes

COLOURED STONES

Andradite from San Carlos, Arizona

During the 2014 Tucson gem shows in Tucson, Arizona, USA, this author was shown some new production of faceted andradite from the San Carlos Reservation by Warren Boyd FGA (Apache Gems, San Carlos, Arizona, USA). Two andradites (0.87 ct total weight) were donated by Apache Gems to Gem-A's research and teaching collection. Although gem-quality andradite from San Carlos is not new (e.g. Johnson and Koivula, 1997), recent mining activities have resulted in the greater availability of this greenish to brownish yellow garnet (Figure 1). The andradite is being marketed by Apache Gems as *Apache demantoid,* along with other gem varieties from the reservation or nearby areas including *Diné chrome pyrope, San Carlos peridot* and *Slaughter Mountain fire agate*.

The main andradite deposits on the reservation were recognized nearly two decades ago, as a result of prospecting by Charles Vargas and his brother Michael Haney in a region where ranchers had been active for many years. Charles and Michael are descendants of the Chiricahau Apache Ndeh Nation, and they live and work on the San Carlos Reservation. The mining area is only accessible by all-terrain vehicle, and then on foot. The occurrences are worked with simple hand tools in shallow pits. The mining season is limited by the heat of the summer, and the multi-day mining excursions take place under challenging conditions in areas patrolled by mountain lions, bears and other predators. Although no formal geological mapping has been done to date, it is apparent that the garnet is associated with skarn zones that contain a variety of associated minerals.

Figure 1: These andradite gemstones were cut from material recently mined near San Carlos, Arizona. The gems weigh up to 1.2 ct. Photo by Jeff Scovil.

The mining and recovery of the gems is done with a spiritual reverence and respect for nature that is rarely seen in mining activities worldwide. Over the course of several seasons, the gem rough has been accumulated, sorted, classified and cobbed. Facet-quality material is rare, and most of the andradite is suitable only for use as mineral specimens, bead material or cabochons. Nevertheless, to date Apache Gems has cut over 20,000 stones, with most weighing less than 5 ct; the vast majority are under 2 ct. Many of the smaller gems were cut in Sri Lanka using precision cutting equipment, while some larger and finer stones were cut in the USA, including the San Carlos reservation.

Brendan M. Laurs

Reference

Johnson M.L. and Koivula J.I. (Eds.), 1997. Gem News: Andradite from Arizona. *Gems & Gemology,* **33**(1), 61.

Bobdownsite, a Relatively New Mineral from Canada, Faceted as a Gemstone

Bobdownsite, ideally $Ca_9Mg(PO_4)_6(PO_3F)$, was first discovered in 2001 on a ridge on the west side of Big Fish River (Figure 2), Yukon, Canada, at coordinates of approximately 68°28'N, 136°30'W, by Rod Tyson of Tysons' Fine Minerals (Parrsboro, Nova Scotia, Canada). It was initially misidentified as another phosphate, whitlockite, before being correctly described by Tait et al. (2011), who named it for Dr Robert Downs (University of Arizona, Tucson, USA). The mineral is hosted by narrow veins cutting bedded ironstones and shales, and is associated with siderite, quartz and various phosphates (lazulite, an arrojadite-group mineral, kulanite, gormanite and collinsite). It forms colourless tabular crystals up to 27 mm wide and 4 mm thick, and has a Mohs hardness of ~5 with no cleavage observed.

Three faceted bobdownsite samples from the collection of Brad Wilson (Alpine Gems, Kingston, Ontario, Canada) were loaned to the Royal Ontario Museum (ROM) for examination (Figure 3). The stones ranged from 0.05 to 0.23 ct, and the following properties were recorded: colour—colourless; lustre—vitreous; diaphaneity—transparent to semi-transparent; RI—n_o = 1.625 and n_e = 1.622; optic character—uniaxial negative; Chelsea colour filter reaction—none; fluorescence—weak red-purple to long-wave and inert to short-wave UV radiation. In addition, a weak orange phosphorescence was noted. A density value of 3.14 g/cm^3 was measured by Tait et al. (2011), and Raman and IR spectra for bobdownsite are available at http://rruff.info/bobdownsite/display=default/R050109, along with XRD data.

Figure 3: These bobdownsite gemstones were faceted by Brad Wilson and weigh 0.23 ct (left), 0.13 ct (centre) and 0.05 ct (right). Photo courtesy of the Royal Ontario Museum, © ROM; photo by Brian Boyle, MPA, FPPO.

ROM personnel visited the bobdownsite locality in the summer of 2012, but no more material was found in situ. However, several small pieces were recovered from the talus slope and reside in the ROM collection. To this author's knowledge, this is the first time that faceted bobdownsite has been characterized in the literature. With only a few such gems in existence, this is certainly a very rare collectors' gemstone.

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Katherine Dunnell
Royal Ontario Museum
Toronto, Ontario, Canada

Reference

Tait K.T., Barkley M.C., Thompson R.M., Origlieri M.J., Evans S.H., Prewitt C.T. and Yang H., 2011. Bobdownsite, a new mineral species from Big Fish River, Yukon, Canada, and its structural relationship with whitlockite-type compounds. *Canadian Mineralogist*, **49**, 1065–1078, http://dx.doi.org/10.3749/canmin.49.4.1065.

Figure 2: Bobdownsite is known only from this steep terrain on the west side of the Big Fish River in Canada's Yukon territory. Photo by K. Tait.

Orange Lizardite from South Africa

Lizardite, $Mg_3(Si_2O_5)(OH)_4$, is a member of the kaolinite-serpentine group, and is probably the most common serpentine mineral. It has a Mohs hardness of 2–3, and is noticeably softer than antigorite and harder than chrysotile (Gaines et al., 1997). It is commonly green to yellow-green, bluish green, or nearly black, and rarely yellow or white. It was a surprise, therefore, to encounter faceted bright orange stones sold as 'lizardite' at the 2014 Tucson gem shows. The material was offered by Mauro Pantò (The Beauty in the Rocks, Laigueglia, Italy), who had two varieties: pure lizardite (Figure 4) and lizardite-included quartz (Figure 5). Pantò obtained the rough material at the February 2012 Tucson gem shows, in a parcel mixed with sugilite reportedly from the Wessels mine in South Africa. Although the orange stones in the parcel were sold to him as bustamite, an X-ray diffraction (XRD) analysis performed by John Attard (Attard's Minerals, San Diego, California, USA) showed that the material was actually lizardite.

Pantò reported that most of the rough lizardite was opaque with rare translucent areas. From the most saturated rough material, he had approximately 40 stones cut between 0.5 and 2 ct. In addition, from rough pieces of lizardite-included quartz he had around 20 stones cut, ranging from 0.80 to 1 ct. He donated to Gem-A one faceted lizardite (1.10 ct) and one faceted lizardite-included quartz (3.33 ct), and these were sent to one of the authors (GRR) to confirm the identity of the material and investigate the cause of its orange colour.

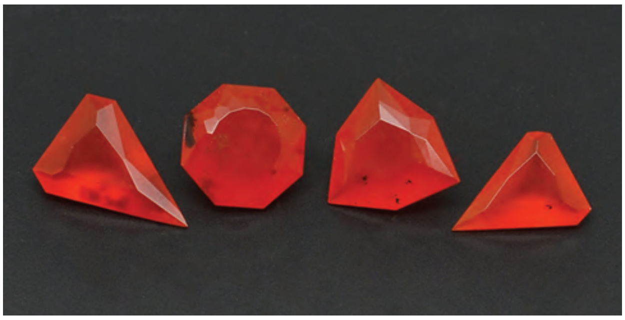

Figure 4: These translucent orange stones (0.80–1.88 ct) proved to be lizardite that is coloured by hematite micro-inclusions. Photo by Mauro Pantò.

Figure 5: These lizardite-included quartz specimens range from 1.87 to 3.33 ct. Photo by Mauro Pantò.

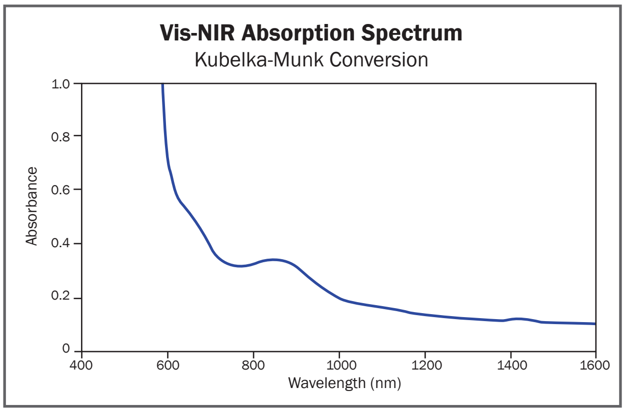

Figure 6: Vis-NIR spectroscopy of the orange lizardite gave a reflectance pattern typical of hematite. A Kubelka-Munk transformation of the reflectance pattern yields an absorption spectrum that is also characteristic of hematite.

Raman spectroscopy was performed on both samples, and the results were compared to data reported by Rinaudo et al. (2003). The spectrum of the 'lizardite' sample was a much closer match to lizardite than to antigorite, with the strongest peaks located at 688.7, 385.9 and 235.4 cm^{-1}. The 'lizardite-included quartz' sample was confirmed as quartz with weak, noisy features consistent with lizardite. Vis-NIR spectroscopy of this sample gave an excellent reflectance pattern for hematite (cf. Scheinost et al., 1998), with features at ~870 and ~680 nm (and saturation below 600 nm), as well as an OH band near 1400 nm that would be expected from lizardite. Following a Kubelka-Munk transformation, the data resemble an absorption spectrum that is typical of hematite (Figure 6). A similar spectrum was obtained from the 'lizardite' sample, although the transmission pattern was of lower quality, apparently due to the presence of black impurities in the stone. Still, the pattern indicated that hematite is the cause of colour. The hematite is apparently present as micro-inclusions within the lizardite.

To confirm the identity of the 'lizardite' sample that was used for the analyses described above, a small portion of it was sent to Attard for XRD analysis. The pattern matched lizardite, with a minor amount of garnet (probably andradite). Although hematite was not detected in the XRD pattern, this technique does not detect admixtures of minerals present at low concentrations, and only trace amounts of hematite would be needed to impart the orange coloration exhibited by this material.

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References

Gaines R.V., Skinner H.C.W., Foord E.E., Mason B. and Rosenzweig A., 1997. *Dana's New Mineralogy,* 8th edn. John Wiley & Sons Inc., New York, New York, USA, 1418–1420.

Rinaudo C., Gastaldi D. and Belluso E., 2003. Characterization of chrysotile, antigorite and lizardite by FT-Raman spectroscopy. *Canadian Mineralogist,* **41**, 883–890, http://dx.doi.org/10.2113/gscanmin.41.4.883.

Scheinost A.C., Chavernas A., Barron V. and Torrent J., 1998. Use and limitations of second-derivative diffuse reflectance spectroscopy in the visible to near-infrared range to identify and quantify Fe oxide minerals in soils. *Clays and Clay Minerals,* **46**, 528–536, http://dx.doi.org/10.1346/CCMN.1998.0460506.

Large Faceted Quartz from Arkansas, USA

The McEarl mine in Garland County, Arkansas, is located within the Blue Springs area, which is famous for producing some of the world's finest quartz crystals. The deposits are hosted by the Blakely sandstone (Engel, 1951), and there are 10 mines in the area, two of which are currently active. Avant Mining LLC is the largest landholder in the district, and owns five mines on approximately 150 acres. Avant acquired a 50 acre portion of the McEarl mine (Figure 7) from Weyerhaeuser Co. in 2010, and has been developing the property since 2011.

The McEarl mine was first opened in 1940 and operated until 1943 by the Diamond Drill Carbon Co. of New York City, to explore for optically clear quartz suitable for use as radio frequency oscillators. Mini McEarl then owned the property from 1943 until 1981, when she sold the mine to Jimmy Coleman. (The well-known Coleman mine is located only 1 km from the McEarl property.) The last major McEarl find occurred in 1986–1987, when Coleman encountered a large pocket at the property's boundary (marked by the line of trees on the right side of Figure 7).

Figure 7: The McEarl mine is currently worked as an open pit with a trackhoe and dump truck. Photo by J. Zigras.

Figure 8 (left): This exceptionally fine quartz specimen (23 cm long) from the McEarl mine was found in 1986–1987. Fine Minerals International specimen, now in the MIM Collection, #880; photo by Elliott/Fine Minerals International.

Figure 9 (below): The largest faceted quartz from the McEarl mine is this 804 ct stone cut by Joel Baskin. At 57 mm in diameter, the Portuguese cut is shown together with a typical apple to give an idea of its scale. Photo by Jason Baskin.

Figure 10: This 428 ct quartz from the McEarl mine appears eye-clean in normal lighting (above), but displays conspicuous 'blue needles' when illuminated in certain orientations by strong transmitted light (right). Photos by Tino Hammid.

This pocket produced some exceptionally fine quartz crystals (e.g. Figure 8), and their quality remains unmatched worldwide.

Avant's current operation has now merged with the historically mined portion of the deposit, in an open pit worked with a trackhoe and dump truck (again, see Figure 7). As Avant has mined down to the pocket zone, numerous broken crystals of clear quartz that are suitable for lapidary use have been found. So far, seven large stones have been cut, ranging from 150 to 804 ct (e.g. Figures 9 and 10). The quartz was faceted as Portuguese cuts by Joel Baskin of Baskin & Sons (Wolf Creek, Oregon, USA).

Interestingly, the optically clear quartz from the McEarl mine commonly contains localized clouds and needle-like inclusions that appear blue when they are illuminated with bright transmitted light in certain orientations (e.g. Figure 10). These inclusions are only seen when illuminated in this fashion, and similar features also were described in optical quartz from unspecified localities by Gordon (1945, p. 286) as follows:

> 'Blue needles' and 'blue feathers'…are inexplicable linear clouds which appear bluish because of selective absorption of rays of others colors. They occur as pairs of needles forming a V, with the apex of the V always towards the base of the crystal, and the two arms of the V have a preferred orientation parallel to *r*:*z* edges….'Blue needles' are not uncommon in quartz…. These structures are hard to resolve, even under a magnification of 150×, but they seem nothing more than systems of linear parting planes.

Gordon (1945) ascribed their blue appearance to the Tyndall effect (i.e. due to light scattering from the extremely small needles).

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Gold Inclusions in a Large, Clear Quartz Crystal

Quartz is host to an amazing diversity of mineral inclusions. Quartz is also a common ore mineral in vein-hosted gold deposits, so it should be no surprise to find native gold as inclusions in quartz. However, such inclusions may be difficult to appreciate since the host quartz is almost always milky (e.g. Gübelin and Koivula, 2005, pp. 140, 604, 605).

Therefore, this author was most interested to encounter a large transparent crystal of quartz containing gold inclusions at the 2014 Tucson gem shows. The crystal was featured in a sculpture titled 'Gold Rush' (Figure 11) by Lawrence Stoller of CrystalWorks, Bend, Oregon, USA. The quartz originated from Brazil, and it was polished on all sides except the back, which had been naturally etched by hydrothermal fluids (Figure 12). The etched quartz hosted several inclusions of native gold measuring up to 4.4 mm long that were partially embedded in the underlying clear quartz (Figure 13). When the sculpture was viewed from the front, the inclusions reflected through the quartz crystal; their colour was mimicked by the metallic base that supported the specimen.

While it is quite rare for gold inclusions to be hosted by clear quartz (Gübelin and Koivula, 1986, p. 319), their presence in a large transparent quartz crystal is even more unusual.

Brendan M. Laurs

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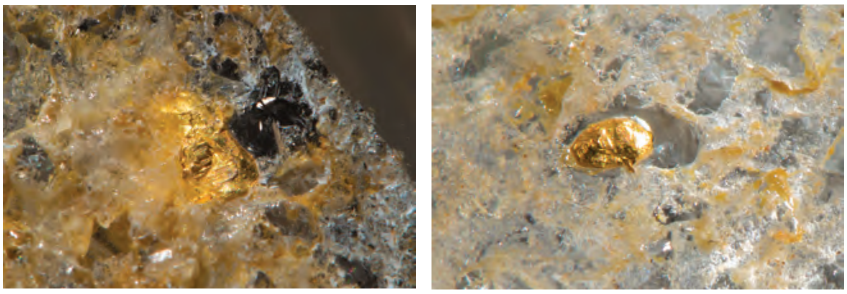
Figure 11 (left): The large polished quartz crystal (21.5 × 16.0 × 10.0 cm) in this sculpture titled 'Gold Rush' contains inclusions of native gold that are seen reflecting through the faces on the upper left. Photo by Gary Alvis and Lawrence Stoller.

Figure 12 (above): Viewed from the rear, the quartz crystal exhibits a flat partially iron-stained surface that has been naturally etched by hydrothermal fluids, and hosts inclusions of gold. Photo by Gary Alvis and Lawrence Stoller.

Figure 13: Bright yellow inclusions of gold are present within the etched iron-stained layer of quartz. The gold inclusions seen here measure 4.4 mm (left) and 4.0 mm (right). Photos by Gary Alvis and Lawrence Stoller.



Some Gemmological Rarities Seen in Tucson

The annual gem shows in Tucson, Arizona, USA, provide a wonderful opportunity to encounter many unusual gem materials. During the 2014 shows, rare-stone dealer Mauro Pantò (The Beauty in the Rocks, Laigueglia, Italy) had several such gemstones: yellowish green kyanite from Madagascar, blue halite from New Mexico, lepidolite from Brazil and tinzenite from Italy, as well as orange lizardite from South Africa (see Gem Note on pp. 100–101 of this issue).

Pantò initially obtained the yellowish green kyanite rough during the 2012 Tucson shows. The material reportedly came from an unspecified locality in Madagascar, and was easily identified by its visual appearance (confirmed by Thierry Cathelineau using IR reflectance spectroscopy). Most of the rough was heavy included, and Pantò selected the cleanest pieces to cut stones ranging from 0.40 to 3.00 ct (e.g. Figure 14). Green kyanite is also known from Brazil and Tanzania, and its coloration is due to Fe^{3+} (see Hyršl and Koivula, 2002; Renfro and Shen, 2013; http://minerals.caltech.edu/FILES/Visible/Kyanite/Index.html).

The blue halite came from the Intrepid Potash East mine, Eddy County, New Mexico. From two pieces of rough that Pantò obtained in Tucson in 2011, eight gemstones were cut, ranging from 5 to 8 ct (e.g. Figure 15). The stones were faceted by Luigi Mariani (Milano, Italy), using a special cutting process that employs a mixture of alcohol and acetone on the cutting wheel. Blue colour in halite is caused by exposure to natural radiation, which results in the formation of colloidal-sized aggregates of sodium metal (documented in halite from Germany: http://minerals.caltech.edu/COLOR_Causes/Radiate/index.html). However, traces of colloidal gold also occur in the blue halite from New Mexico and may be the cause of its coloration (Bickham, 2012).

Very good–quality lepidolite has recently appeared on the market from Araçuaí, Minas Gerais, Brazil, and it is translucent and 'tough' enough to be faceted. Pantò had about 25 stones cut that ranged from 1 to 15 ct (e.g. Figure 16). Most were cut in China, except for the largest piece that was cut by Luigi Mariani.

Tinzenite is a reddish orange borosilicate with the formula $(CaMn^{2+})_2Mn^{2+}Al_2BSi_4O_{15}(OH)$ and a Mohs hardness of 6½–7. In 2013, Pantò obtained some rough material that had been gathered by local collectors from the famous manganese deposits near the Graveglia Valley, about 40 km east of Genova, Italy (Marchesini and Pagano, 2001). The tinzenite typically occurs in flat pieces and is commonly mixed with white quartz and black veins of braunite and manganese oxide, so it is difficult to obtain facetable material. Most of the ~50 faceted tinzenites offered by Pantò ranged from 1 to 3 ct, although a few pieces were larger (e.g. Figure 17).

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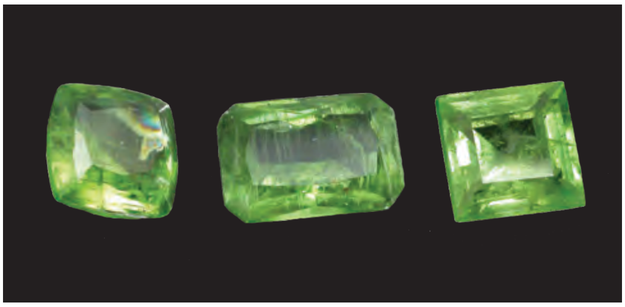

Figure 14: Madagascar is reportedly the source of these unusual yellowish green kyanites (1.40–1.70 ct). Photo by Mauro Pantò.

Figure 15: These halite gemstones (6.26–6.93 ct) from New Mexico, USA, display an attractive blue colour. Photo by Mauro Pantò.

Figure 16: These faceted Brazilian lepidolites (5.10–11.39 ct) are remarkable for their transparency and size. Photo by Mauro Pantò.

Figure 17: Tinzenite displays a bright reddish orange colour. The unusually large 7.02 ct stone on the left is pure tinzenite, while the 3.52 ct piece on the right displays the more typical appearance of tinzenite mixed with quartz. Photo by Mauro Pantò.

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Pastel Green Sapphire from Myanmar (Burma)

The pastel shades of Burmese corundum are not as well known as their more famous brethren, ruby and blue sapphire. However some of the mines in the Mogok area produce lovely pastel shades of yellow, pink, purple and blue-to-green sapphire (Figure 18). Within the blue-to-green range, the gems commonly share a blend of these two colours ranging from greenish blue to bluish green. However, it is much less common to encounter sapphires in pure green pastel shades. Recently American Gemological Laboratories had the opportunity to examine a relatively large, 26.12 ct, pure green Burmese sapphire (Figure 19), submitted by Hussain Rezayee of Rare Gems & Minerals, Beverly Hills, California, USA.

Microscopic examination revealed narrow bands of faint rutile needles and pinpoint particles, as well as pristine negative crystals and healed fissures. The stone also contained subtle planar growth features and colour zoning, and was inert to long- and short-wave UV radiation. Taken together, these characteristics confirmed the natural, unheated condition of the sapphire. The absorption spectrum in the ultraviolet-visible–near-infrared (UV-Vis-NIR) region revealed dominant features related to Fe^{3+}, as well as a weak broad absorption due to $Fe^{2+} \leftrightarrow Ti^{4+}$ intervalence charge transfer (Figure 20). Energy-dispersive X-ray fluorescence spectroscopy showed traces of Fe (0.35 wt.%), Ti (0.008 wt.%) and Ga (0.006 wt.%), with other elements such as V and Cr below the detection limit.

Figure 18: A variety of pastel shades are shown by these sapphires (0.75 to 1.20 ct), which were recently acquired by the AGL during a research expedition to the Mogok area of Myanmar. Photo by Kelly Kramer and Bilal Mahmood.

Figure 19: This 26.12 ct green sapphire from Myanmar is unusual for its size and clarity, as well as the lack of any bluish or yellowish undertones to the colour. Photo by Bilal Mahmood.

Large, gem-quality, pastel-coloured, pure green sapphires from Myanmar are not frequently encountered in the trade. However, the properties of this sapphire are consistent with those that have been examined previously by the author.

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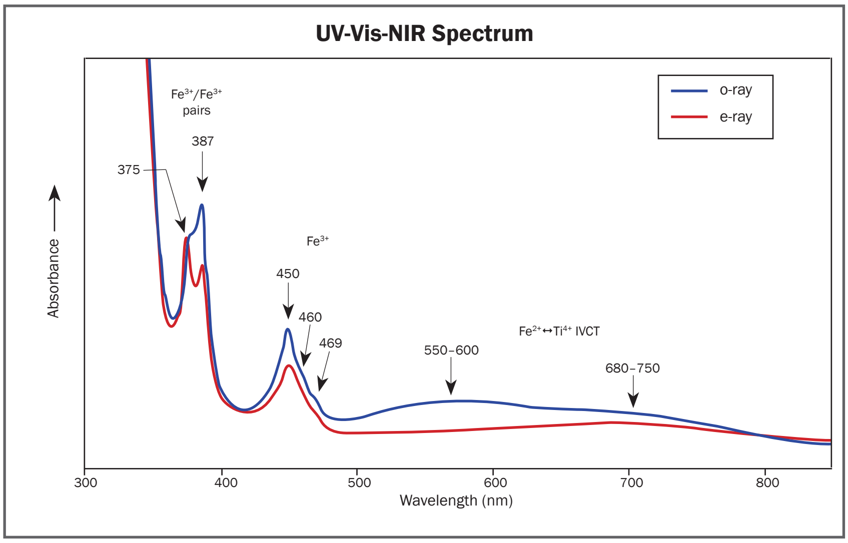
Figure 20: The UV-Vis-NIR spectrum of the pastel green Burmese sapphire revealed dominant absorption bands positioned at ~375 and 387 nm, as well as ~450, 460 and 469 nm, which are all related to trivalent iron (Fe^{3+}). Also present are weak broad absorptions between ~550 and 600 nm for the ordinary ray (vibrational direction perpendicular to the c-axis) and at ~680–750 nm for the extraordinary ray (vibrational direction parallel to the c-axis) related to Fe^{2+}↔Ti^{4+} intervalence charge transfer (IVCT).



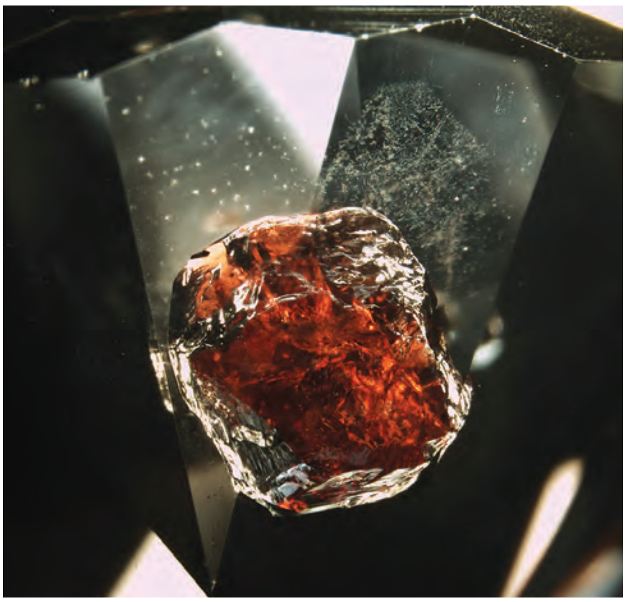
Sapphire with a Large Spessartine Inclusion from Songea, Tanzania

The American Gemological Laboratories (AGL) recently examined an interesting 3.61 ct blue sapphire (Figure 21), reportedly from Songea, Tanzania, that was loaned by Don Thompson (Quest Minerals, Billings, Montana, USA). The stone contained a large, ~2.1 × 1.8 mm, surface-reaching crystal inclusion (Figure 22). It showed similarities to the cover photo of Gübelin and Koivula (2008), which depicts an inclusion identified as 'garnet' in a blue sapphire from Tunduru, Tanzania.

The inclusion in Thompson's sapphire was easily identified as spessartine using Raman spectroscopy, and this was consistent with the presence of Mn recorded by energy-dispersive X-ray fluorescence (EDXRF) spectroscopy.

Figure 21: This 3.61 ct sapphire contains a large reddish orange crystal inclusion that is obvious without magnification. Photo by Bilal Mahmood.

Figure 22: Using basic gemmological tools, the large, surface-reaching inclusion was identified as a pyralspite garnet. Further analytical testing using Raman and EDXRF spectroscopy refined the identification to spessartine. Photomicrograph by Christopher P. Smith; magnified 25×.



Considering the inclusion's large size and exposure on the surface, we thought it would be interesting to see if we could have identified the mineral species without the use of advanced instrumentation. Examination with a 10× loupe revealed the inclusion was reddish orange with an equant subhedral shape. It was inert to both long- and short-wave UV radiation. When the host sapphire was placed in a polariscope, it exhibited the expected 'blinking' effect intrinsic to optically anisotropic material. The inclusion, however, stayed dark during a full rotation in the polariscope, indicating that it was isotropic. We then attempted to take an RI reading of the inclusion where it was exposed on the surface of a pavilion facet, and obtained a measurement ~1.80 or OTL (depending on the upper limit of the RI fluid used). These features are sufficient to conclude that this inclusion is a pyralspite garnet (O'Donoghue, 2006).

While many of the stones encountered by gemmologists have inclusions that can be conclusively identified only with Raman micro-spectroscopy, this particularly rare sapphire contained an inclusion that could be identified—to the level of its mineral subgroup—by its standard gemmological properties alone.

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New Tourmaline Production from the Cruzeiro Mine, Brazil

At this year's Tucson gem shows, Paulo Vasconcelos (Vasconcelos Brazil, Governador Valadares, Brazil) displayed some tourmaline crystals that were obtained from a series of pockets found in September–October 2013 at the famous Cruzeiro mine in Minas Gerais. The Cruzeiro pegmatite is well known for producing pink and green tourmaline suitable for both mineral specimens and cut gemstones (e.g. Cassedanne et al., 1980), and is currently operated by Vasconcelos' company and partners.

According to Vasconcelos, when the miners initially broke into the main pocket, water drained from the drill hole for three days. This suggested the presence of a large cavity, and subsequent mining revealed a series of interconnected

Figure 23: Numerous well-formed pink-red tourmaline crystals such as this one (5.7×1.8 cm) were recently found at the Cruzeiro mine in Brazil. Photo by B. M. Laurs.

Figure 24: The recent Cruzeiro production included some large bicoloured pink and dark green tourmalines, such as this 70 kg crystal. Photo by B. M. Laurs.

pockets that in total measured 10–15 cubic feet (0.3–0.4 m^3). Approximately 300 kg of tourmaline were recovered, as well as a few quartz crystals. The tourmaline was pink-to-red (Figure 23) and bicoloured pink-green (Figure 24), and the largest crystals weighed 70 and 22 kg. Many of the pink-red crystals were of gem quality, but the company has focused on selling the tourmaline as mineral specimens, and no gems have been faceted yet from this material.

This find shows that the Cruzeiro mine still has good potential for producing gem tourmaline, and it comes at a time when relatively few other pegmatites in Brazil are being commercially mined.

Brendan M. Laurs

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DIAMONDS

A Natural Diamond Showing a 'Synthetic' Pattern in the DiamondView

The Laboratoire Français de Gemmologie (LFG, French Gemmological Laboratory) in Paris recently had the opportunity to study a near-colourless, 1.01 ct, old-cut diamond (Figure 25) with a DiamondView pattern reminiscent of a high-pressure, high-temperature (HPHT)–grown synthetic diamond.

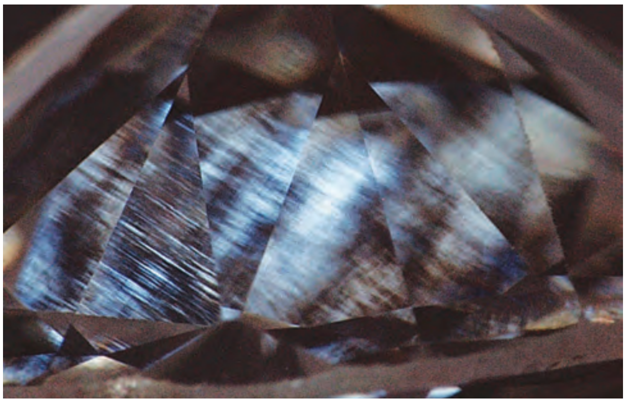
The G-colour SI_1-clarity stone was inert to long- and short-wave UV radiation, and no phosphorescence was observed. Between crossed polarizers it showed a banded strain pattern with low first-order interference colours (Figure 26). The infrared spectrum revealed the diamond was type IaB with low nitrogen; it also showed a small hydrogen-related peak. These characteristics are consistent with natural diamond, and they rule out the possibility of a synthetic.

Nevertheless, when the stone was placed in the DiamondView ultra-short-wave imagery system, to our surprise the blue emission formed a cross-shaped pattern of less-intense luminescence with a square-shaped central core (Figure 27), corresponding to the cubo-octahedral growth pattern generally observed in near-colourless HPHT-grown synthetic diamonds. The square core and the four branches of the cross corresponded to {100} or cube growth sectors (see e.g., Shigley et al., 1997).

Photoluminescence spectra collected at liquid-nitrogen temperature (Figure 28) showed the GR1 (741 nm), N-V (637 and 575 nm), H4 (496 nm) and N3 centres (415 nm). The presence of

Figure 25: This 1.01 ct old-cut diamond showed a very unusual growth pattern in the DiamondView instrument. Photo by A. Delaunay.

Figure 26: Banded graining is observed in the diamond between crossed polarizers. Photomicrograph by A. Delaunay; magnified 70×.



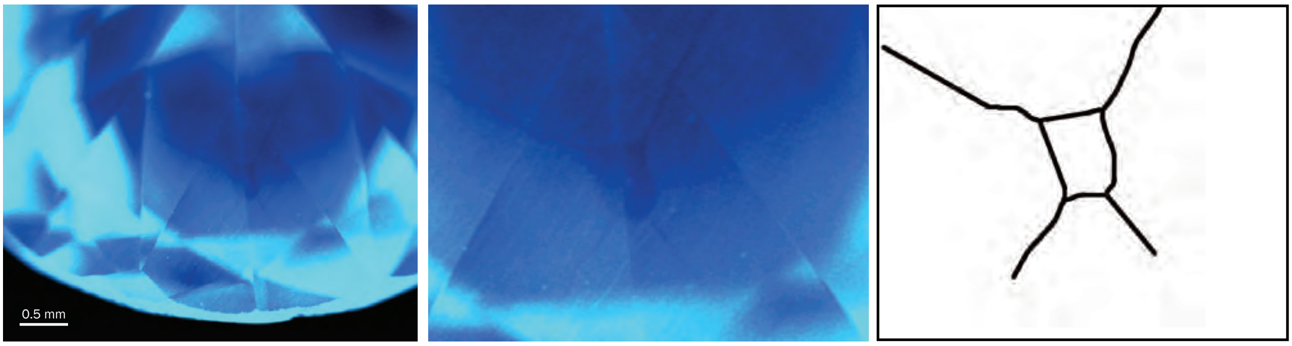


Figure 27: The DiamondView images of the 1.01 ct diamond show a luminescence pattern reminiscent of near-colourless HPHT synthetics, with a square core and four branches radiating from the corners. Photomicrographs and drawing by A. Delaunay.

all these features in the PL spectra further proves the natural origin of the stone. The ratio of the intensity of the N-V centres at 575 and 637 nm was 1.23, and the full width at half maximum (FWHM) of the N-V⁻ centre peak was 11 cm^{-1}, which indicates that the diamond was not HPHT treated (see, e.g., Hänni et al., 2000).

To the authors' knowledge, this is the first time that a cubo-octahedral growth pattern has been reported in a natural faceted diamond. It probably corresponds to very small cubic growth sectors, which are known to occur in natural diamonds, but are always minute (typically much less than a millimetre; Moore, 1979). This demonstrates that on rare occasions, identifying natural vs. synthetic origin solely on the basis of DiamondView imaging could be misleading. Complementary tests are always needed to ensure that the DiamondView-based conclusion is consistent with all observable properties.

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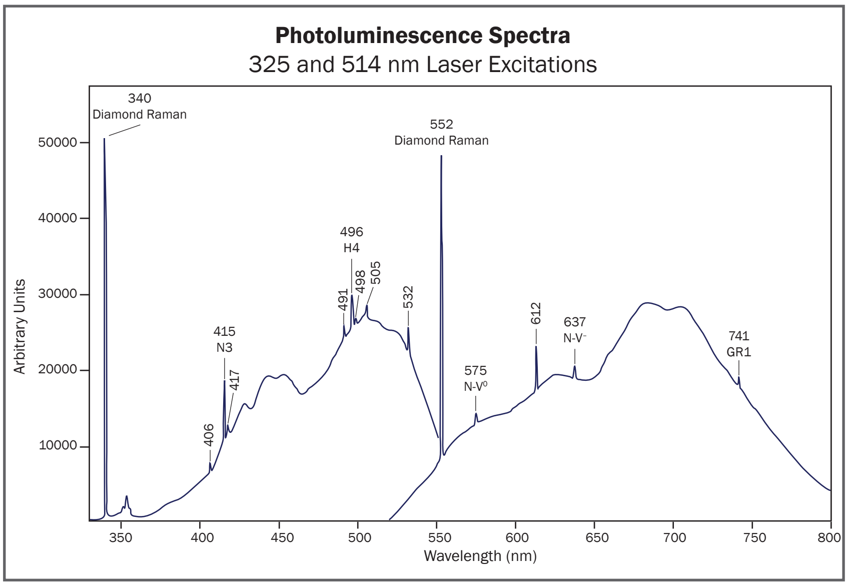
Figure 28: These photoluminescence spectra of the diamond were recorded at liquid-nitrogen temperature with 325 nm (left) and 514 nm (right) laser excitations. The presence of the GR1 (741 nm), H4 (496 nm), and N-V centres at 575 and 637 nm (both their ratio and the FWHM of N-V⁻) confirm that the stone is natural and untreated.



SYNTHETICS AND SIMULANTS

Beryl Triplets Imitating Colombian Emerald, set in Jewellery

Phenakite corrected to petalite (see note below).

During the September 2013 Hong Kong gem show, this author was shown some new triplets that imitated emerald by Anil Dholakia (Anil B. Dholakia Inc., Franklin, North Carolina, USA). Marketed as Emerald Essence, the triplets were assembled using pieces of colourless beryl (and, less commonly, petalite) from Brazil, which are joined together with a proprietary coloured cement that is designed to imitate the appearance of fine Colombian emerald (Figure 29). The triplets are produced in sizes ranging from ~5 mm to 8 × 10 mm, and since January 2013 they have been mounted into a line of jewellery (e.g. Figure 30). The jewellery is hand-fabricated in China using silver with a platinum plating, and contains Emerald Essence accented by 1-mm-diameter topaz or cubic zirconia. So far, jewellery including pendants, rings and earrings has been manufactured (approximately 100 pieces of each).

Figure 30: These earrings contain 8-mm-diameter Emerald Essence beryl-beryl triplets that are mounted in platinum-plated silver with cubic zirconia. Photo by Orasa Weldon.

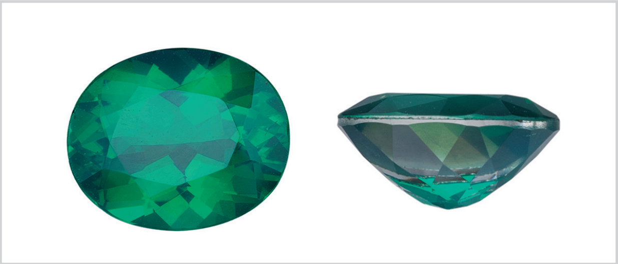


Figure 29: This 2.29 ct beryl-beryl triplet, marketed as Emerald Essence, is shown from the top and side. Gift to Gem-A from of Anil Dholakia; photo by Orasa Weldon.

In addition, Dholakia has created six bracelets consisting of the Emerald Essence triplets set in 18 ct gold together with diamonds. The presence of triplets in fine jewellery is quite unusual.

Brendan M. Laurs

It should have been indicated that some of the gems were assembled using colourless beryl for the pavilion and petalite (not phenakite) for the crown. According to Anil Dholakia, petalite was used because of its brighter appearance than beryl.

Glass Imitation of Tanzanite

In June 2014, a jeweller submitted a group of three loose gems and a man's ring containing what looked like tanzanite (Figure 31). The ring consisted of 18 ct white gold, and the centre stone was surrounded by one-point diamonds.

Upon initial inspection, the purplish blue colour of the material showed a strong resemblance to tanzanite. However, testing of an 8.83 ct cushion cut showed it to be singly refractive, with an RI of 1.705 and an SG of 4.13. With magnification and transmitted light, the gem was clean except for swirl-like structures (Figure 32). The presence

Figure 31: These attractive purplish blue gems proved to be glass, rather than tanzanite. The cushion cut on the far right weighs 8.83 ct. Photo by Tay Thye Sun.

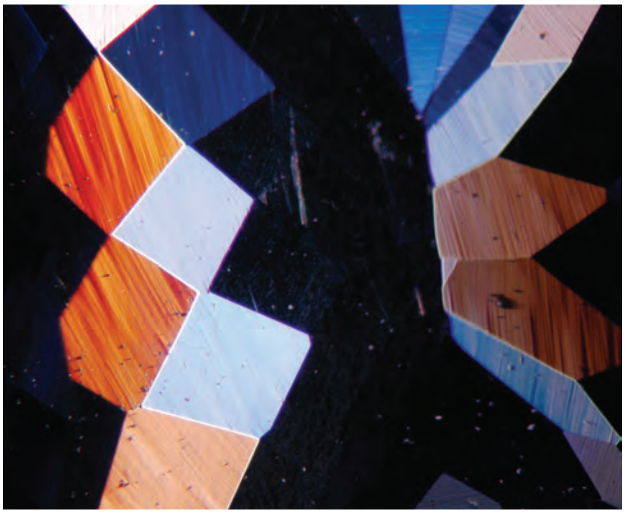


Figure 32: Swirl marks were evident in the glass (particularly on the left) when viewed with magnification and transmitted light. Polishing marks are also seen on some pavilion facets. Photomicrograph by Tay Thye Sun; magnified 15×.

of abundant polishing marks (again, see Figure 32) and some scratches suggested it was a relatively soft material. It was inert to long-wave UV radiation, and fluoresced a weak chalky white to short-wave UV. No absorption features were evident with a desk-model spectroscope. These features are similar—but not identical—to those documented for a high-RI glass imitation of tanzanite by Quinn (2003). Fourier-transform infrared spectroscopy confirmed the identification of this material as artificial glass.

Although this type of tanzanite imitation has been known for more than a decade, it continues to circulate on the market. It is also interesting to note that even fine jewellery may contain such glass imitations. Therefore, it is important to exercise vigilance and always be sure that a 'tanzanite' gemstone has the strong pleochroism (and other expected properties) characteristic of this gem material.

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Synthetic Ruby Doublet with a Natural-Appearing Sheen

Doublets and triplets are some of the oldest manufactured products to imitate the appearance as well as the optical effects of natural gems. Emeralds, rubies and sapphires are the most common materials imitated by such composites. In the case of rubies and sapphires, doublets or triplets are made using pieces of natural and/or synthetic corundum, and they may even imitate the asterism seen in natural gems (e.g. Kammerling, 1993; Yeung and Mayerson, 2004).

Recently, the Gem Testing Laboratory (Jaipur, India) received a purplish red, 4.78 ct, 10.04 × 8.50 × 6.21 mm, pear-shaped gem for identification (Figure 33). Upon initial observation with the unaided eye under normal room lighting, the specimen displayed sheen-like reflections when viewed face-up. This appearance is typically associated with dense 'silk' inclusions in rubies and sapphires. However, when the gem was observed with the microscope, no silk inclusions were present. Instead, a plane consisting of fine reflective dendritic inclusions was visible (Figure 34). This plane was positioned just below the girdle, and was easily visible in reflected light as a thin gap between the crown and pavilion (Figure

Figure 33: This 4.78 ct doublet, composed of synthetic ruby pieces, shows sheen-like reflections from within the gem that resemble the 'silk' in natural ruby. Photo by G. Choudhary.

Figure 34: Reflective dendritic features are visible within the cement used to assemble the doublet. These features are responsible for the sheen-like reflections shown by this synthetic ruby doublet. Photomicrograph by Sandeep Vijay; magnified 32×.

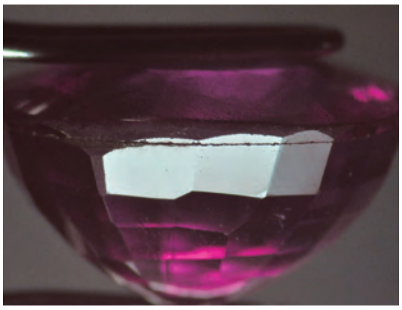

Figure 35: The junction plane of the synthetic ruby doublet is positioned just below the girdle. Photomicrograph by Sandeep Vijay; magnified 32×.

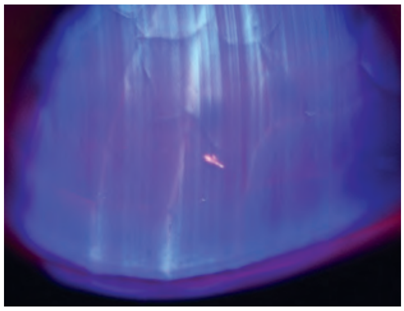

Figure 36: DiamondView imaging of the synthetic ruby doublet revealed distinct curved growth lines, proving its synthetic origin. Photo by Sandeep Vijay.

35). This confirmed the specimen was a doublet. The sheen-like reflections were produced by the reflective dendritic features that formed along the junction plane with the cementing material. Triplets displaying a pronounced sheen or adularescence to imitate moonstone have been known for years (e.g. McClure, 2006), and the cause of their sheen was shown to be a metallic foil placed along the cement layer—which is not the case here.

Gemmological testing gave RI values of 1.760–1.770 (for both the crown and pavilion) and a hydrostatic SG of 3.98, as expected for corundum. A typical ruby spectrum was observed with a desk-model spectroscope. The doublet fluoresced bright red with a chalky blue glue line when exposed to long-wave UV radiation, and the entire gem showed chalky blue luminescence when exposed to short-wave UV. No distinct inclusion features were visible in either the crown or pavilion portion of the doublet. Because of the composite nature of the specimen, we did not observe it using any type of immersion liquid. However, when examined with the DiamondView, prominent curved striae were evident in both the crown and pavilion portions (e.g. Figure 36), thereby proving the doublet was assembled from synthetic corundum.

The subtle sheen-like reflections visible in this doublet were quite convincing, and its identification could have been challenging, especially if bezel set in jewellery. In addition, such doublets can easily be passed as natural stones in ruby parcels.

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TREATMENTS

Corundum with Coloured Lead-Glass Fillings

Since 2004, large numbers of faceted, transparent-to-translucent rubies containing fracture fillings of lead glass have appeared on the gem market. The treatment technique and identification methods of this clarity enhancement process were published in this journal by Milisenda et al. (2006). In 2007, corundum treated with blue cobalt-bearing lead-glass fillings was observed for the first time (Abduriyim, 2007); a further description was given by Milisenda et al. (2013).

Figure 37: These faceted tablets of red and pale green corundum (6.03 and 10.41 ct, respectively) have been treated by coloured lead-glass fillings. Photo by S. Koch, DSEF.

Recently, red and pale green corundum have been found on the market with coloured fracture fillings of lead glass (e.g. Figure 37). According to information from the trade, the original material consists of pieces of brown to grey corundum that are cut into thin tablets so they show sufficient transparency after the treatment process.

The red sample in Figure 37 contained what appeared to be dark bubbles that were visible to the unaided eye. Microscopic observation confirmed the presence of these dark bubbles, and also revealed distinct red colour concentrations, as well as the typical flash effect seen in lead-glass-filled corundum (Figure 38). The high-RI glass causes blue-to-violet or purple colour flashes when viewed approximately parallel to the fissures. Unlike typical lead-glass-filled rubies, the filling in this material possesses a strong red colour that is responsible for the coloration of the host corundum. The green sample showed dull green residues in the surface-reaching fractures (Figure 39).

The identification of the coloured fillers as lead glass was confirmed by X-radiography (Figure 40) in combination with chemical analysis by EDXRF spectroscopy, which detected Pb in addition to Al. The coloration of the lead glass in the red corundum is assumed to be due to 'red lead' (Pb_3O_4). The colour of the green specimens might be due to Cr or Cu, which are both known colouring agents in glass. Traces of both these elements were detected by EDXRF, but more work is needed to determine whether they are constituents of the glass filling or residues of the cutting/polishing process.

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Figure 38: The treated red corundum contains dark bubbles of lead glass, and also shows distinct red colour concentrations (best seen on the left side) in addition to the typical flash effect resulting from lead-glass-filling. Photomicrograph by U. Henn; magnified 40×.

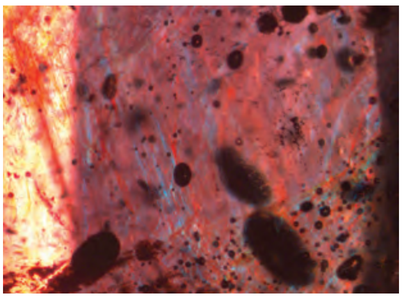


Figure 39: Flat lead-glass residues of dull green colour are observed in surface-reaching fractures of the green corundum sample. Photomicrograph by U. Henn; magnified 50×.

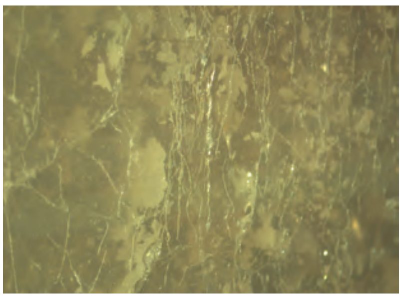
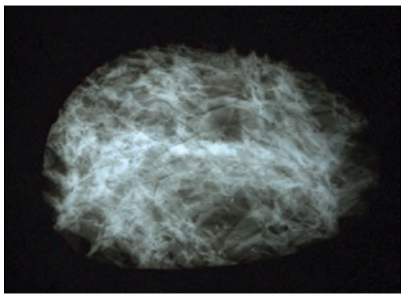


Figure 40: This X-radiograph of the pale green sample shows a distinct contrast between the host corundum (dark) and the lead-glass–filled fractures, which appear light due to the lower permeability of the lead-glass fillings to X-rays. The sample is 18.11 mm wide.



Dyed Labradorite

Recently, large amounts of colourful material sold as dyed rainbow moonstone were observed at the Europe Jewellery & Gem Fair in Freiburg, Germany. The most common colours were 'turquoise' blue, purple and pink (Figure 41). The coloration does not show an even distribution, due to its concentration in cracks that follow the two cleavage directions in feldspar.

Figure 41: Sold as dyed rainbow moonstone, these cabochons proved to be labradorite that has been treated with organic dyes. The diameter of the light blue cabochon is 16 mm. Photo by S. Koch, DSEF.

The term *rainbow moonstone* is used on the gem market for certain white feldspars (mostly from India) that show both labradorescence and adularescence (Henn, 2006). The adularescence is not always present or may only be visible to a limited extent, so Prof. Henry Hänni has suggested describing such material as white labradorite (Koivula, 1987).

An examination of the three samples in Figure 41 showed an approximate RI (spot reading) of 1.56 and a hydrostatic SG of 2.67–2.69. Both values characterize the material as labradorite. Electron microprobe analyses confirmed the material as plagioclase, with a Na/Ca ratio of labradorite, close to the border with andesine.

The dye is of an organic nature and can be removed easily by cleaning with a solvent.

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Evolution of Diamond Cuts in Portuguese Jewellery and Sacred Objects During the 16th–18th Centuries: A Brief Review

Rui Galopim de Carvalho

This review of the evolution of diamond cuts during the 16th to 18th centuries is illustrated with Portuguese jewellery and sacred objects from this period. We follow the evolution from point cuts already in existence prior to Portuguese navigational discoveries in the late 15th century, to *table* and *rose cuts* that co-existed for most of the 16th and 17th centuries, to the now-called *old brilliant* (or *old mine*) *cut*, which became popular a few decades after the discovery of the Brazilian diamond fields in the 1720s. The use of each cut and shifts in their popularity are discussed. These observations of diamond cuts in Portuguese jewellery and devotional objects may also be applicable to trends within wider European manufacture.

The Journal of Gemmology, 34(2), 2014, pp. 114–128.

Introduction

Diamond has been used as a gemstone for millennia, particularly in Asia where it was originally found (Bruton, 1978; Harlow, 1998; Bari and Sautter, 2001). Diamond's unique visual properties (brilliance, fire and scintillation) only began to be fully appreciated in Europe with advancements in cutting technology during the last quarter of the 14th century, in what is today Italy (Tillander, 1995). This evolution of cutting techniques, in addition to advancements in understanding of the optical properties of diamond as well as fashion trends, have all influenced the way that diamonds were cut and polished through the ages, and continue today (Bruton, 1978; Bari and Sautter, 2001; Klein, 2005; Ogden, 2006, 2012; Gilbertson, 2007).

The vicissitudes of jewellery use throughout history have resulted in the dismantling of many artefacts that fell out of fashion. In addition, the liquidation of old jewellery has served as an efficient way to realize financial gain. The diamonds in such pieces were frequently re-cut to meet the demand of the period in terms of cutting style, and then set into more fashionable pieces. As a result, the quantity of diamonds with ancestral cutting styles is inversely proportional to their antiquity. In fact, going back to the pre-17th-century era, there are only a few such artefacts that are still set with their original diamonds in period cuts. In addition to jewellery, sacred gem-encrusted objects, such as those kept in churches (e.g. Figure 1), provide a valuable record of the progression of early diamond cutting. Additional

Figure 1: The magnificent late-17th-century silver-gilt, gold and gem-set reliquary of the Holy Cross of Évora's cathedral (51 × 25 × 25 cm) contains 1,374 gemstones. The 845 diamonds are mostly rose cuts, with table cuts reserved for the smallest stones. The close-up photo shows some details of the reliquary, where rose-cut diamonds and four Colombian emeralds surround a carved hessonite (22.5 × 16.5 mm) depicting the Ecce Homo. *Photos by Carlos Pombo Monteiro; © Fundação Eugénio de Almeida—Arquidiocese de Évora, Portugal.*

insights may be gleaned indirectly through the interpretation of ancient documents and portraits.

This article reviews the evolution of diamond cuts in Portuguese jewellery and sacred objects from the late 15th to late 18th centuries. Since the progression of fashion and taste was somewhat consistent throughout Europe, the reader may extrapolate this review to the evolution of diamond cutting styles in jewellery throughout the Old Continent. Although some of the information in this article has been published previously in Portuguese (Galopim de Carvalho, 2000, 2006b; Galopim de Carvalho et al., 2011; Vasconcelos e Sousa, 2010), this is the first time it has been compiled together in English.

Background

The systematic gemmological study of historical Portuguese objects has taken place for nearly two decades in both national museums and, more importantly, in churches where a significant number of both devotional items and secular jewellery are still kept (e.g. Orey, 1995; Falcão, 2000, 2002; Goulart de Melo Borges, 2004; Galopim de Carvalho, 2009, 2010). Occasionally, private collectors and auction houses provide opportunities for jewellery historians and gemmologists to inspect their items, thus adding to the inventory of dated artefacts with accurate gemmological descriptions (Vassalo e Silva, 2005). Thousands of jewellery pieces have been studied in these contexts, with emphasis placed on identifying the gems and describing their cutting styles. This has resulted in the publication of various books and articles, mostly in Portuguese (e.g. Galopim de Carvalho, 2006b; Galopim de Carvalho et al., 2011) and less commonly in English (e.g. Galopim de Carvalho, 2010).

The most relevant historical period for Portugal's jewellery industry goes from the 16th century to the late-18th or early-19th centuries. For the purpose of this article, diamond-bearing artefacts from this period are described with a special focus on cutting style. Only the most important and significant cuts are taken into consideration, although several less-common styles of cutting have been identified. For example, smaller double cuts and even small-sized rough diamonds from this era have been reported in the literature, but they are not considered in this review. The focus of this interpretative article is the evolution of the mainstream cutting styles in Portuguese jewellery during the considered period.

The information gathered for this review is based on the author's own observations of hundreds of jewels, in conjunction with the limited published works on them by other researchers. The actual dating of historical jewellery is not the author's expertise, necessitating reliance on the work of local jewellery historians that has been published in the literature or recorded on the collections' information sheets.

Diamond Cuts

During the period considered for this review, four cutting styles stand out as the most popular in Portuguese jewellery: the *point cut* (from prior to the 16th century until the very end of the 1500s), the *table cut* (from the first half of the 16th century until the 18th century), the *rose cut* (developed in the 15th century with a long-lasting presence in jewellery, even rarely seen today), and the *old brilliant cut* (from the mid-18th century onward). Following are some considerations about these four cutting styles and their use in Portuguese jewellery.

Point Cut

Until the late 1300s, diamonds were set in jewellery in their rough state, often displaying a euhedral crystal form (most commonly the octahedron). There are examples of Roman jewellery dating back to the 2nd century AD that contain uncut diamond crystals as gems (Bedini et al., 2012). Octahedra set in jewellery resemble a pyramid, so the name *point* became common to describe them. In Portugal during the 16th century, such a diamond was also called a *naife* (Barbosa, 1519; Orta, 1563), a French term possibly dating back to the 12th century (Tillander, 1995).

During the 15th century, advances in technology and expertise permitted the cutting and polishing of diamond crystals. Since the square pyramidal shape described above was prized and popular all around Europe, it was natural for early diamond cutters to mimic this shape (Figure 2). In addition, by following the

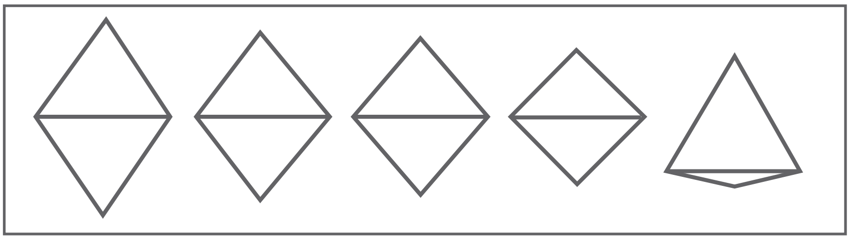

Figure 2: The point cut roughly follows the shape of an octahedral diamond crystal. These drawings show the appearance of different proportion variations. After Tillander (1995).

shape of the octahedral faces, the cutter could obtain the best weight retention (Bari and Sautter, 2001). Note that the designation of *point* can be misunderstood in the literature, since it has been used for uncut octahedra, and also for actual point cuts with proportions different from those of natural diamond crystals (as well as poorly or superficially cut octahedra; J. Ogden, pers. comm., 2014). The proper use of *point cut* should be restricted to fashioned diamonds (Tillander, 1995; Harlow, 1998), whereas the word *point* by itself may refer to the shape of either rough or cut diamonds.

In Portugal, and elsewhere in Europe, this shape had a significant impact beyond jewellery, in both architecture and decorative arts. The facade of the Casa dos Bicos in Lisbon (Figure 3; built in ca. 1523 by D. Braz de Albuquerque) provides a stunning example of the presence of diamonds in architecture. The point motif is also evident in the Palazzo dei Diamanti, in Ferrara and Bevilacqua (Bologna, Italy), which both predate the Lisbon building. In the decorative arts, clear allusions to point-cut diamonds are shown by small pyramid decorations, (1) on a late-1400s silver platter from the collection of the Fundação Ricardo Espírito Santo Silva, and (2) on a 1500s rock-crystal pectoral cross from the Museum Nacional de Machado de Castro, in Coimbra, Portugal. Probably the most famous examples are depicted by late-16th-century tiles manufactured in Seville, Spain, with motifs representing both point and table cuts (Figure 4). These tiles commonly decorate the interior of period churches and important homes. The richness of these references to point-shaped diamonds reveals the importance they had in European society at that time.

In central Europe, there are only a few examples of point-cut diamonds in jewellery, mainly from the 15th–16th centuries, but they are not from Portugal. In fact, among the numerous Portuguese artefacts currently referenced in both public and private collections, only one has a point-cut diamond: the reliquary of the Holy Thorn and Holy Cross (Figure 5), which was commissioned by Queen Leonor, widow of King John II of Portugal (1445–1495); this sacred object was made in 1510 by a foreign goldsmith known as 'Mestre João' (Vassalo e Silva, 1991; Galopim de Carvalho, 2010). The near-colourless point-cut diamond that it contains has an apparent black

Figure 3: Point-cut diamonds are clearly represented on the facade of Casa dos Bicos (House of Spikes; ca. 1523) in Lisbon, Portugal. Photo by Joaomartinho63, via Wikimedia Commons.

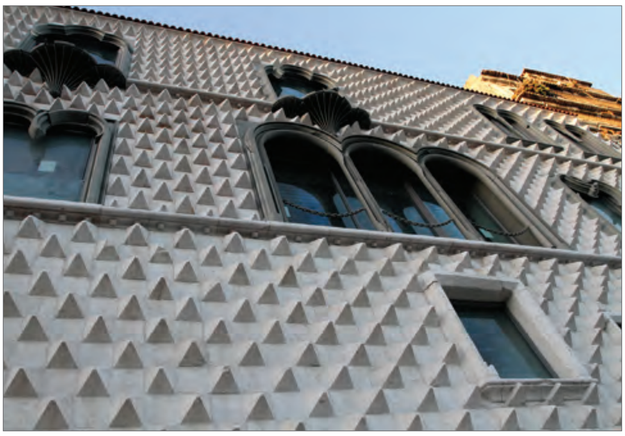

Figure 4: These late-16th-century Spanish tiles in the Church of São Roque, Lisbon, have motifs representative of point- and table-cut diamonds. Each tile measures approximately 14 cm across. Photo by R. Galopim de Carvalho.

Figure 5: The gold, enamel and gem-set reliquary of the Holy Thorn and Holy Cross (35.0 × 15.5 × 12.0 cm), commissioned by Queen Leonor of Portugal (ca. 1510), contains the only point-cut diamond known in a Portuguese artefact. The diamond is located under the cross in the upper-middle part of the relic (see arrow and the enlarged view in the inset). Note the apparent dark colour of the stone. Photo courtesy of Museu Nacional de Arte Antiga, Lisbon; © IMC-DDF.

colour that is due to the extinction of light within the gem, combined with the closed setting and dark backing (Tillander, 1995). This circumstance is also visible in the work of the period's painters, who would use a dark colour to represent point-cut diamonds in their portraits. For example, a portrait of Maria Maddalena Baroncelli by Hans Memling (ca. 1435–1494) clearly shows a necklace set with gems, in which a point-cut diamond is represented using dark paint (Figure 6).

Table Cut

The opening of the sea route to India by Portuguese navigators in the late 1500s contributed to the greater availability of diamonds (and other gemstones) in Europe (Vassalo e Silva, 1989). As more stones became available to the continent's diamond cutters, new cutting styles started to take off along with the established point cuts that remained in use throughout the 16th century. The *table cut* became popular during the first quarter

Figure 6: In this portrait of Maria Maddalena Baroncelli (ca. 1471) by Hans Memling, a point-cut diamond in the necklace (see arrow) is painted in a dark colour, thus representing its appearance. Oil on wood, 42.2 × 32.1 cm; photo courtesy of the Metropolitan Museum of Art, New York, USA.

of the 16th century, although small numbers of these diamonds may have been present in European inventories dating back to the 15th or even 14th centuries. Table-cut diamonds were cut in a quadrangular (usually square) shape with 10 facets (Figure 7). A large quadrangular top facet (or table) replaced the apex of a point-cut, and a smaller parallel facet was placed on the opposite point (the culet). This cutting style was conveniently used to repolish point-cut diamonds that were damaged in jewellery. It represents the first time a popular diamond cutting style embraced the concept of a crown and pavilion (although these words seem to have appeared much later, when describing brilliant cuts).

Figure 7: These drawings of a table-cut diamond show views from the top (left) and bottom (right).

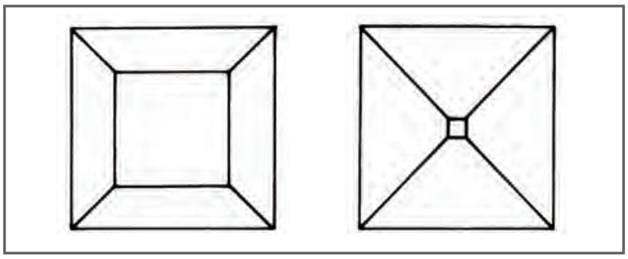

Figure 8: In this early-17th-century gold-and-enamel pendant (5.9 × 3.5 cm), six table-cut diamonds form the arms of the cross together with a rose-cut diamond at the base. Note the darker appearance of the table-cut diamonds. Photo courtesy of Museu Nacional de Arte Antiga, Lisbon; © IMC-DDF.

Table cuts were extensively used in the 16th century to the first half of the 17th century, and they still enjoyed occasional use in the 18th century, but mainly in smaller sizes. Two rings containing table-cut diamonds are present in the Museu Nacional de Arte Antiga, Lisbon; one is dated ca. 1550 and the other is from a later period in the same century (Orey, 1995). The museum also has a gold-and-enamel cross pendant dating from the beginning of the 1600s that is set mainly with rectangular table cuts (Figure 8). Additional examples are described in the literature (Orey, 1995).

As with point cuts, table-cut diamonds commonly have a dark appearance due to

Figure 9: In this Joos van Cleve portrait (ca. 1530) of Eleanor of Austria, all the diamonds in her jewellery are painted to look dark, as was consistent with the appearance of table-cut stones. The inset is an enlarged view to show the diamonds in more detail. Oil on panel, 35.5 × 29.5 cm; photo courtesy of Museu Nacional de Arte Antiga; © IMC-DDF.

Figure 10: This close-up of the reliquary of the Holy Cross of Évora's cathedral shows a line of small table-cut diamonds, each with an estimated weight of less than 0.05 ct. Photo by R. Galopim de Carvalho.

extinction, but not to the same extent. Again, paintings offer valuable information, as seen in a ca. 1530 Joos van Cleve portrait of Eleanor of Austria (third wife of King Manuel I of Portugal; Figure 9). The quadrangular gems and the triangular centre stone are depicted by the artist using dark paint.

The popularity of table-cut diamonds started to decline significantly in the 17th century, in favour of more fashionable rose cuts (see below). Table cuts were reserved almost exclusively for smaller stones. As an example, the reliquary of the Holy Cross of Évora's cathedral (Figures 1 and 10), from the late 1690s, is set with 845 diamonds—but only 46 are table cuts, and all of these are under 0.05 ct (Galopim de Carvalho et al., 2011).

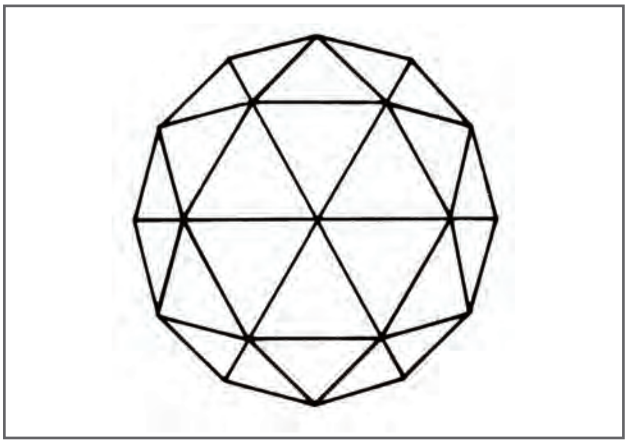

Figure 11: The top view of a rose cut (specifically, the Holland rose) is shown in this drawing. The bottom view is not shown since rose cuts have a flat base.

Diamond simulants were also cut according to fashion, and some curious examples have been identified with table cuts. For example, a 17th century devotional pendant in the collection of the Museu Nacional de Machado de Castro (Coimbra, Portugal) is set with table-cut rock-crystal (Luz Afonso, 1992, pp. 338–339).

Rose Cut

The *rose cut* began gaining popularity in the 1500s, although its presence in jewellery was more pronounced during the 1600s and in the first half of the subsequent century. This cut generally consists of a flat-based dome covered with triangular facets of diverse symmetry resembling a fully-blossomed rose (Figure 11). This cut may show several variations, depending on the number of facets and their disposition (Tillander, 1995). The most popular variation from Portugal has 24 facets arranged in two circular rows, with six-fold symmetry, in a pattern known as the *Holland rose cut*. Various stone shapes were used (e.g. round, oval, pear, etc.), with round being most common. However, the rounds almost always showed an irregular outline until technology improved during the second half of the 19th century. Rose cuts show greater light reflection from the surface of the faceted dome, creating a visual effect that is much brighter than shown by the previously mentioned cutting styles, especially when illuminated by candlelight.

Rose cuts coexisted with table cuts for many decades, but in the 17th century they became the cut of choice. This is exhibited by the late-17th-century reliquary of the Holy Cross of Évora's cathedral (Figure 1), in which the vast majority of diamonds, some with estimated weights of more than 2 ct, are rose cuts (Figure 12). Another example is provided by the Patriarchal Monstrance, a 17 kg solid gold gem-set implement ordered by King John V of Portugal (Lourenço, 1996; Galopim de Carvalho, 2010). The vast majority of diamonds except those set in the aura (of later manufacture) are rose cuts in various shapes, suggesting that this style of cut was the most appreciated, available and sought after at the time of King John's order in the second quarter of the 18th century. Likewise, diamond simulants were cut in this style, and an interesting example is provided by a pair of gold earrings

Figure 12: The top of the reliquary of the Holy Cross of Évora's cathedral contains a rose-cut diamond with an estimated weight of 2 ct. Photo by Carlos Pombo Monteiro; © Fundação Eugénio de Almeida—Arquidiocese de Évora, Portugal.

Figure 13: These 18th-century gold earrings (each 7.0 × 1.6 × 1.2 cm) are set with colourless pastes in rose cuts, simulating diamonds as they were supposed to look. The inset has been enlarged to show one of the pastes in more detail. Photo by Carlos Pombo Monteiro; © Fundação Eugénio de Almeida—Arquidiocese de Évora, Portugal.

from the 18th century set with small rose-cut paste (Figure 13).

Such appreciation for rose-cut diamonds is also seen in secular jewellery (both gold and silver) manufactured in the first half of the 1700s. Some important jewels from this period containing large rose-cut diamonds are housed in the Museu Nacional de Arte Antiga in Lisbon, which holds one of the most important collections of Portuguese historical jewellery in the country.

With the advent of the brilliant cut in the mid-18th century, the popularity of rose cuts declined in larger and in most smaller diamonds. Many of the larger diamonds were subsequently re-cut as brilliants (Jeffries, 1751).

Old Brilliant Cut

Massive quantities of diamonds started to arrive in Portugal and Europe after the discovery of Brazil's gem fields in the 1720s; the amounts far surpassed production from India and Borneo (Lenzen, 1970; Ogden, 2005; Drumond Braga, 2007). With the greater abundance and availability of diamonds, jewels progressively transformed into metal structures to hold as many stones as their face-up surface would allow (e.g. Figure 14), rather than the elaborate gold or silver artefacts in which diamonds served as isolated details throughout the design. As such, diamond jewellery became lavishly plentiful of diamonds, making the metal progressively more invisible as it merely was used to secure the stones. This trend was also seen in historical Portuguese coloured gemstone jewellery, known for its extensive use of Brazilian gems (Vasconcelos e Sousa, 1999, 2010; Galopim de Carvalho, 2006a, 2010).

The plentiful supply of diamonds during this period may also have been responsible for greater boldness and experimentation in cutting diamonds. Even prior to the discovery of the Brazilian deposits, a new cutting style was evolving, consisting of a distinct crown (with a table facet) and a pavilion (containing a culet). In the crown there were two sets of triangular facets, which is a possible reason why some authors have called this the *double cut* (Gaal, 1977). This cutting style has only been seen in rather small diamonds (less than a quarter carat) in 18th-century jewels observed by the author. However, during the late 17th century, a more complex development of this cut was made in Europe, comprising a greater number of facets on the crown (33) and pavilion (25), for a total of 58, with a squarish shape (Jeffries, 1751; see Figure 15). This style is called the *brilliant cut* due its much greater brilliance compared to the other cutting styles of that period. In the candlelight that illuminated the salons where social events took place, these brilliants reflected back much of the incident light, generating scintillation and fire. This visual effect

Figure 14: This mid-18th century demi-parure demonstrates the trend of using as many diamonds as possible in a jewellery piece, which occurred after the discovery of Brazil's diamond fields in the 1720s. Although this jewellery contains rose cuts, the preferred faceting style later shifted to brilliant cuts toward the end of the century. The pendant is 7.3 × 4.9 × 1.2 cm, and the earrings each measure 4.8 × 2.8 × 1.9 cm. Photo by Carlos Pombo Monteiro; © Fundação Eugénio de Almeida—Arquidiocese de Évora, Portugal.

played an important role in the way diamonds were perceived in fashion (Becker, 1987).

If we look at diamond-set jewellery of this period through the eyes of a painter, diamonds were no longer depicted with a dark grey or black colour, but rather with white, light grey or slightly tinted whites. This is consistent with a major evolution in the appearance of diamonds in jewellery that is still valued today: whiteness and brilliance. Even the name *brilliant* is still used today to describe the most popular modern proportioned cutting style. Curiously, the original style is now called *old brilliant* or *old mine* to distinguish it from the 20th century's modern brilliant which has different proportions.

Brilliant-cut diamonds rapidly surpassed rose cuts in popularity in the second half of the 18th century, in both gold and silver jewellery of devotional as well as secular use (Galopim de Carvalho, 2009). By this time, table cuts were almost non-existent and double cuts were seen only occasionally in small sizes. Rose cuts were still in use, but to a much lesser extent in progressively smaller sizes, and particularly in shallow stones where the brilliant proportions would result in excessively low yield from the rough. Brilliant cuts eventually were preferred even in smaller stones, as seen in many jewels of the period. An interesting variation of the brilliant cut is the little-known *Lisbon cut* (see Box A).

The Portuguese royal collections are useful repositories for illustrating the importance of the brilliant cut in regalia dating mostly from the last quarter of the 18th century. An abundance of large, good-quality brilliant-cut diamonds entirely covers the surface of some of the jewels (Silveira Godinho, 1991). Also, some important devotional implements are richly decorated with diamonds

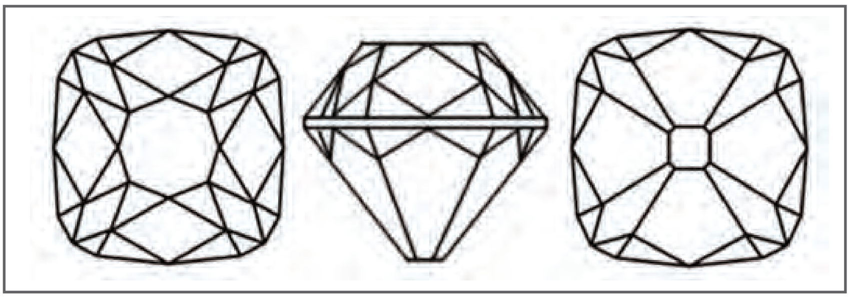

Figure 15: The facet pattern of the early brilliant cut is shown from the crown (left), side (centre) and pavilion (right) in these drawings.

BOX A: The Lisbon Cut

The Lisbon cut is usually defined as a modified old-mine cut with 16 extra facets (eight on the crown and eight on the pavilion), for a total of 74 facets (Figure A-1). Little is known about the development of this brilliant cut or the origin of its name. It seems to have appeared in the literature only around the 1850s (J. Ogden, pers. comm., 2014).

Of the many thousands of diamonds inspected in 18th-century Portuguese jewellery, only one diamond that provides evidence for the Lisbon cut has been identified by this author. This approximately 10 ct oval-shaped diamond (Figure A-2) is mounted in a gold snuff box that was made in ca. 1755–1756 by a French jeweller (Jacmin, who lived 1718–1770). However, the extra facets are present only on the crown and not the pavilion, so this stone has a total of 66 facets rather than the 74 that have been proposed in the literature for the Lisbon cut. Nevertheless, this diamond provides the only known physical evidence of the Lisbon cut in Portuguese jewellery and elsewhere.

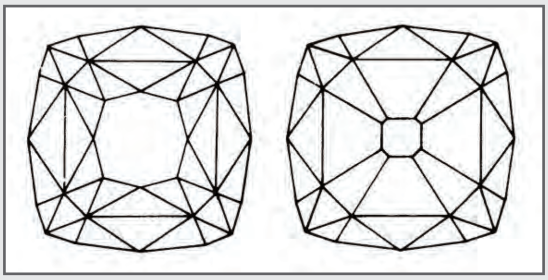

Figure A-1: These diagrams of the Lisbon cut show the facet arrangements on the crown (left) and pavilion (right).

Considering Portugal's connection with Brazil and its diamonds, one would assume that diamond manufacturing was important in Portugal during the 17th–18th centuries. Research is on-going into Portugal's diamond cutting industry at that time, and more information on the Lisbon cut should become available in the future.

Figure A-2: This approximately 10 ct oval diamond, set in a gold snuff box made in ca. 1755–1756 for King José I of Portugal, contains extra facets on the crown that are consistent with the design of the Lisbon cut. The bezel facets are each divided into two triangular facets. Photo by R. Galopim de Carvalho; courtesy of Palácio Nacional de Ajuda, Lisbon.

Figure 16: The aura of the Bemposta Monstrance (97 × 33 cm), a late-18th-century implement richly set with thousands of gems, is decorated with brilliant-cut diamonds. Photo courtesy of Museu Nacional de Arte Antiga, Lisbon; © IMC-DDF.

faceted in this style (Vassalo e Silva, 2000). Some artefacts stand out for their size and importance, such as the Bemposta Monstrance (Figure 16) and the Estrela Monstrance (Figure 17). In the latter piece, not all the colourless gems in the aura are diamonds. Some are substitutes, namely topaz and very slightly blue to colourless beryl (Galopim de Carvalho, 2008).

In pre-19th-century Portuguese jewellery, most diamonds were set in silver, whereas coloured gemstones (e.g. ruby and emerald) were typically set in gold. The settings commonly were close-backed, not *a jour* as open settings were called. This caused the apparent extinction of the brilliant's culet, making it appear as a dark point in the centre of the diamond (e.g. Figure 18). This visual characteristic was perceived as proper for diamonds in those days, and even diamond simulants were made to look as if the culet was dark. In Portugal, the most popular simulants were quartz, topaz and beryl, all colourless to near-colourless, and because they were set with a foil back, the culets were painted black to achieve the desired appearance face-up (Galopim de Carvalho, 2008). However, there is no significant record of the use of foils (either colourless or coloured) in diamond settings in Portuguese jewellery, as reported for European jewels of the same period in the late 18th century (Becker, 1987), since the foils were only used for coloured gemstones.

Conclusion

The jewellery industry in Portugal was vibrant from the late 15th century (when navigators opened the sea route to Asia) until the early 19th century, prior to Napoleonic invasions. The significant amount of dated diamond-set jewellery and sacred objects in Portuguese public and private collections tells the story of the evolution of diamond cuts during this period. The greater number of more recent

Figure 17: The colourless gems set in the aura of the Estrela Monstrance, commissioned in the last quarter of the 18th century, consist of brilliant-cut diamonds as well as topaz and beryl. The dimensions of the monstrance have not been published, but the entire piece is estimated to be 1 m tall. Photo © Patriarcado de Lisboa, Portugal.

jewellery pieces is interpreted as evidence that out-of-fashion jewels were dismantled, either motivated by fashion or as a consequence of the sale of those pieces for financial gain. In the same manner, recutting diamonds to meet fashion trends also explains the scarcity of older cuts.

Point-cut diamonds were in existence prior to the 16th century. They were eventually overtaken by the table cut, which remained popular during the first half of the 16th century before being progressively relegated to smaller-sized stones. The rose cut emerged in the 1500s and coexisted with small table cuts until newer cutting styles became more fashionable. The brilliant cut became prominent in the mid-1700s, coincident with the availability of large quantities of diamonds from Brazilian mines. The brilliant cut rapidly surpassed the rose cut as the style of choice.

A distinct change in the visual appearance of faceted diamonds occurred when brilliant cuts came into play, as they showed much better light return, sparkle and fire than the previous cuts, a circumstance that was well illustrated in portraits from the 18th and 19th centuries. Moreover, due to the fact that brilliant-cut diamonds were mostly set in closed-back settings, their culet looked like

Figure 18: This gold and silver breast pin (ca. 1758; 6.8 × 7.8 × 1.8 cm) is set with brilliant-cut diamonds, rubies, garnets and a foil-backed pink topaz for the centre stone. Note the diversity of the brilliant-cut shapes and the dark culets shown by the diamonds. The pin also demonstrates the use of different metals to set diamonds (silver) and coloured gemstones (gold). Photo by Carlos Pombo Monteiro; © Fundação Eugénio de Almeida—Arquidiocese de Évora, Portugal.

a black dot. This visual effect was replicated in diamond simulants, in which the culets were painted black.

The information provided in this brief review, based on the observation of Portuguese jewellery and devotional objects, may serve as an illustration of the trends in diamond cutting within wider European manufacture.

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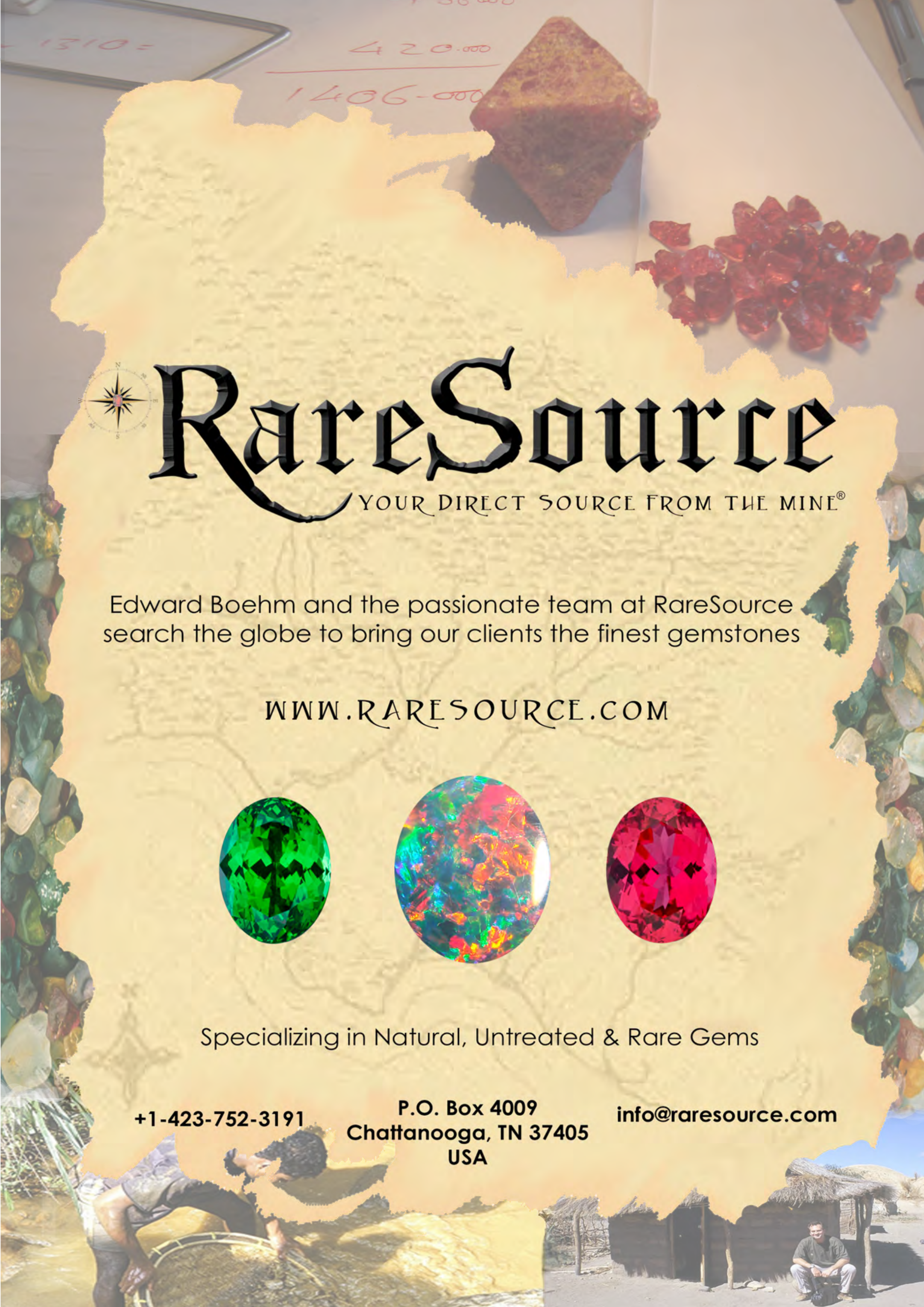
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Beryllium-Diffused Corundum in the Japanese Market, and Assessing the Natural vs. Diffused Origin of Beryllium in Sapphire

Kentaro Emori, Hiroshi Kitawaki and Makoto Okano

More than a decade has passed since Be-diffused corundum was first recognized by gemmologists, and such material is still present in the gem market. This study summarizes data from about 22,000 pieces of corundum submitted for identification to the Central Gem Laboratory in Japan in 2012. LA-ICP-MS analysis revealed an average of 10 ppm beryllium in Be-treated samples, regardless of corundum colour or the specific spot analysed on a stone. Traces of naturally occurring Be also were detected in corundum that was identified in the laboratory as being heat treated without Be-diffusion treatment. Such stones were identified by their colour distribution and by wide variations in Be measured in different spots, which was positively correlated with other trace elements (i.e. Nb and Ta in blue sapphires, and Zr and Hf in yellow to yellowish orange sapphires). These elements were typically associated with clouds of minute inclusions, but they also were present in the blue sapphires in areas where no inclusions were visible with the gemmological microscope. While the LA-ICP-MS technique is useful for identifying Be-diffused corundum, the simple presence of Be is not always proof of this treatment.

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Introduction

Since September 2001, vividly coloured sapphires including orangey red, orange, pink and yellow have been widely seen on the gem market (e.g. Figure 1). In particular, the sudden emergence of numerous orangey pink to pinkish orange (padparadscha-like) sapphires raised concern in the jewellery industry. These stones showed a surface-conformal layer (coloured rim) that was not due to conventional heat treatment. Research by international gem laboratories elucidated that these sapphires had been subjected to a new

Figure 1: Various colours of Be-diffused corundum in the marketplace are shown here. The rough pieces weigh 0.10–0.13 ct, and the faceted stones range from 0.42 to 1.53 ct. Photo by H. Kitawaki.

heating process called Be-diffusion treatment, in which the light element beryllium originated from pieces of chrysoberyl that were also present in the crucible (Emmett et al., 2003). Nowadays Be-diffusion treatment is also applied to some blue, violet and green sapphires, as well as to ruby.

The existence of a surface-conformal layer suggests the diffusion of elements of external origin. However, some Be-diffused corundum does not show such a colour layer, and therefore cannot be visually identified. Thus, direct chemical analysis of Be is needed to detect the treatment. Beryllium is a light element, so it cannot be detected by standard analytical techniques in gemmological laboratories such as X-ray fluorescence. More sophisticated analyses including laser ablation–inductively coupled plasma–mass spectrometry (LA-ICP-MS) or laser-induced breakdown spectroscopy (LIBS) are required to detect the trace levels of Be. Well-equipped laboratories now employ such instrumentation for the identification of Be-diffused corundum on a daily basis (e.g. Abduriyim and Kitawaki, 2006).

Initially, the detection of Be by LA-ICP-MS was regarded as evidence of Be-diffusion treatment because it was thought that this element did not exist within untreated corundum. However, traces of naturally occurring Be have subsequently been confirmed in untreated corundum (e.g. Shen et al., 2007), which has made the identification of Be-diffusion treatment more complicated.

In this study, we report on (1) statistical data regarding the presence of Be-diffused corundum in the Japanese gem market, and (2) a method for distinguishing between stones treated by Be diffusion and those containing Be of natural origin by measuring their trace-element signatures using LA-ICP-MS.

Materials and Methods

More than 22,000 samples of corundum that had been submitted to the Central Gem Laboratory (CGL) in 2012 were evaluated for this study. More than 1,000 of these were suspected to be Be-diffused after standard gem testing, due to their coloration, inclusions that showed evidence of high-temperature heating, and absence of hydrogen-related absorption features recorded by infrared spectroscopy (cf. Emmett et al., 2003). Those stones were therefore analysed by LA-ICP-MS when permitted by the client.

Since CGL's identification service is not based on a membership system and the laboratory accepts stones from any client, the samples of this study are considered representative of the sapphires and rubies in the Japanese market. In addition, to study the relationship between natural-origin Be and other trace elements, we obtained LA-ICP-MS analyses of 86 pieces of corundum that were collected for a geographical origin determination project. Although some of these samples had undergone conventional heat treatment, none were Be diffused.

A New Wave Research UP213 laser ablation unit and an Agilent 7500a ICP-MS system were used for trace-element analysis (see Table I for

Table I: Analytical parameters of LA-ICP-MS.

Laser Ablation	**New Wave Research UP213**
Wavelength	213 nm
Crater size	15 μm or 30 μm
Laser power	0.025 mJ
Pulse	10 MHz
Ablation time	25 sec
ICP-MS	**Agilent 7500a**
ICP	27.15 MHz
RF power	1200 W
Gas flow	Plasma gas: 14.93 l/min
	Auxiliary gas: 0.89 l/min
	Carrier gas: 1.44 l/min
Analysis mode	Al: analog mode
	Be, Zr, Nb, Hf, Ta, W, Th: pulse counting mode
Sample introduction	Torch: SiO_2
	Skimmer cone: Ni
	Sampling cone: Ni
Integration time	Al: 0.01 sec
	Be, Zr, Nb, Hf, Ta, W, Th: 0.1 sec

equipment parameters). The size of the analytical crater was 15 μm for the qualitative detection of Be and 30 μm for quantitative trace-element analysis. Two points were analysed on the girdle of each stone, and if Be was detected and suspected to be of natural origin, then up to eight points were analysed. The external standard used was NIST SRM 612 multi-element glass, and we set the internal standard to Al_2O_3 = 99.0%. The analyses are reported in units of parts per million by weight.

Results and Discussion

The Proportion of Be-Diffused Corundum and Its Be Content

Figure 2 shows the colour variations of all the corundum submitted to CGL in 2012 on the left, and the coloration of just the Be-diffused corundum from that year is shown on the right. Among the former, ruby and blue sapphire were dominant, while the latter mostly consisted of pink to orange (including padparadscha-like) and yellow to yellowish orange stones.

For each of the colour groups shown in Figure 2, the proportion of corundum samples was then calculated according to the following parameters:

- Beryllium diffused, as determined by LA-ICP-MS
- Beryllium diffused, as determined by standard identification methods
- Not analysed, due to client preference or jewellery mounting
- Not beryllium diffused

As depicted in Figure 3, the yellow to yellowish orange stones showed the maximum probability of being Be-treated, and a significant proportion of the pink to orange samples also were diffused with Be. Among those samples determined to be Be-diffused, some of the pink to orange sapphires had surface-conformal layers, but the yellow to yellowish orange and blue sapphires did not have such layers.

Figure 4 shows the range of beryllium concentration in Be-diffused corundum analysed by LA-ICP-MS in each colour group. The average concentration of Be in each colour variety was approximately 10 ppm, regardless of the stones'

Figure 2: The colour variations of the corundum submitted to CGL in 2012 are plotted on the left, and the coloration of the Be-diffused samples is shown on the right.

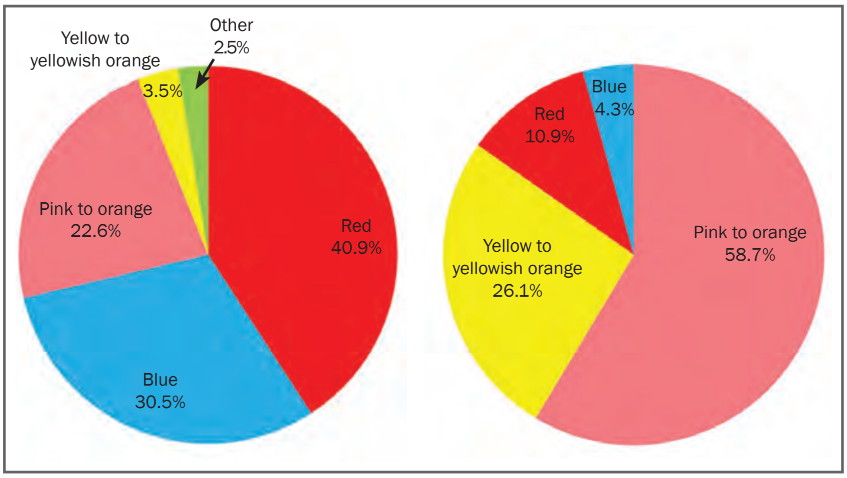


Figure 3: The proportion of corundum samples is shown for each colour group according to four parameters. The highest proportion of Be-diffused stones was found within the yellow to yellowish orange group.

coloration or the location of the analytical spots on the sample. This is quite close to the average value (9.74 ppm) obtained for 20 samples of Be-diffused corundum of various colours that were directly obtained from gem treaters in Bangkok, Thailand, by one of the authors (HK) in 2002 and 2007. The lowest beryllium concentration measured in the Be-diffused samples was 2 ppm. There was no correlation between Be and other trace elements in the corundum samples treated by Be diffusion.

Sapphires Containing Natural-Origin Beryllium

Yellow to Yellowish Orange Sapphires: A 16.95 ct yellowish orange sapphire (Figure 5) of unknown origin was identified in our laboratory as having undergone standard heat treatment, and it did not show features of Be-diffusion treatment such as a coloured rim. However, since the lack of a coloured rim does not preclude Be-diffusion treatment, we analysed it by LA-ICP-MS. Analyses of eight random points on the stone's girdle showed the following: 1.42–7.14 ppm Be, 0.65–11.11 ppm Zr and 0.09–2.24 ppm Hf; the elements Nb, Ta, W and Th were not detected. Shen et al. (2009) reported a similar correlation between Be, Zr and Hf, and concluded that these trace elements were of natural origin. Figure 6 shows a fairly well-defined positive correlation of Be with Zr and Hf.

Similar trace-element results were obtained for 34 pieces of yellow to yellowish orange sapphires identified as containing natural-origin Be that were analysed in routine daily work in

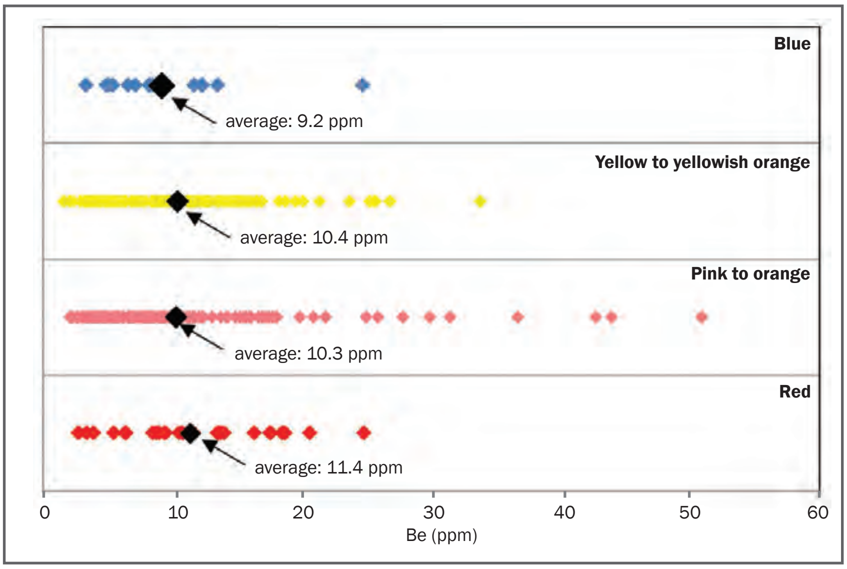


Figure 4: Beryllium concentration ranges are shown for the four colour groups of Be-diffused corundum analysed in this study. The average value for each colour group is approximately 10 ppm Be.

Figure 5: This 16.95 ct yellowish orange sapphire of unknown origin is inferred to have undergone standard heat treatment, but not Be-diffusion treatment. Nevertheless, the stone contains concentrations of 1.42–7.14 ppm Be, together with Zr and Hf. Photo by K. Emori.

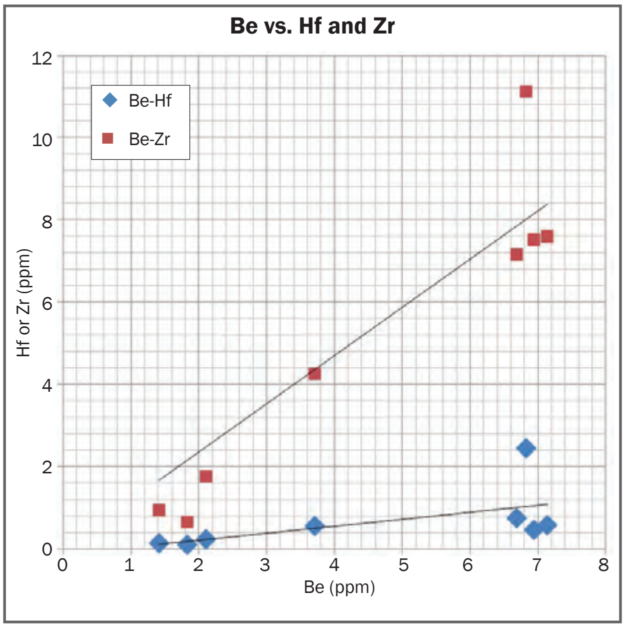


Figure 6: A fairly well-defined positive correlation of Be with Zr and Hf is shown by the 16.95 ct yellowish orange sapphire. This correlation is consistent with the presence of natural-origin Be.

2012. These sapphires constituted 4.4% of the overall number of yellow to yellowish orange sapphires that were examined in our laboratory during that time.

Blue Sapphires: We also found natural-origin Be in 14 blue sapphires from Cambodia, Nigeria and Laos (Figure 7), which are of magmatic origin (Hughes, 1997), that were obtained for our studies of geographical origin determination. These stones were provided by a dealer in Chanthaburi, Thailand, who owns mines all over the world. We were told that they had undergone standard heat treatment but were not Be-diffused. Our examination showed inclusion features that were consistent with this claim, and none of the stones had the coiled spring-like inclusions that are commonly seen in Be-diffused blue sapphires (DuToit et al., 2009). However, LA-ICP-MS analyses (five spots per sample) showed widely varying amounts of Be in all these samples, ranging from undetectable to nearly 10 ppm (Table II), typically in association with clouds of particles observed with the gemmological microscope. Nevertheless, Be was also detected from some areas in which no clouds or other inclusions were visible. The trace elements Nb and Ta were well correlated with Be, as plotted in Figure 8. The majority of the analysis showed <1 ppm Be.

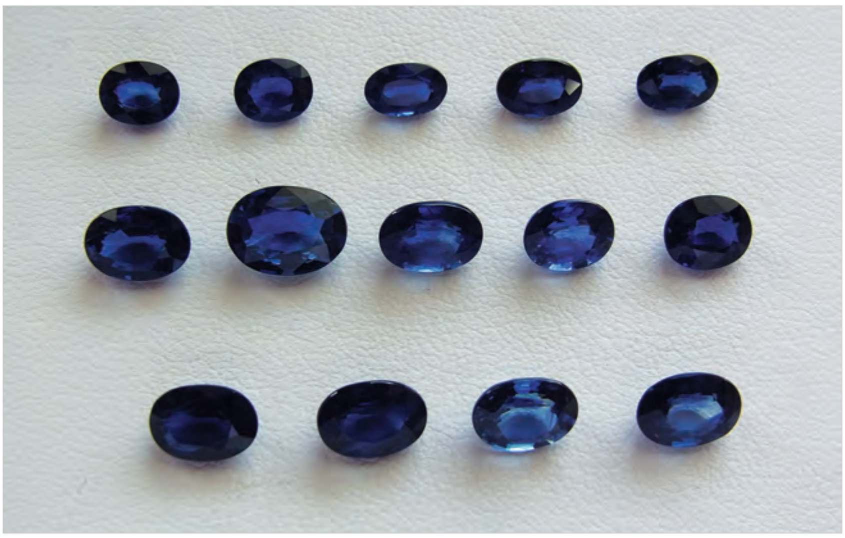


Figure 7: These blue sapphires of magmatic origin were found to contain naturally occurring beryllium. Top row: Pailin, Cambodia (0.59–0.74 ct), middle row: Mabila, Nigeria (0.88–1.44 ct) and bottom row: Ban Huay Xai, Laos (0.92–1.11 ct). Photo by K. Emori.

Table II: Trace elements in blue sapphires from Cambodia, Nigeria and Laos containing natural-origin Be.[a]

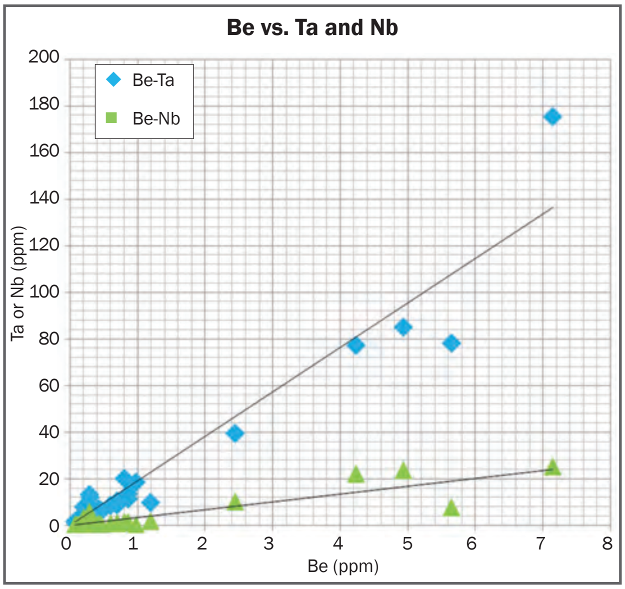
Element	Cambodia	Nigeria	Laos
Be	nd–5.65	nd–9.69	nd–7.15
Nb	nd–191	nd–5.53	nd–25.1
Ta	0.32–140	nd–18.4	nd–175

[a] The elements Zr, Hf, W, and Th were sought but not detected.
Abbreviation: nd = not detected.

Among the client stones submitted to our laboratory in 2012, 14 of the blue sapphires (or 0.2%) proved to contain natural-origin Be, with the same trace-element associations described above. Some were of magmatic origin, but others were of metamorphic origin resembling sapphires from Madagascar or Sri Lanka.

Summary: The presence of natural-origin Be in sapphire is correlated with the following characteristics:
(1) The absence of the coloured rim that is shown by some pink to orange Be-diffused corundum
(2) Be concentrations that vary significantly from undetectable or very small amounts up to 10 ppm in different spots of a sample
(3) Most importantly, a well-defined positive correlation between Be and Zr and Hf in yellow sapphires, or Be and Nb and Ta in blue sapphires.

Figure 8: The blue sapphires with naturally occurring Be collected for our geographical origin studies showed a good correlation between the concentration of Be and that of Ta and Nb.

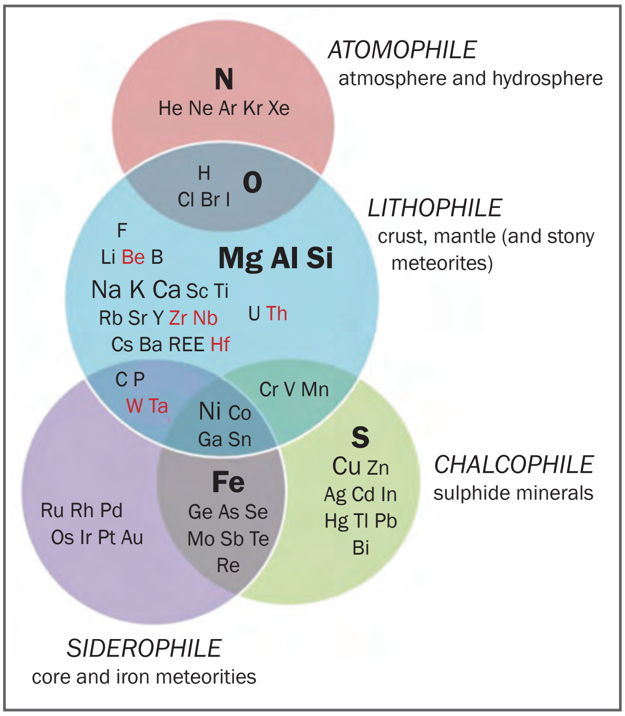


Natural Incorporation of Be and Associated Trace Elements into Corundum

Chemical elements are divided into four categories depending on their affinity: *atomophile* (gaseous elements), *lithophile* (elements concentrated in a silicate phase), *chalcophile* (elements concentrated in a sulphide phase, such as Cu) and *siderophile* (elements with an affinity for metallic Fe; see e.g., Gill, 1996). The elements Be, Zr, Hf, Nb, Ta, W and Th are lithophile (Figure 9), and they also are known as geochemically *incompatible* since they typically are omitted from the crystallization of rock-forming minerals and are therefore concentrated into the residual liquid phase during magmatic crystallization. They also may be the first elements to be released during the partial melting of the earth's crust (Gill, 1996).

Elements with an ionic potential (i.e. nominal cation charge divided by ionic radius) that fall in the range between 30 and 80 nm^{-1} are called *hydrolysates* (Figure 10), and these elements become insoluble precipitates when they undergo

Figure 9: The four affinity categories of chemical elements are shown in this diagram. Beryllium, Zr, Nb, Hf, Ta, W and Th are considered lithophile elements, meaning they are concentrated in a silicate phase. Adapted from Gill (1996, p. 247).



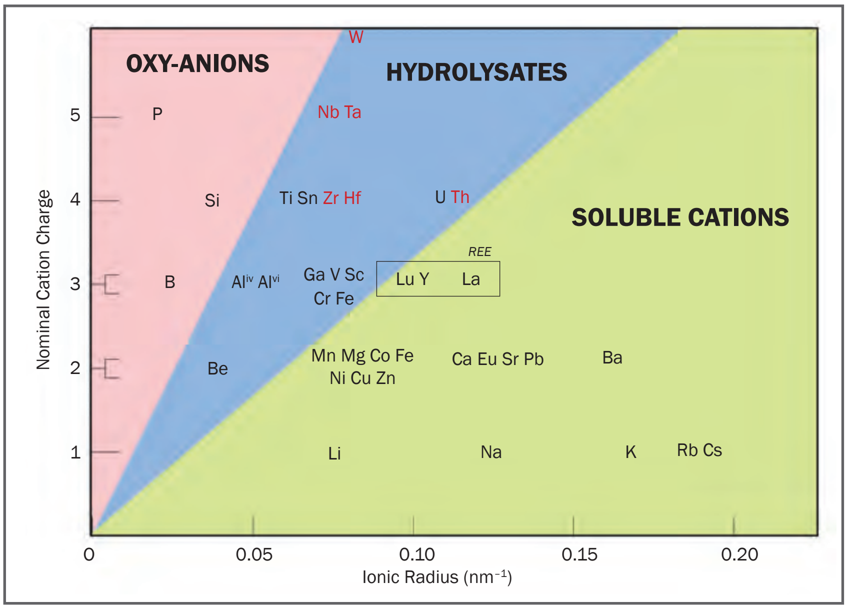


Figure 10: Based on their ionic potential, Be and the other elements shown in the blue area are categorized as hydrolysates. Adapted from Gill (1996, p. 207).

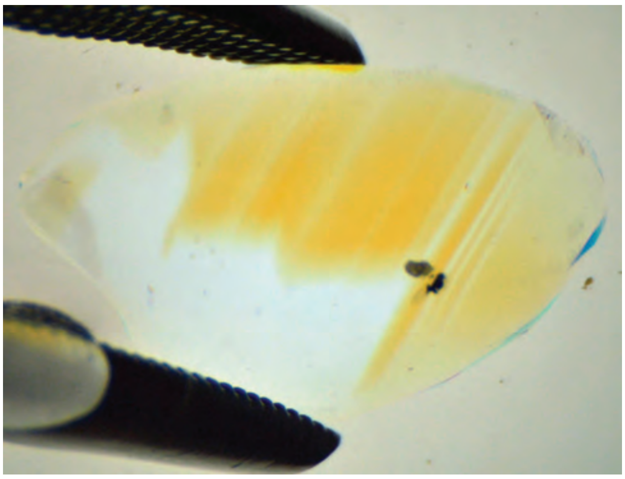
hydrolysis (Gill, 1996). For example, in the case of aluminium:

$$Al^{3+} + 3H_2O \Rightarrow Al(OH)_3 + 3H^+$$
$$\text{(insoluble precipitate)}$$

We propose that in corundum containing natural-origin beryllium, the incompatible lithophile elements Zr, Nb, Hf, Ta and potentially other elements were concentrated and underwent hydrolysis together with Be, and were then incorporated into corundum as minute inclusions.

A different type of minute inclusion was documented by Shen and Wirth (2012) in a blue sapphire from Ilakaka, Madagascar, that had cloudy inclusions associated with Be, Nb and Ta. High-resolution transmission electron microscopy showed that the clouds consisted of nano-inclusions of an unnamed Ti-rich phase that had the same crystal structure as scrutinyite (α-PbO_2). The Be, Nb and Ta are evidently incorporated together into this unnamed phase.

Figure 11: Viewed in immersion, this 5.55 ct yellow sapphire shows distinct colourless and yellow areas related to the corundum's crystal growth. Photomicrograph by H. Kitawaki.



Sapphire Containing Be, Possibly from Secondary Contamination

We also studied a 5.55 ct yellow sapphire that contained tension haloes indicative of heat treatment when viewed with the microscope, but did not show the coloured rim associated with Be diffusion treatment. Immersion in diiodomethane revealed distinct colour zoning with sharply defined colourless and yellow areas related to the corundum's crystal growth (Figure 11). In contrast, most of the Be-diffused stones we examined showed uniformly distributed colour. In those samples that did show colour zoning related to their crystal growth, there were no colourless areas observed. Thus the type of zoning shown by the 5.55 ct sapphire is not characteristic of Be diffusion treatment (although it is not inconsistent with standard heat treatment).

Figure 12 shows the results of analysing six spots on the girdle of the 5.55 ct sapphire by LA-ICP-MS. Only very small amounts of Be were measured (0.47 to 1.29 ppm), and there was no correlation between Be concentration and colour zoning. Also, trace elements such as Zr, Nb, Hf, Ta, W and Th that have been found to accompany natural-origin Be were not detected in this stone.

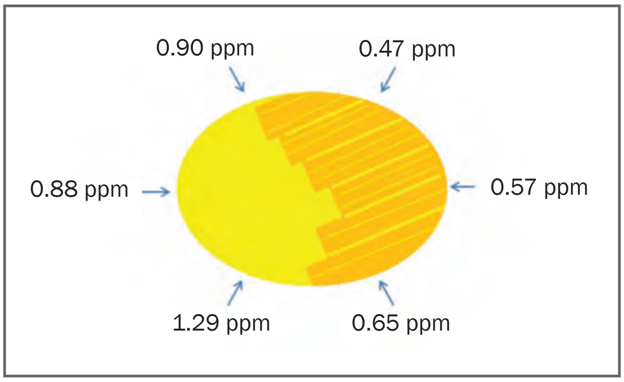


Figure 12: LA-ICP-MS analyses of six spots on the girdle of the 5.55 ct yellow sapphire show very low concentrations of Be (0.47–1.29 ppm). There is no correlation between Be concentration and coloration, and the lack of those trace elements associated with natural-origin Be suggest that the beryllium originated from secondary contamination.

The properties exhibited by this stone suggest that the beryllium originated from secondary contamination, perhaps due to reusing a crucible or furnace that was previously employed for Be-diffusion treatment.

Conclusion

More than a decade after its appearance on the gem market, Be-diffused corundum is still seen on a daily basis in gem laboratories. According to our statistical analysis of the corundum submitted to the CGL laboratory in 2012, yellow to yellowish orange sapphires form the maximum proportion (about 10%) of the stones identified as Be-diffused.

In gemmological laboratories, LA-ICP-MS analysis is generally used to analyse Be in corundum. Stones with no detectable Be are determined as not being treated by Be-diffusion. However, trace amounts of Be in some corundum may be of natural origin, or possibly due to secondary contamination by reusing a crucible or furnace that was previously employed for Be-diffusion treatment. Natural-origin Be is not distributed evenly in corundum, and it is found together with Nb and Ta in blue sapphires and with Zr and Hf in yellow to yellowish orange corundum. Detection of Be-diffused corundum should be done in a careful manner, by considering data of not only Be but also associated elements such as Zr, Nb, Hf, Ta, W and Th, as well as the concentration distribution of Be.

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A Rare 100+ ct Jeremejevite

Christopher P. Smith

Collectors' stones represent some of the most intriguing gems in our industry. Not often, however, do gemmologists get the opportunity to present a complete study on such unique items. American Gemological Laboratories (AGL) has documented a 106.50 ct jeremejevite, the largest faceted example of this mineral reported to date. The gemmological properties of this stone are consistent with those published previously for jeremejevite. The first published LA-ICP-MS analyses on jeremejevite, obtained from this stone, showed the presence of the following trace elements: Si, Ca, Ga, Fe, Zn, Ti, V and Mg.

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Introduction

Of the nearly 5,000 recognized mineral species and varieties, fewer than roughly 400 are known to occur in suitable transparency for faceting as a gemstone. The vast majority of these are considered collectors' stones, as they do not occur in sufficient quantities to establish a broader market, or their low hardness precludes jewellery use. Further still, such stones tend to be small after fashioning, most commonly less than 1 ct.

One example of such a collectors' stone is jeremejevite. Jeremejevite (pronounced 'year-ah-mee-yeah-vite') is a rare aluminium borate mineral with the formula $Al_6(BO_3)_5(F,OH)_3$. It was discovered in 1883 at Mt Soktui in the Adun-Chilon Mountains of Siberia (Arem, 1987), and was named after Russian mineralogist Pavel Vladimirovich Eremeev (from the German spelling, Jeremejev).

Jeremejevite typically forms during a late hydrothermal phase in granitic pegmatites, where it is associated with albite, tourmaline and quartz (O'Donoghue, 2006). As a result of this restricted formation, there are relatively few places where jeremejevite has been found,

Figure 1: The well-proportioned cutting and fine polishing of the 106.50 ct jeremejevite complement its high clarity. Photo by Bilal Mahmood.

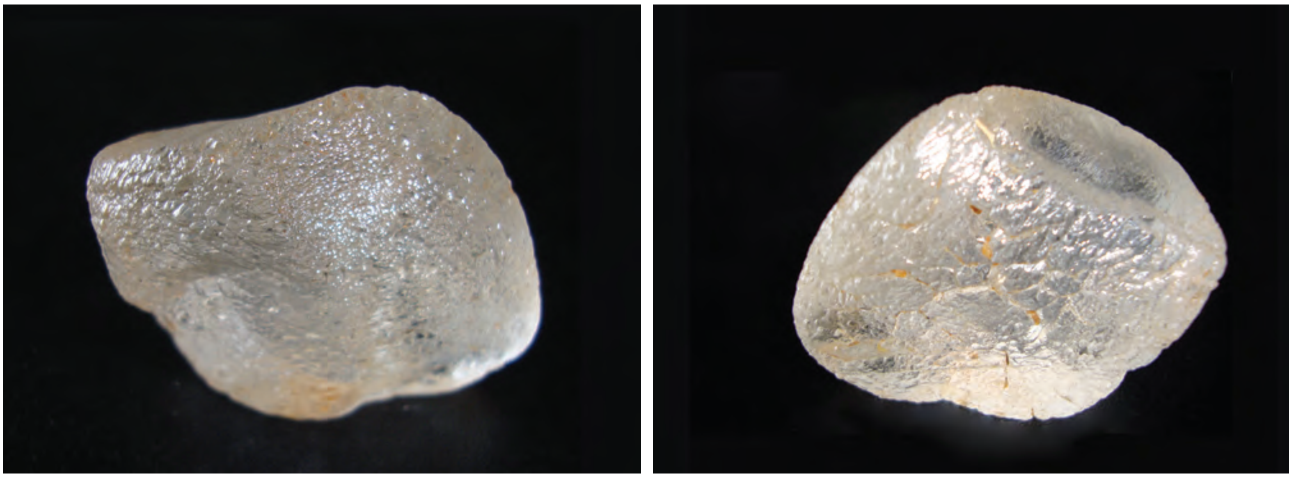


Figure 2: The 106.50 ct jeremejevite described in this article reportedly was cut from this 254 ct piece of rough. These two views show the overall shape and surface characteristics of the pebble. Photos courtesy of Visaka Gems.

including Russia, Tajikistan, Myanmar, Sri Lanka, Madagascar and Namibia. In addition, a seemingly unique occurrence is known in Germany, where jeremejevite formed in cavities within basalt (see, e.g., Stachowiak and Schreyer, 1998; Blass and Graf, 1999). Typically jeremejevite ranges from colourless to blue, as in material from Namibia, or colourless to yellow, as from Myanmar and elsewhere.

Jeremejevite has a Mohs hardness of 7, so it is appropriate for jewellery use. However, the majority is not of gem quality, although a number of faceted specimens have been produced over the years (see, e.g., Scarratt et al., 2001; Laurs and Fritz, 2006). The cut stones typically weigh less than 2–3 ct and possess obvious inclusions. In very rare instances, faceted jeremejevites approaching 60 ct have been seen (e.g. www.curiousnotions.com/gemstones).

Recently, however, the author was given the opportunity to examine a very large jeremejevite (Figure 1). At 106.50 ct, it is the largest faceted jeremejevite reported to date. This article describes the gemmological properties of this unique gemstone.

Background

The owner of the jeremejevite indicated that it came from a 254 ct piece of rough (Figure 2) that had been acquired by his father in the early 1990s. It reportedly was found in Sri Lanka. Although Sri Lanka is not an important source of jeremejevite, it is known to have produced a few examples of this gem (Laurs and Fritz, 2006). Considering the diversity of mineral wealth found on this island, we cannot eliminate the possibility that this large jeremejevite was found there.

In 2006, a Sri Lankan gem lab reportedly documented an even larger jeremejevite pebble weighing 374 ct (http://gemologyonline.com/Forum/phpBB2/viewtopic.php?t=1471), but its quality is unknown and its identity has not been confirmed by the author.

Materials and Methods

Gemmological properties were recorded on the 106.50 ct jeremejevite using standard instrumentation, including a binocular microscope, refractometer, hydrostatic balance, polariscope, desk-model spectroscope, and a long- and short-wave ultraviolet lamp. Spectroscopy in the ultraviolet-visible–near infrared (UV-Vis-NIR) region was performed with a Perkin-Elmer Lambda 950 spectrophotometer, and in the mid-IR region using a Thermo Nicolet 6700 spectrometer. Raman spectra were recorded using a Renishaw InVia micro-Raman spectrometer equipped with 514 nm argon-ion laser excitation. Chemical analyses were obtained using an EDAX energy-dispersive X-ray fluorescence (EDXRF) spectrometer. Laser ablation–inductively coupled plasma–mass spectrometry (LA-ICP-MS) was performed with a Thermo X-Series ICP-MS equipped with a New Wave 213 nm laser-ablation sample introduction system. Five spots were analysed on the girdle of the stone.

Table I: Gemmological properties of the 106.50 ct jeremejevite.

Shape and cutting style	Cushion mixed cut (brilliant/step cut)
Measurements	32.45 × 26.70 × 15.78 mm
Appearance	Colourless, transparent
Refractive index	n_o = 1.648, n_e = 1.638
Birefringence	0.010
Optic character	Uniaxial negative
Polariscope reaction	DR, uniaxial figure
Specific gravity	3.29
UV fluorescence	Inert
Visible-range spectrum	No distinct features

Results

Visual Appearance and Gemmological Properties

Viewed face-up, the 106.50 ct jeremejevite appeared colourless. However, careful inspection through the pavilion showed a very faint bluish tint. The stone possessed a high degree of transparency with few inclusions (see below).

It is rather common for collectors' stones to be cut poorly to retain as much weight as possible. Conversely, the cutting and polishing of this gemstone were very good, resulting in a well-proportioned cushion mixed cut that displayed brilliance all the way down to the keel, with no windowing when viewed face-up and perpendicular to the table facet.

All of the stone's standard gemmological properties were consistent with those previously reported for jeremejevite (Table I).

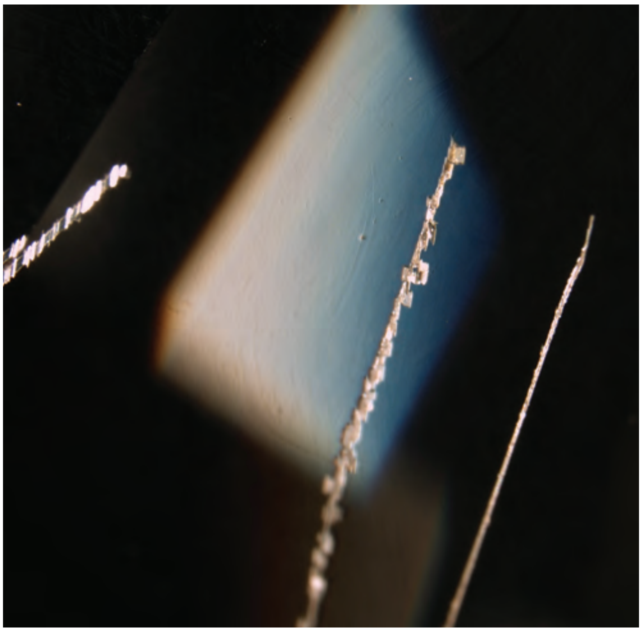
Microscopy

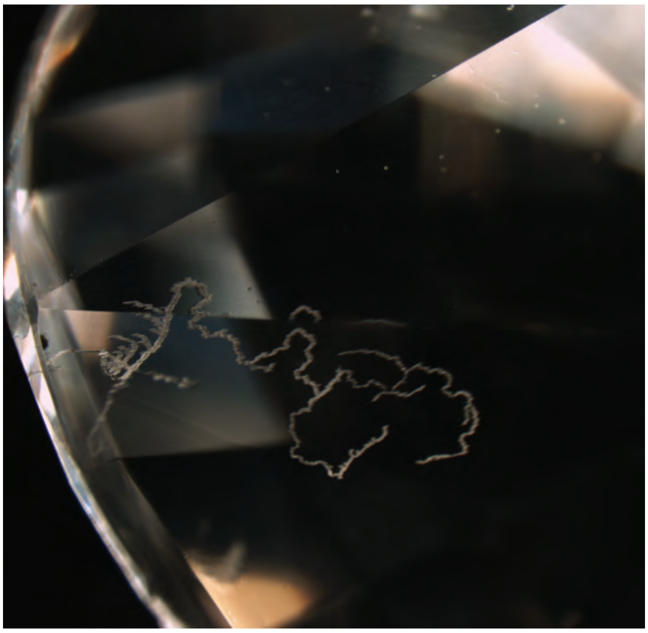
Considering its large size, this gemstone possessed few inclusion features. Most notably, these consisted of etch tubules or channels that ranged from straight and angular to quite erratic, some with squarish or geometric fringes (Figure 3). Very subtle internal growth structures were also noted.

UV-Vis-NIR and Mid-IR Spectroscopy

No distinct absorptions were recorded in the UV-Vis-NIR region of the spectrum. The large size of the gemstone prevented the collection of mid-IR spectra, since the long path length using the diffuse reflectance method resulted in the saturation of the detector. For spectral properties of jeremejevite, the reader is referred to Scarratt et al. (2001) and Thanachakaphad (2010), as well as Frost and Xi (2012).

Figure 3: The only inclusion features in the large jeremejevite consist of etch channels. The left photo shows straight etch channels, one of which is decorated with a fringe of angular geometric features. The image on the right depicts the erratic path of irregular etch channels through this remarkable gem. Photomicrographs by C. P. Smith; magnified 30× (left) and 20× (right).





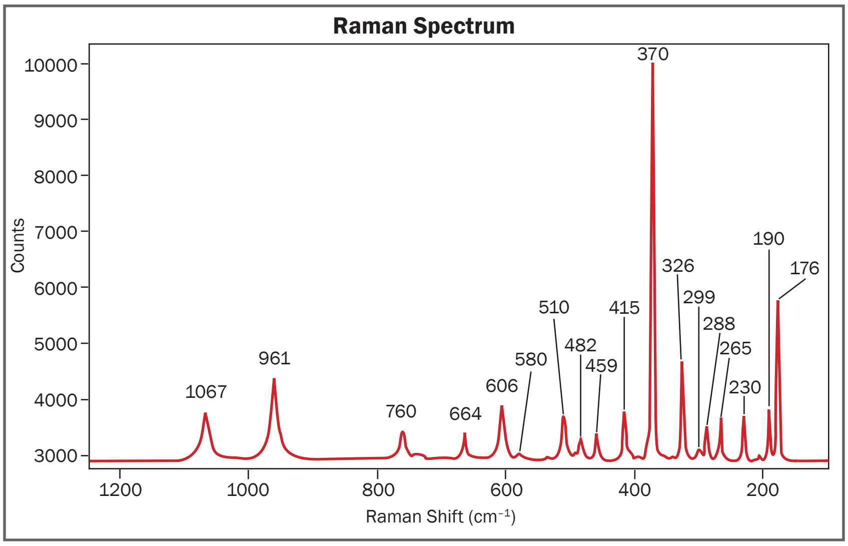


Figure 4: The Raman spectrum of the 106.50 ct gemstone conclusively identifies it as jeremejevite.

Raman Spectroscopy

Raman spectra taken in random orientations showed a number of distinct bands (Figure 4). The dominant Raman band was positioned at 370 cm^{-1} and three bands of secondary prominence were at 961, 326 and 176 cm^{-1} Raman shift. A series of subordinate bands were positioned at 1067, 760, 664, 606, 580, 510, 482, 459, 415, 299, 288, 265, 230 and 190 cm^{-1} Raman shift. These spectral features are consistent with those previously recorded for jeremejevite (see, e.g., Scarratt et al., 2001; Frost and Xi, 2012).

Chemical Composition

EDXRF spectroscopy revealed a large amount of Al, as expected; the other major components B and F were not recorded since these light elements are not detectable by this technique. In addition, traces of Ga and Fe were detected by EDXRF. LA-ICP-MS analyses showed the presence of several trace elements: Si, Ca, Ga, Fe, Zn, Ti, V and Mg (Table II).

Table II: LA-ICP-MS trace element composition (in ppmw) of the 106.50 ct jeremejevite.

Element	Spot 1	Spot 2	Spot 3	Spot 4	Spot 5	Average
Mg	1.04	0.58	0.56	1.72	0.57	0.89
Si	na*	509	1630	1130	1750	1250
Ca	1148	978	926	1240	1450	1150
Ti	15.4	17.6	3.01	4.07	3.63	8.73
V	0.96	0.94	0.92	1.32	1.25	1.08
Fe	100	109	166	203	132	142
Zn	9.35	15.6	12.6	14.2	16.4	13.6
Ga	139	147	146	154	162	150

* na = not analysed.

Discussion

The size and quality of this 106.50 ct gemstone set it apart from all other jeremejevites encountered by the author and described in the literature (e.g. Foord et al., 1981; Scarratt et al., 2001; Johnston, 2002). The natural origin of this stone is indicated by its inclusions and its large size; gem-quality synthetic jeremejevite is unknown in the market, and published experiments have succeeded in producing only micro-crystals of synthetic jeremejevite and a hydrated form of synthetic jeremejevite (OH fully replacing fluorine), using both high-pressure and hydrothermal growth methods (see, e.g., Sokolova et al., 1987; Stachowiak and Schreyer, 1998).

This is the first time that LA-ICP-MS data on jeremejevite have been published. A trace element assemblage consisting of Si, Ca, Ga, Fe, Zn, Ti, V and Mg further confirm the natural origin of this gemstone.

Conclusion

The diversity of collectors' gemstones reflects a variety of growth environments in the earth, but these conditions rarely produce minerals with suitable transparency to be faceted. Although the average consumer is not aware of these unusual

Figure 5: At 106.50 ct, this is the largest faceted jeremejevite reported to date. Here it is shown together with a 2.40 ct yellow Burmese jeremejevite for comparison. Photo by Jeremy Prowitz and Bilal Mahmood.

stones, gemmologists, enthusiasts and collectors find such gems fascinating and highly desirable.

It is a rare pleasure to have the opportunity to examine collectors' stones such as the present 106.50 ct jeremejevite (Figure 5). This unique and highly important gem is the largest known faceted jeremejevite to date. Its size and stature are likely to help elevate the awareness and appreciation of this little-known gem material.

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Some Characteristics of Taaffeite from Myanmar

Thanong Leelawatanasuk, Wilawan Atichat, Tay Thye Sun, Boontawee Sriprasert and Jirapit Jakkawanvibul

Although taaffeite from Myanmar was reported over 30 years ago, few gemmological studies have been published on this material. Five specimens of very pale purplish pink and heavily included taaffeite from the Mogok area were characterized for this report. Chemical analysis revealed 75.2–76.4 wt.% Al_2O_3 and 18.2–19.1 wt.% MgO, with trace amounts of Fe, Zn, Ga, Mn and other elements. Compared to similarly coloured taaffeite from Sri Lanka and Africa, these Burmese samples showed no significant differences except for lower Fe content.

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Introduction

Among gem minerals, taaffeite is considered one of the rarest, with only a handful of deposits reported to date. The mineral was named in 1945 after its discoverer, Count Edward Charles Richard Taaffe, a Dublin gemmologist. He noticed a stone within a parcel of spinel from Sri Lanka that exhibited a slight birefringence. He sent the gem to London, where it was eventually confirmed as a new mineral species (Anderson et al., 1951). Its chemical formula is $BeMg_3Al_8O_{16}$ (Schmetzer 1983a,b), intermediate between chrysoberyl ($BeAl_2O_4$) and spinel ($MgAl_2O_4$). Since the nomenclature revisions by Armbruster (2002), *taaffeite* has been considered a group name, consisting of the members magnesiotaaffeite-6*N*'3*S* (which used to be called musgravite), magnesiotaaffeite-2*N*'2*S* (taaffeite) and ferrotaaffeite-6*N*'3*S* (pehrmanite). More recently, a new iron-rich end member of the taaffeite group was defined by Yang et al. (2012) as ferrotaaffeite-2*N*'2*S*. For simplicity, in this article magnesiotaaffeite-2*N*'2*S* will simply be referred to as *taaffeite*.

Due to its scarcity, taaffeite is considered a collectors' stone. The mineral is known to crystallize in metasomatized limestone or in high-grade amphibolite- or granulite-facies rocks (Kampf, 1991; Chadwick et al., 1993). Gem-quality material is mainly known from Sri Lanka (e.g. Schmetzer et al., 1999; Abduriyim et al., 2008), but also has been found in Tanzania (Schmetzer et al., 2007) and Myanmar (Kampf, 1991; Schmetzer et al., 2000). Madagascar was mentioned as a possible source of gem-quality taaffeite by Schmetzer et al. (2007), but this has not yet been confirmed.

Burmese taaffeite was first reported in 1983, when Bangkok-based gemmologist William Spengler found a near-colourless piece of rough in a parcel of spinel from the Mogok Stone Tract (Spengler, 1983). Later, additional Burmese specimens were found. In the Mogok area, taaffeite is associated with spinel in a marble belt that developed along the contact of dolomitic

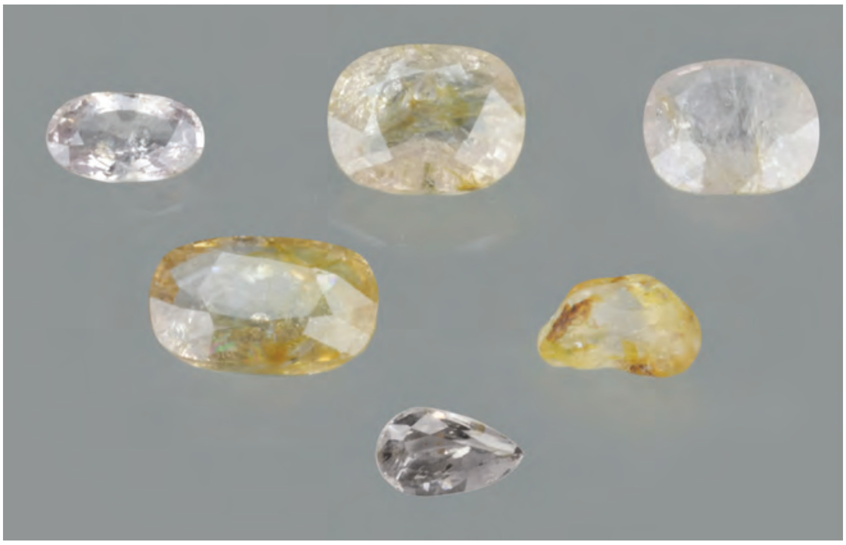


Figure 1: One rough (1.92 ct) and four faceted (1.33–5.16 ct) taaffeite samples were examined in this study. Also shown is a faceted taaffeite from Sri Lanka (bottom; 1.09 ct) that was analysed for comparison. The colour of some samples is obscured by iron staining in surface-reaching fissures. Photo by Jirapit Jakkawanvibul.

limestones with granitic intrusives; the granites provided a source of beryllium for the taaffeite (Drev et al., 2012). The Burmese taaffeite is reportedly found at Chaung Gyi, north of Mogok, in rocks of the Chaung Magyi Group. These rocks have undergone regional metamorphism, followed by contact metamorphism in the vicinity of granitic intrusions (Bender, 1983).

Materials and Methods

This study was performed on four very pale purplish pink faceted gems and a rough stone, all provided by co-author TTS from his reference collection (Figure 1; 1.33–5.16 ct). All of these samples were originally obtained from gem dealers in Yangon, who reported that they were mined from Chaung Gyi in the Mogok area of Myanmar. For comparison, we also analysed a 1.09 ct pale purple faceted taaffeite from Sri Lanka from the collection of co-author TTS (Figure 17).

Gemmological properties were determined at the Gem and Jewelry Institute of Thailand's Gem Testing Laboratory in Bangkok, using standard instruments such as a refractometer, hydrostatic balance, polariscope, long- and short-wave UV lamp, and binocular microscope. Further testing was carried out on all samples using a Renishaw inVia Raman spectrometer (2000–200 cm^{-1} range, using 785 nm laser excitation), a PerkinElmer Lambda 950 ultraviolet-visible–near-infrared (UV-Vis-NIR) spectrophotometer (250–800 nm range, with a data collection interval of 3 nm), a Thermo-Nicolet 6700 Fourier-transform infrared (FTIR) spectrometer (mid-IR range of 400-4000 cm^{-1}, 4 cm^{-1} resolution, 128 scans), an EDAX Eagle III energy-dispersive X-ray fluorescence (EDXRF) spectrometer (40 kV voltage, 250 μA beam current) and an Agilent 7500 laser ablation–inductively coupled plasma–mass spectrometer (LA-ICP-MS) with a 213 nm laser, laser output energy of 12–13 J/cm^2, carrier Ar gas flow rate of 0.8 L/min, and a 55 μm crater size.

Results

Gemmological Properties

The basic gemmological properties are summarized in Table I. The Burmese samples were very pale purplish pink (though some samples were iron-stained) and heavily included. The RIs of the faceted samples were n_o = 1.720–1.721 and n_e = 1.716–1.717, with a birefringence of 0.004. The SG values ranged from 3.60 to 3.61 for the cut stones, and the SG was 3.57 for the rough sample. All specimens showed a typical doubly refractive character in the polariscope. All were inert to short-wave UV radiation, and some showed weak chalky green or white fluorescence to long-wave UV.

Microscopic examination revealed prominent fingerprint-like fluid inclusions (Figure 2). In addition, several tiny colourless mineral inclusions were observed in the rough specimen. Unfortunately, those inclusions could not be identified by Raman spectroscopy due to their position below the surface.

Table I: Gemmological properties of the studied taaffeite samples from Myanmar and Sri Lanka.[a]

Sample no.	Weight (ct)	RI			SG	UV fluorescence (long-wave/short-wave)
		n_o	n_e	Birefringence		
TA01	1.33	1.720	1.716	0.004	3.61	Inert/inert
TA02	4.99	1.720	1.716	0.004	3.60	Inert/inert
TA03	2.86	1.721	1.717	0.004	3.60	Weak chalky white/inert
TA04	5.16	1.720	1.716	0.004	3.60	Weak chalky green/inert
TA05	1.92	1.72 (spot)			3.57	Weak chalky white/inert
TA-SRI	1.09	1.721	1.718	0.003	3.63	Inert/inert

[a] Samples TA01–TA05 are from Myanmar; all are faceted except TA05, which is a water-worn pebble. Sample TA-SRI is from Sri Lanka.

Spectroscopy

Raman spectroscopy confirmed that all five stones were taaffeite. The Raman spectra perfectly matched our reference spectrum for taaffeite and also were consistent with the representative taaffeite spectrum given by Kiefert and Schmetzer (1998).

The UV-Vis-NIR spectra displayed absorption peaks and bands at approximately 370, 385, 460 and 550 nm, with increasing overall absorption toward the UV region (Figure 3). The mid-IR spectrum showed broad transmission in the 3500–1500 cm^{-1} range with weak absorption bands at approximately 1937, 1795 and 1674 cm^{-1} (Figure 4). In addition, small peaks at approximately 2923 and 2856 cm^{-1} are due to C-H stretching vibrations, possibly from oil residue in fractures.

Chemical Composition

Semi-quantitative EDXRF chemical analyses revealed that the Burmese taaffeite samples contained 75.2–76.4 wt.% Al_2O_3 and 18.2–19.1 wt.% MgO; beryllium is assumed present at 4.5 wt.% BeO according to the theoretical formula (Schmetzer et al., 2007). In addition, EDXRF measured traces of Fe, Zn, Ga, Mn and Cr. LA-ICP-MS analyses of the Burmese samples showed the expected major elements (Al, Mg and Be), as well as several trace elements (Li, B, Ti, V, Cr, Mn, Fe, Zn, Ga and Sn; see Table II).

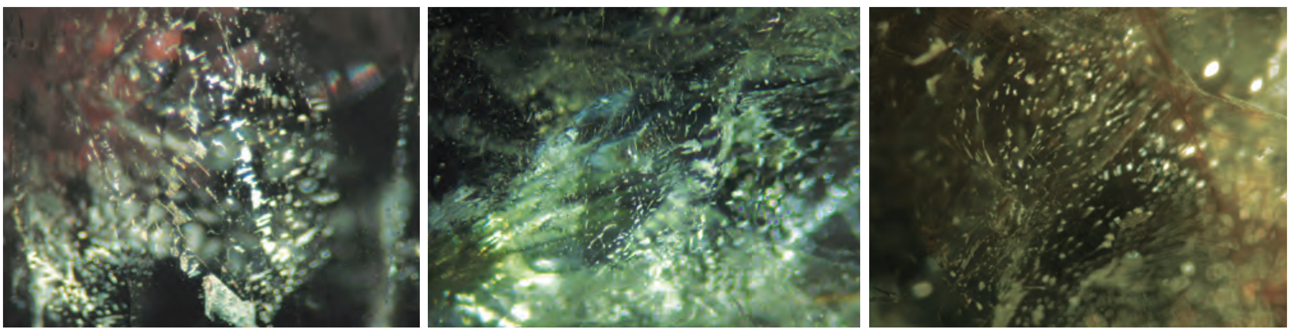
Comparison with Taaffeite from Sri Lanka

Our Burmese taaffeites—and those from the literature—showed no significant differences in RI, SG and UV fluorescence compared to similarly coloured taaffeite from Sri Lanka (i.e. data from the studied sample and from Schmetzer et al., 2006). In addition, the UV-Vis-NIR spectra (see Figure 3) and mid-IR spectra were also quite similar.

Discussion and Conclusions

Our study samples of taaffeite from Myanmar were pale purplish pink and highly included. The most prominent inclusion feature consisted of clusters of fingerprint-like fluid inclusions. Their properties are comparable to similarly coloured

Figure 2: Planes of reflective fluid inclusions hosted by partially healed fissures were prominent in the Burmese taaffeite samples examined in this study. Photomicrographs by Jirapit Jakkawanvibul; darkfield illumination, magnified 40×.



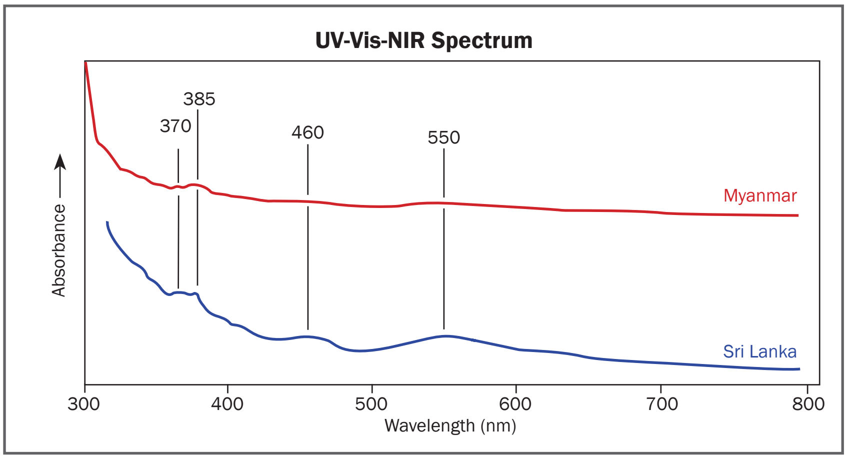


Figure 3: This representative non-polarized UV-Vis-NIR spectrum of sample TA03 shows absorption features due to iron. The same features (though somewhat stronger) are visible in the spectrum of a Sri Lankan taaffeite that was recorded for comparison.

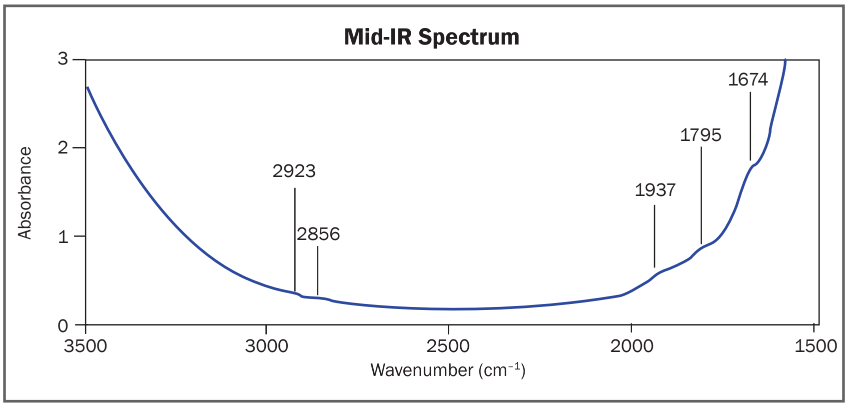


Figure 4: This representative mid-IR spectrum of sample TA03 shows broad transmission in the 3500–1500 cm^{-1} range.

Table II: LA-ICP-MS analyses (in ppmw) of selected taaffeite samples from Myanmar and Sri Lanka, compared to data for taaffeite from Africa.[a]

Element	TA01	TA02	TA05	TA-SRI	Samples from Schmetzer et al. (2007)
	Myanmar			Sri Lanka	Africa
Li	24.9	52.6	19.8	13.2	3–22
B	42.2	46.3	44.6	15.8	24–50
Ti	35.9	13.5	14.9	16.1	0.01 wt.% TiO_2[b]
V	16.4	13.1	17.5	13.3	nd–0.01 wt.% V_2O_3[b]
Cr	9.18	3.04	4.06	nd	nd–0.02 wt.% Cr_2O_3[b]
Mn	46.7	66.8	32.1	104	0.01–0.05 wt.% MnO[b]
Fe	1150	1190	558	1680	0.31–2.79 wt.% FeO[b]
Co	nd	nd	nd	2.58	nr
Zn	570	633	330	1930	nr
Ga	224	134	207	475	172–610
Sn	5.00	3.97	7.37	2.64	1–9

Abbreviations: nd = not detected, nr = not reported.

[a] For data obtained in this study, the values are averaged from two analysis spots per sample.

[b] Obtained by electron microprobe, and therefore not directly comparable to LA-ICP-MS data.

taaffeites from both Sri Lanka and Africa, although our Burmese samples had lower Fe contents. Research on a violet 4.02 ct taaffeite reportedly from Myanmar also showed it to contain low Fe contents compared to purple to purplish red samples from Sri Lanka (Schmetzer et al., 2000).

The UV-Vis-NIR spectra of the studied Burmese samples clearly show iron-related absorption features at 370, 385, 460 and 550 nm, matching previous studies of taaffeite and musgravite from Sri Lanka and Africa (Schmetzer et al., 2007). The main absorption peak of chromium in the visible range is close to the maximum of an iron-related absorption band (Schmetzer et al., 2000), and thus cannot be separated in the spectra of Cr-bearing samples. However, the low Cr contents of our Burmese samples (Table II) probably have little if any influence on the coloration of these samples. The spectra show normal iron-related absorption features, and the very pale purplish pink coloration of the samples is due to their low Fe content (as compared to taaffeite from Sri Lanka or Africa). The low iron content of the Burmese material is the main difference from gem-quality taaffeite from other sources.

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Natural Pearls from Edible 'True Oysters' in Zeeland, The Netherlands

J. C. (Hanco) Zwaan and Peter Groenenboom

Recently, some natural pearls were found in Zeeland, The Netherlands, reportedly from the Grevelingenmeer and Westerschelde areas. Three whole pearls and one blister, still attached to its shell, were examined. These non-nacreous pearls were white, although the blister also had a light grey portion. They displayed a dull lustre and showed an uneven, bumpy surface in the microscope. X-radiography and micro-CT scanning of the whole pearls revealed concentric structures consistent with their natural origin; the blister pearl was partially hollow. Raman spectroscopy identified calcite as the sole component for three samples; one showed only features of aragonite. A relatively low Mn and high Sr content (with SrO/MnO>>12) confirmed their saltwater origin. The host oyster for these very rare pearls was identified as *Crassostrea gigas* (Thunberg, 1793), a common 'true oyster' species in Zeeland, which is harvested for its meat but not used for pearl cultivation. There is no human intervention in the growth of these oysters, which supports the conclusion that these pearls are truly natural.

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Introduction

From mid-2013 to March 2014, four pearls of very similar appearance were sent to the Netherlands Gemmological Laboratory for examination (Figures 1 and 2). They were submitted by different sources, but were all claimed to be from oysters originating from Zeeland Province in the south-western part of The Netherlands. Zeeland has a long history harvesting meat from native oyster banks, as well as gathering oysters that have been introduced for the seafood industry, especially in the Westerschelde, Oosterschelde and Grevelingen sea inlets that divide Zeeland into separate pieces of land (Figure 3). In the early 1970s, Grevelingen was cut off from the sea by two dams, creating the Grevelingenmeer, which is the largest saltwater lake in Western Europe (13,872 hectares; http://nl.wikipedia.org/wiki/Grevelingenmeer). The Westerschelde and Oosterschelde are still open to the sea, but the latter inlet can be closed during severe storms by a weir, called the *Oosterscheldekering*.

The origins of the submitted pearls were indicated as 'Zeeland', the 'Westerschelde' and 'Grevelingen'. The most precise locality was given by a nine-year old boy, Boris de Kort, who found an oyster containing a blister pearl 'at the bank of the Westerschelde, along the beach near

Figure 1: Pearl sample P5234 (~7.7 mm in diameter) was found in this oyster, reportedly from Grevelingen, Zeeland, The Netherlands. Photo by Dirk van der Marel.

Figure 2: Blister pearl sample P5235 is shown together with two whole pearls measuring ~5.8–8.2 mm and ~3.6 mm in diameter (samples P5229 and P5301, respectively), from Zeeland, The Netherlands. Photo by Dirk van der Marel.

De Griete or at Ossenisse/Zeedorp'. The pearl from 'Zeeland' was found in a 'Zeeuwse creuse', an oyster from Zeeland, that was purchased by the owner at a local food store called the Marqt. When asked about the source of their oysters, Marqt personnel stated that they came from Grevelingenmeer. The pearl mentioned above as coming from 'Grevelingen' was evidently also found in this area, reportedly in December 2012.

Materials and Methods

Three whole pearls and one blister, still attached to the shell, were studied for this article (Figures 1 and 2). The basic characteristics of each pearl are listed Table I. Also examined was the oyster shell in which the ~7.7-mm-diameter round pearl was found (Figure 1). The pearls were characterized using a standard gemmological microscope, X-radiography, X-ray computed

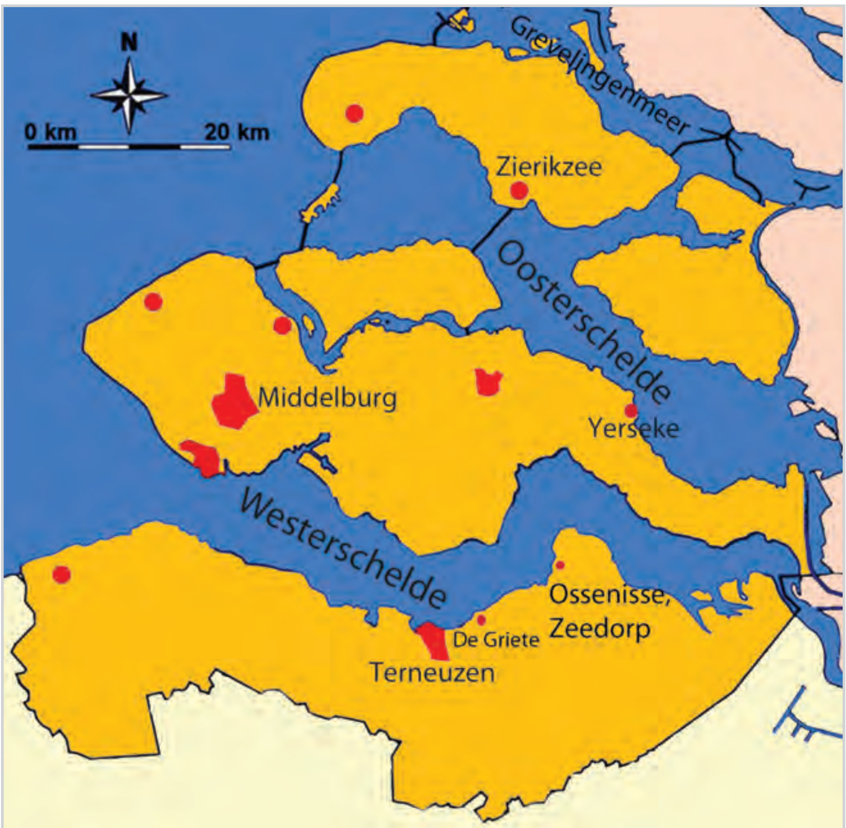


Figure 3: Zeeland, a south-western province of The Netherlands (below), is divided by sea inlets: the Westerschelde, Oosterschelde and Grevelingen. The last inlet has been converted to a saltwater lake called the Grevelingenmeer. All three areas are well-known for their oyster beds.

Table I: Examined pearls from Zeeland, The Netherlands.

Sample no.	Shape	Weight (ct)	Measurements	Reported origin
P5229	Drop	2.00	8.18 × 6.61 × 5.77 mm	Westerschelde
P5234	Round	3.01	7.69–7.72 × 7.67 mm	Grevelingen
P5301	Button	0.32	~3.6 mm in diameter	Zeeland
P5235	Blister	--	~13 mm in diameter	Westerschelde

microtomography (micro-CT), energy-dispersive X-ray fluorescence (EDXRF) spectroscopy and micro-Raman spectroscopy at Naturalis in Leiden. X-radiography was performed with a Faxitron 43855 Cabinet X-ray system operating at 100 kV and 3 mA, with 20–30 seconds of exposure time. High-resolution micro-CT scanning used a Skyscan 1172 instrument. For the two pearls that were scanned (P5229 and P5234), the operating conditions were very similar, at 65 kV and 153 μA, and 70 kV and 141 μA, respectively, using an Al-foil filter of 0.5 mm and an exposure time of 750 milliseconds for each image. The pearls were rotated 360°, in rotation steps of 0.35° and 0.30°, resulting in 1,028 and 1,200 images, respectively. For each position, respectively 5 and 4 frames were averaged. The camera pixel size was fixed at 8.70 μm. An Orbis μProbe EDXRF spectrometer was used to chemically characterize the pearls. This instrument has a focus spot of 200 × 200 μm and a beam diameter of 300 μm. A voltage of 20 kV and a count time of 100 seconds were used for each measurement. For Raman spectroscopy, a Thermo DXR Raman microscope with 532 nm laser excitation was used. Raman spectra were collected at room temperature in the confocal mode, which is necessary for analysis of individual layers of a sample on a micron scale (1–2 μm). In this study, random spots at and slightly underneath the surface were analysed. A grating of 1800 grooves/mm and a pinhole size of 25 μm were used, which combined with the optical path length yields a spectral resolution of ~1.0 cm^{-1}. Spectra were collected in the range of 1800–100 cm^{-1} to study the vibrations of the carbonate anion $(CO_3)^{2-}$.

Results

The pearls were all white in colour. In addition, a portion of the blister pearl was light grey, and the 3.01 ct sample also showed a very small greyish area. All had a dull lustre, and viewed with the microscope they showed an uneven, bumpy surface (Figure 4). X-radiographs of all the samples showed a concentric layered structure that is expected for natural pearls (c.f. Alexander, 1941; Farn, 1986; Sturman, 2009). The blister

Figure 4: The examined pearls are non-nacreous, and typically display a dull lustre and an uneven, bumpy surface when viewed with the microscope. The slightly darker spots on this pearl (P5234; ~7.7 mm in diameter) indicate areas of higher transparency. The inset shows the surface texture in more detail (image width: 4.5 mm). Photos by J. C. Zwaan.

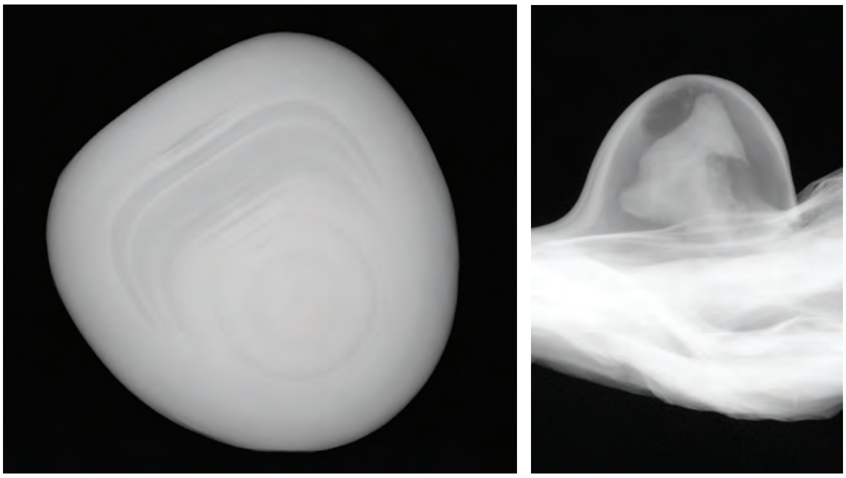


Figure 5: X-radiography of pearl P5301 (left, ~3.6 mm in diameter) reveals concentric layering that is typical of natural pearls. The X-radiograph of the blister pearl (right, 13 mm across) shows that it is partially hollow. The irregular structure underneath may have been caused by the drilling of an intruding worm (H. Hänni, pers. comm., 2014).

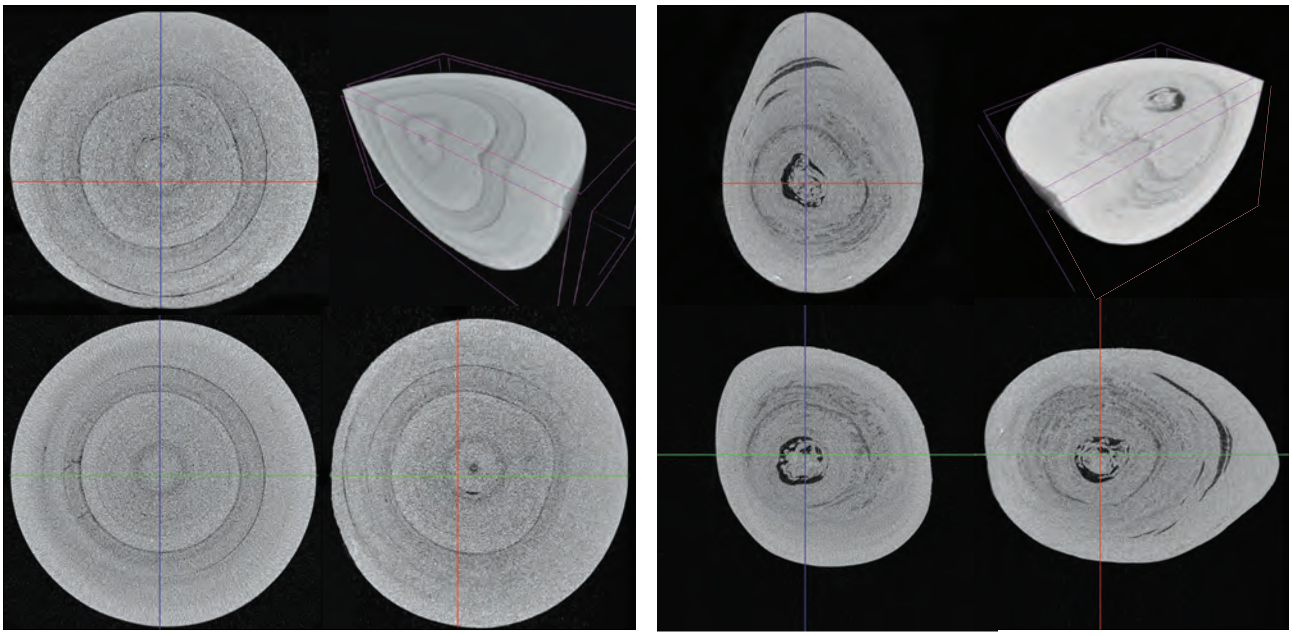
pearl turned out to be partially hollow, and its internal structure appeared to be a continuation of the highly irregular shell underneath it (Figure 5). Micro-CT scanning confirmed the concentric structure characteristic of natural pearls (Figure 6).

Raman analysis of various points on each sample revealed that all of the pearls except for the drop shape consisted of calcite, with two main peaks at 1086–1085 and 712–711 cm^{-1} (compare, e.g., Wehrmeister et al., 2010). The strongest band, at 1086 cm^{-1}, derives from the symmetric stretching mode (ν_1) of the carbonate ion; the peak at 711 cm^{-1} corresponds to in-plane bending (ν_4) of the carbonate ion (Urmos et al., 1991; Wehrmeister et al., 2010). Also, the surface of the inside of the associated shells consisted of calcite. However, the drop-shaped pearl only gave Raman spectra for aragonite, with a main peak at 1085 cm^{-1} and a doublet at 705 and 701 cm^{-1}.

EDXRF analysis showed a low manganese content (≤0.03 wt.% MnO) and varying strontium (0.28–0.46 wt.% SrO), consistent with the pearls' saltwater origin (compare, e.g., Gutmannsbauer and Hänni, 1994).

Frank Wesselingh, a malacologist at Naturalis, identified the shells associated with the round pearl (Figure 2) and the blister pearl (Figure 3) as belonging to *Crassostrea gigas* (Thunberg, 1793; also known as the 'Japanese oyster'), a member of the Ostreidae family.

Figure 6: Micro-CT images in the XYZ direction of pearls P5234 (left, ~7.7 mm in diameter) and P5229 (right, ~5.8–8.2 mm) show concentric structures that confirm their natural origin.



Box A: Cultivation of Edible Oysters in Zeeland, The Netherlands

In Zeeland, an oyster producer obtains a licence for gathering oysters in specific areas of the delta/sea inlets. The oyster beds are found in shallow waters (<3 m) close to shore, sometimes even falling dry at low tide. The oysters are gathered about once a year. The larger oysters are taken to holding tanks onshore (Figure A-1), where they stay from a few days to two weeks while awaiting transport to local and international markets. The smaller ones are returned to the oyster beds and given more time to grow. When the oysters spawn, most of the larvae will attach to a hard substrate, hopefully located close to the same area.

It takes about five years for an oyster to reach harvestable size. The oysters are distributed to clients in The Netherlands and in many other countries throughout Europe. The best ones are sold to France to grow further. After some years those oysters are harvested, and their meat is considered to be of the highest quality.

The method used for gathering the oysters means that there is no human intervention in terms of producing more or fewer oysters, or influencing their quality. It is nature that decides if, and how many, oyster larvae will grow in an area. That depends on the weather, temperature, currents and, most of all, the water quality.

The oyster shells are not cleaned (as is done on pearl farms), so when harvested they are encrusted with all kinds of seaweed and algae. Also, worms may infest the oysters, which may cause the growth of a pearl. However, the commercially important edible oysters (Ostreidae family) are not used for pearl cultivation since they do not yield nacreous pearls.

Figure A-1: These tanks hold oysters at Delta Ostrea, Yerseke, Oosterschelde, Zeeland. Photo by Franz Ulrich.

Discussion and Conclusion

The described pearls can be seen as curiosities from The Netherlands that are very rarely found. Although they have all the characteristics of natural pearls, due to their low lustre and imperfect surface, they are of limited commercial interest. However, larger pearls, such as the ~7.7 mm round sample with a precisely known origin, may have considerable value—especially in light of the recent popularity of natural pearls from all types of molluscs. Furthermore, calcitic pearls are very rare; only scallop and pen shell pearls have been described as mostly calcitic (Fritsch et al., 2012), although some low-quality pearls from *Pinctada radiata* may also be fully calcitic (S. Karampelas, pers. comm., 2014). Both calcite (as purplish spots) and aragonite have been documented as part of a pearl attached to the inner shell of *Crassostrea virginica* (American or Eastern oyster; Scarratt et al., 2006).

The calcitic nature of three of the examined pearls is consistent with the shell composition of edible oysters (e.g. Strack, 2006). While it was claimed that the drop-shaped pearl was found in an oyster from the Westerschelde, its aragonite composition is inconsistent with the composition of oysters present in Zeeland. It has a very similar surface and appearance, though, when compared to the other pearls, and aragonite can also be observed inside the shells of *Ostrea edulis* and other molluscs from the Ostreidae family (Checa et al., 2007). *Ostrea edulis,* the so-called 'flat oyster', is the autochthonous species that formed the wild oyster banks until the 1960s, when they suffered an illness and were then gradually overtaken by *Crassostrea gigas*, a species from the Pacific that was introduced in the 1960s (Wolf, 2005). The shells examined in this study are from this species, which continues to be gathered and harvested in Zeeland for its delicate meat (see Box A).

Although the *Crassostrea gigas* species was originally introduced to the Zeeland area by man, there is otherwise little to no human intervention in growing the oysters. This supports the conclusion that the described pearls are natural, without any reservation. Concerning the relatively large size of the round pearl (~7.7 mm in diameter), the growth must have started when the oyster was young and continued until the shell was of harvestable size (i.e. perhaps exceeding five years).

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Conferences

12th Annual Sinkankas Symposium: Peridot and Uncommon Green Gem Minerals

This annual symposium in honour of noted author John Sinkankas took place 5 April 2014 at the Gemological Institute of America (GIA) in Carlsbad, California, USA, with approximately 120 people in attendance. The conference theme was *Peridot and Uncommon Green Gem Minerals,* and a proceedings volume is available for US$45 (plus shipping and handling) at www.sinkankassymposium.net; it contains presentation summaries as well as outside contributions. As in prior years, the conference was expertly organized by **Roger Merk** (Merk's Jade, San Diego, California, USA).

The opening presentation was given by **Lisbet Thoresen** (Beverly Hills, California, USA) on the archaeogemmology of peridot. A collaborative study with Dr James A. Harrell (University of Toledo, Ohio, USA) showed that the earliest use of peridot as a gem material occurred during the Hellenistic era, dating back to perhaps the mid-2nd century BC. The peridot was obtained from Zabargad Island (Egypt) in the Red Sea until the 6th century AD, when the island was abandoned of human habitation. In a separate presentation, Thoresen examined another green gem, chrome chalcedony, in ancient cameos and intaglios. Most of them originated from the Roman Empire during the 1st century BC through the 1st century AD. They are commonly incorrectly identified in the literature as 'plasma', 'chrysoprase' or 'prase'.

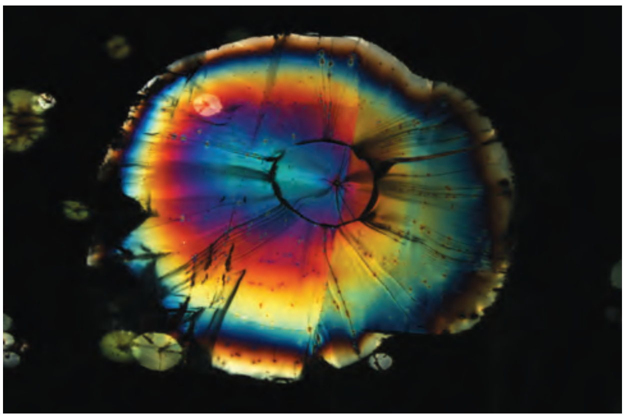
Dr William 'Skip' Simmons (University of New Orleans, Louisiana, USA) reviewed the mineralogy and crystallography of olivine (peridot), which consists of a solid-solution series between forsterite (Mg_2SiO_4) and fayalite (Fe_2SiO_4). He said that the best colour of peridot is seen when it contains 12–15 wt.% FeO; higher Fe contents produce a brown tint.

Dr James E. Shigley (GIA, Carlsbad) surveyed the geology of peridot, which is a major constituent of the earth's mantle. It may be transported to the earth's surface within tectonically-emplaced assemblages (ophiolites) or as xenoliths in eruptions of alkali basalt or kimberlite. Forsterite is also found in metamorphosed carbonate rocks. In addition, peridot is the only gem with the distinction of also having an extraterrestrial origin, from pallasitic meteorites. In a separate presentation, Dr Shigley gave a brief review of 13 other green gem materials besides peridot.

Nathan Renfro (GIA, Carlsbad) covered the faceting of peridot and described its inclusions. He explained how he uses GemCad to perform computer modelling of a desired cut stone before working on a piece of rough, a process he called digital cutting. Renfro showed photomicrographs of an amazing variety of internal features in peridot, including mineral/fluid/melt inclusions, cleavage discs (e.g. Figure 1), growth zoning and dislocation channels.

Dr Raquel Alonso-Perez (Harvard University, Cambridge, Massachusetts, USA) examined the geological origin of peridot from Supat, Pakistan. The deposits are located at an elevation of approximately 16,000 ft. (4880 m), where the miners search for veins containing olivine, calcite and magnetite that cross-cut dunite host rock. **Dr George E. Harlow** (American Museum of Natural History, New York, New York, USA) studied the

Figure 1: This peridot from Arizona, USA, is host to a large 'lily pad' cleavage disc. The inclusion appears to record the 'double-burst' of a fluid-filled negative crystal during the host peridot's multi-stage ascension to the earth's surface. Photomicrograph by Nathan Renfro/GIA; field of view 8.68 mm.



Myanmar, and noted similarities to the deposits in Pakistan and Egypt. He found abundant evidence for the involvement of hydrous fluids in the formation of Burmese peridot, and suggested that it crystallized during the exhumation of the host dunite.

In a well-illustrated presentation, **William Larson** (Palagems.com, Fallbrook, California, USA) reviewed important green gem materials in his collection. He indicated that jadeite is the most sought-after gem in the world after diamond, with approximately US$10 billion traded since 2006.

Corrected from 'annually' to 'since 2006'. For additional Burmese jadeite production data, see www.palagems.com/gem_news_burma_stats.php.

Robert Weldon (GIA, Carlsbad) provided photos and videos from his visit to the Cheapside Hoard at the Museum of London. The green gems in the Hoard consist of Colombian emerald and Egyptian peridot.

The causes of coloration in peridot and other green minerals were reviewed by **Dr George Rossman** (California Institute of Technology, Pasadena, California, USA). The colour of peridot depends on the overall amount of Fe present and its oxidation state, with Fe^{2+} producing green and Fe^{3+} giving brown-to-black.

Brendan M. Laurs

Scottish Gemmological Association Conference

The 2014 conference of the Scottish Gemmological Association took place on 2–5 May in Peebles, Scotland, with about 120 people in attendance. Presentations covered a diverse array of topics.

Dr Michael Krzemnicki (Swiss Gemmological Institute SSEF, Basel) delivered a presentation titled 'The Quest for "Kashmir" Sapphires and "Burma" Rubies—Origin Determination of Gemstones: Possibilities, Challenges and Limitations'. He stated that by analysis of colouring elements using UV-Vis spectroscopy, it is possible to determine the origin of similar-looking gem corundum from various sources, and even the origin of treated stones may be determined, provided that the inclusions remain intact. In a separate presentation, Dr Krzemnicki described interesting items that recently have been encountered in his laboratory. Examples include jadeite from Kazakhstan, which is identifiable by petrographic analysis, and a colour-change garnet that exhibited elements of the Usambara effect.

Antoinette Matlins (gem and jewellery author, South Woodstock, Vermont, USA) discussed lead-glass-filled corundum, and posed the question of whether selling this treated material without disclosure could cost jewellers and gemmologists their reputations. Some faceted pieces have been encountered that essentially consist of a sponge-like matrix of corundum that is held together with lead glass (potentially with colouring agents), raising the issue of the proper nomenclature for such material.

Figure 2: This early 18th century wooden quaich (shallow two-handled drinking cup from Scotland) is decorated with silver. It was made by Hugh Ross and Robert Anderson, and measures approximately 13 cm in diameter. Photo courtesy of Bonhams.

Gordon McFarlan (Bonhams, Edinburgh, Scotland) reviewed the history and value associated with Scottish provincial silver. Using examples of surviving silver spoons and cups (e.g. Figure 2), as well as auction results, he illustrated differences in the silverwork from various Scottish provinces.

Alan Hodgkinson (Scottish Gemmological Association, Ayrshire, Scotland) explored the characteristics of zircon, from its 'high' state through its metamict state, showing how the gemmological properties change as the crystal structure is modified by the radioactive decay of naturally occurring impurities in the gem.

Dr Cigdem Lule (Gemworld Inter-national Inc., Glenview, Illinois, USA) described the multidisciplinary approach of archaeogemmology. This science combines archaeological practices with gemmological identification to determine historic trade routes.

Robert Weldon (GIA, Carlsbad) provided an update on East Africa's gems, in which he surveyed the vast range of materials found in this region. From garnets to diamonds, the sources and colours of these gems were discussed, against a backdrop of gemmological and wildlife images, and interesting stories about the late Campbell Bridges.

Malcolm Appleby (Grandtully, Scotland) recounted his life and experiences as a silversmith and engraver, working first for gunsmiths, then as an independent artist. His commissions have included condiment sets for past prime ministers of the United Kingdom.

Andrew S. Fellows (andrew@gem-a.com)
Gem-A, London

Swiss Gemmological Society Conference 2014

On 4–6 May, the annual meeting and conference of the Swiss Gemmological Society (Schweizerische Gemmologische Gesellschaft, or SGG) took place at the Jugendstilhotel Hotel Paxmontana in Flüeli-Ranft, central Switzerland. The multi-lingual conference was attended by about 85 members and guests (Figure 3). The conference theme was tourmaline and its deposits, and there were also talks given on other topics. The conference was chaired by Michael Hügi, head of the Scientific Committee of the Society.

Prof. Henry Hänni (GemExpert GmbH, Basel, Switzerland) gave an overview of the mineralogical characteristics and classification of the tourmaline group, focusing on the tourmaline species important to the gem trade as well as on the most recently described tourmaline end-members. **Paul Rustemeyer** (Gundelfingen, Germany) gave a beautifully illustrated presentation on the growth characteristics and crystal forms of tourmaline, as seen in slices of numerous samples. He highlighted the relationship between crystal structure and macroscopic growth structures as well as the internal colour zonation. **Alexander Wild** (Wild & Petsch, Kirschweiler, Germany) gave an extensive market report on tourmaline. Mozambique has become the principal producer of Cu-bearing (Paraíba-type) tourmaline, providing some large stones that often show strong colour saturation. Tourmaline is in high demand, and the market is witnessing skyrocketing prices for top-quality stones, not only for 'Paraíba' colours, but also for indicolite, rubellite and 'mint'-green stones. The use of tourmaline in the work of famous jewellers was documented by **Catherine DeVincenti** (CdV Consulting, Lausanne, Switzerland). Her well-illustrated presentation explored the presence of tourmaline as central stones in masterwork jewellery.

Michael Hügi (Swiss Gemmological Society, Bern, Switzerland) discussed indicolite from the Neuschwaben mine in Namibia. A recent visit to

Figure 3: Some of the participants who attended the 2014 Swiss Gemmological Society Conference. Photo courtesy of M. Hügi.

this pegmatite showed that small-scale artisanal mining continues to yield small quantities of fine-quality indicolite and some green tourmaline. Spectrophotometry of the indicolite showed that the typical 'ink'-blue colour may be influenced by Mn^{3+}, in addition to the dominant absorption due to iron. **Dr Ulrich Henn** (German Gemmological Association, Idar-Oberstein) provided a detailed summary of the tourmaline deposits of Rwanda, Democratic Republic of Congo, Malawi and Mozambique. Except for Mozambique, these countries produce only small quantities of tourmaline. In Rwanda and Congo, tourmaline is recovered as a by-product of artisanal mining for other economically important minerals such as cassiterite or columbite-tantalite ('coltan').

Brian Cook (Nature's Geometry, Tucson, Arizona, USA) gave a beautifully illustrated description of the discovery and history of the original deposits of Paraíba tourmaline near São José da Batalha in Brazil. The gems were mined from very steeply dipping dykes of weathered pegmatite and associated alluvial deposits. Recent mining is focusing on a new section of the deposit, which hopefully will produce some additional material of high quality. The Paraíba tourmalines from the Batalha mine are widely regarded as showing superior colour saturation compared to any other source of Cu-bearing tourmaline. This explains why prices of more than US$100,000/carat have been paid for top-quality stones.

On the subject of gem corundum, **Dr Daniel Nyfeler** (Gübelin Gem Lab, Lucerne, Switzerland) provided characteristics of sapphires from the Baw Mar mine near Mogok, Myanmar. These sapphires are typically characterized by polysynthetic twinning with boehmite exsolutions along the twinning planes, and absorption spectra revealing distinct Fe^{3+}. Dr Nyfeler also announced the recently launched Dr Eduard Gübelin Research Scholarship (£20,000), directed at researchers in earth science and related fields who are pursuing innovative projects that contribute to the advancement of gemmological knowledge. **Dr Walter Balmer** (Chulalongkorn University, Bangkok, Thailand) described a recent journey to the ruby and sapphire mines of Mogok with gemmologists from the Swiss Gemmological Institute SSEF. His presentation gave an overview of the current mining activities—including those at the Baw Mar sapphire mine—and of the geological context of this famous gem mining region.

Dr Thomas Hainschwang (GGTL Gemlab–Gemtechlab Laboratory, Principality of Liechtenstein) summarized the criteria for identifying synthetic diamonds in melee parcels, mainly focusing on yellow diamonds. The use of short-wave UV transparency may be problematic with the presence in the market of colourless nitrogen-doped and heat-treated CVD synthetic diamonds. He described a sophisticated instrument used at his laboratory that is capable of testing large quantities of such melee diamonds using photoluminescence spectroscopy. On a similar subject, **Jean-Pierre Chalain** (Swiss Gemmological Institute SSEF) introduced the automated spectral diamond inspection (ASDI) machine, recently developed by SSEF to enable the automatic sorting of colourless natural diamonds from imitations and synthetics. **Walter Muff** (Muff Fine Diamonds, Muri, Switzerland) presented a diamond market report, including developments in diamond pricing in Switzerland, which in recent years were mostly driven by favourable currency exchange rates between the Swiss franc and US dollar.

René Lauper (Frieden AG, Thun, Switzerland) reviewed the cultured pearl market. The markets in Europe and USA are generally saturated with top-quality cultured pearls, but there is some growth potential for moderate-to-good quality saltwater cultured pearls (Akoya, Tahitian, etc.), especially in the emerging markets in Asia. A reduced demand for South Sea cultured pearls may generate serious problems for the Australian cultured pearl industry. **Prof. Henry Hänni** surveyed the most recent developments in pearl farming, especially regarding the traceability of the origin of cultured pearls (see full article in *The Journal of Gemmology,* Vol. 33, Nos. 7–8, 2013, pp. 239–245). **Dr Laurent Cartier** (Swiss Gemmological Institute SSEF) showed how it is possible to separate cultured pearls from *Pinctada radiata, P. maxima* and *P. margaritifera* molluscs using DNA fingerprinting.

Frederik Schwarz (Christie's, Berlin, Germany) recounted the history of the magnificent crown jewels of The Netherlands. Many pieces of the historical jewellery are still in use, although several have been modified from their original settings and designs according to the demands of their owners.

Dr Michael Krzemnicki (Swiss Gemmological Institute SSEF) gave the closing lecture summarizing news from the SSEF laboratory. He included some highlights of items tested recently at SSEF such as the Hutton-Mdivani jadeite necklace, which recently sold at Sotheby's Hong Kong for more than US$27.4 million. He also described a faked 'historic' emerald necklace containing Zambian emeralds, a Melo pearl containing a cavity filled with artificial resin, and exceptional spessartines from Namibia, Nigeria and Mogok.

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Swiss Gemmological Society
Bern, Switzerland

Michael Krzemnicki
Swiss Gemmological Institute SSEF
Basel, Switzerland

Accredited Gemologists Association's 2014 Las Vegas Conference

This educational event took place on 29 May, one day before the start of the JCK Las Vegas Show in Nevada, USA. The conference theme was 'Lab Grown Diamonds: In the Labs…in the Trade…and in YOUR Future!' The event was attended by approximately 60 people, and chaired by **Stuart Robertson**, AGA president and vice president of GemWorld International Inc. (Glenview, Illinois, USA).

Dr James Shigley (GIA, Carlsbad) began the conference by noting that effective research and identification of synthetics can only be accomplished when laboratories have a large and trustworthy database of known natural and synthetic diamonds. Dr Shigley summarized optical defects useful for identification. He also noted that by determining a diamond's type, a gemmologist can get a sense of whether further testing is needed to assess natural or synthetic origin.

Dusan Simic (Analytical Gemology and Jewelry, New York, New York, USA) described the challenges of identifying loose as well as mounted synthetic diamonds. At his lab, he separates diamonds into several categories: (1) natural diamond/natural colour, (2) natural diamond/treated colour, (3) synthetic diamond/as-grown colour, (4) synthetic diamond/treated colour, and (5) diamond imitation. Simic also mentioned the industrial and scientific uses for gem-quality synthetic diamonds; the identification of these materials can be quite challenging. He pointed to De Beers' Element Six laboratory as just one source of 'electronic grade' CVD synthetic diamonds, which are more valuable in electronics applications than in the jewellery industry.

Tom Chatham (Chatham Created Gems, San Francisco, California, USA) gave a fascinating first-hand family history of producing synthetic gems and how the jewellery industry has been affected as each new product has entered the market. It was Chatham's father who created the first commercially available flux-grown synthetic emerald, and the company has also produced and/or marketed synthetic corundum, alexandrite, opal and, most recently, diamond. With synthetic gem-quality diamond now being so accessible, Chatham pointed to the inevitable availability of calibrated-cut synthetic diamonds. Natural diamonds are not necessarily cut to calibrated sizes, but this is where lab-grown products can compete extremely well. Chatham finished his talk by noting that "natural diamond prices staying high is critical for the synthetic growers' maintaining a profitable margin".

Ronnie VanderLinden (Russian Classics Inc., Diamex Inc., and Pintura Cultured Diamonds, New York, New York, USA) is in the unique position of being in both the natural and synthetic gem diamond businesses. With this perspective, he stated: "To produce lab-grown diamond in the factory is 1/10th the cost of the natural. We want that differentiation." Diamond is forever, but diamond mines are not. About synthetic diamonds he stated: "Don't be afraid of the product. It's 100% diamond.…Embrace it!"

Gary A. Roskin (gary@roskingemnews.com)
Roskin Gem News Report
Exton, Pennsylvania, USA


PARAIBA
Powerful Colours

Gem-A Notices

GIFTS AND DONATIONS TO THE ASSOCIATION

The Association is most grateful to the following for their gifts and donations for research and teaching purposes:

Maggie Campbell Pedersen FGA, London, for specimens of burmite amber and wild boar tusk.

Christopher Cavey FGA, Amersham, Buckinghamshire, for a rhino horn and rhino skin specimen.

Steven Collins FGA DGA, Potton, Bedfordshire, for two Presidium gauges.

Anil Dholakia of Anil Dholakia Inc., Franklin, North Carolina, USA, for an 'Emerald Essence' beryl triplet.

Dennis Ho, Yangon, Myanmar, for a large selection of spinel crystals, a crystal-system stone set carved from hackmanite, and a 'Popular Gems' board displaying a selection of rough gems.

Marcus McCallum FGA, London, for ruby crystals and a large selection of garnets, each 'foil-backed' with a piece of metal.

Michael O'Donoghue FGA, Sevenoaks, Kent, for a selection of chrome, pink and green tourmalines.

Prof. Chiu Mei (Mimi) Ou Yang FGA, Hong Kong, for a 'bouquet' of carved orange jade flowers.

Rosemary Routledge, Bath, for a selection of opals and other cut stones.

John E. Roux, Horsham, Sussex, for a quantity of books for the Sir James Walton Library.

Dominic Seligman FGA DGA, London, for gemstones from his personal collection, including carved jadeite, a large red spinel crystal, a hackmanite cabochon and specimens of spinel, tourmaline, chrysoberyl, sapphire, garnet, topaz, ruby, apatite, blue moonstone and amethyst.

Alexandros Sergoulopoulos FGA DGA, Athens, Greece, for a dodecahedral diamond crystal and a bag of rough stones.

Paul Siegel FGA, Rocky Point, New York, USA, for a monetary donation.

Antonio Silva, London, for *Russian Gemstones Encyclopedia* by V. V. Bukanov.

Miranda Wells FGA DGA, Birmingham, West Midlands, for five older back issues of *The Journal of Gemmology*.

Jason Williams FGA DGA, G. F. Williams & Co., London, for a large selection of fashioned stones including quartz, onyx, topaz, turquoise and plastic imitations of amber.

ANNUAL GENERAL MEETING

The Gem-A Annual General Meeting (AGM) was held on Thursday 12 June 2014 in the Bruton Room at Gem-A, 21 Ely Place, London EC1N 6TD. The meeting was chaired by Jason Williams, the Chairman of the Board. The Annual Report and Accounts were approved.

Harry Levy was re-elected President for the term 2014–2016. Professor Andrew Rankin stepped down from the Board and was thanked for his time as trustee and president. Professor Rankin was then elected a Vice President. Mary Burland, Miranda Wells and Jason Williams, who retired from the Council by rotation, and Jonathan Lambert, who had been appointed by the Council since the 2013 AGM, were re-elected.

Hazlems Fenton were re-appointed as auditors for the year.

The AGM was followed by a presentation by Vivien Johnson entitled 'The evolution of ethical jewellery in the UK'.

GEM-A AWARDS

In the Gem-A examinations held in January 2014, 151 students qualified in the Gemmology Diploma Examination, including 13 with Distinction and 22 with Merit, and 201 students qualified in the Foundation Certificate in Gemmology Examination. In the Gem Diamond Examination 75 qualified, including 13 with Distinction and eight with Merit. The names of the successful candidates are listed alphabetically.

Examinations in Gemmology

Gemmology Diploma

Qualified with Distinction

Chen Miaofen, *Chenxi, Guangxi, P.R. China*
Fan Xingyu, *Xuancheng, Anhui, P.R. China*
Féral, Catherine, *Paris, France*
Guo Yaling, *Beijing, P.R. China*
Han Haoyu, *Beijing, P.R. China*
Ke Jiayu, *Beijing, P.R. China*
Khabrieva, Dilyara, *London*
Li Wenli, *Beijing, P.R. China*
Lu Gujun, *Beijing, P.R. China*
Qu Qi, *Paris, France*
Rigaud, Matthieu, *Bayonne, France*
Wu Jingyi, *Beijing, P.R. China*
Zhang Gaoyang, *Beijing, P.R. China*

Qualified with Merit

Bian Jinjin, *Beijing, P.R. China*
Chang Qian, *Shanghai, P.R. China*
Chen Qiang, *Beijing, P.R. China*
Dai An, *Beijing, P.R. China*
Dai Li Li, *Beijing, P.R. China*
Fan Jing, *Beijing, P.R. China*
Guo Bi Jun, *Beijing, P.R. China*
Han Ying Hui, *Beijing, P.R. China*
Lu Xiao, *Beijing, P.R. China*
Marleau, Diane, *Ville Mont-Royal, Quebec, Canada*
Mo Hongyan, *Nanning, Guangxi, P.R. China*
Shi Yang, *Guilin, Guangxi, P.R. China*
Si Yitong, *Pingdingshan, Henan, P.R. China*
Sun Xue Ying, *Anqing, Anhui, P.R. China*
Wang Feidi, *Wuhan, Hubei, P.R. China*
Wang Siyi, *Beijing, P.R. China*
Wang Yan, *Beijing, P.R. China*
Wang Yue, *Beijing, P.R. China*
Wenyan Luo, *Daqing, Heilongjiang, P.R. China*
Xie Meinan, *Beijing, P.R. China*
Yang Meng, *Beijing, P.R. China*
Yuan Yi Rong, *Beijing, P.R. China*

Qualified

Baduza-Sutton, Buyisa, *Birmingham, West Midlands*
Bai Xiao, *Beijing, P.R. China*
Cao Ri, *Bengbu, Anhui, P.R. China*
Chai Jing, *Beijing, P.R. China*
Chant, Francesca, *Chichester, West Sussex*
Cheer, Peter, *Somerton, Somerset*
Chen Qian Ran, *Beijing, P.R. China*
Chen Xiao Ai, *Dalian, Liaoning, P.R. China*
Chen Yaqing, *Hanzhong, Shanxi, P.R. China*
Chen Zhujun, *Wuhan, Hubei, P.R. China*
Cheng Xinyi, *Xi'an, Shanxi, P.R. China*
Colloud Aballe, Lydie, *La Chaux De Fonds, Switzerland*
Cong Xuesong, *Guangzhou, Guangdong, P.R. China*
Corona Blandin, Marie-Azilis, *Belz, France*
De Lamberterie, Isabelle, *Saint-Nom-la Bretèche, France*
Deng Yuli, *Meishan, Sichuan, P.R. China*
Deriaz, Julie Ann, *St John's, Newfoundland, Canada*
Donaldson Lie, Gillian, *Toronto, Ontario, Canada*
Dong Yidan, *Beijing, P.R. China*
Dong Yiping, *Guangxi, Guilin, P.R. China*
Du Hua Ting, *Beijing, P.R. China*
Dupuy, Harold, *Lafayette, Louisiana, USA*
Esterhuysen, Stephanus, *Viljoenskroon, South Africa*
Fang Ao, *Hedong, Tianjin, P.R. China*
Fang Yi Bin, *Beijing, P.R. China*
Feng Xiaoxi, *Xinjiang, P.R. China*
Fiebig, Jim, *West Des Moines, Iowa, USA*
Fu Minli, *Xiaogan, Hubei, P.R. China*
Fu Yu, *Beijing, P.R. China*
Gao Dan, *Wuhu, Anhui, P.R. China*
Gao Manmengxi, *Wuzhou, Guangxi, P.R. China*
Gao Wenting, *Shenzhen, Guangdong, P.R. China*
Gao Xue, *Nanyang, Henan, P.R. China*
Geo Chao, *Guangzhou, Guangdong, P.R. China*
Gericke, Chanel, *Nottingham*
Granic, Kata, *Auckland, New Zealand*
Griffon, Denise, *Montreal, Quebec, Canada*
Han Jie, *Beijing, P.R. China*
Han Yue, *Beijing, P.R. China*
Hu Haifeng, *Wuhan, Hubei, P.R. China*
Huang Liuyun, *Guilin, Guangxi, P.R. China*
Huangzheng Xiao, *Wuhan, Hubei, P.R. China*
Ji Xiaoliu, *Rugao, Jiangsu, P.R. China*
Jia Qiuying, *Beijing, P.R. China*
Katsof, Erika, *Lachine, Quebec, Canada*
Kenyon, Janelle, *Auckland, New Zealand*
Kolator, Barbara, *London*
Kuo Hsin, *Taipei, Taiwan, R.O. China*
Lammertse, Max, *Amsterdam, The Netherlands*
Lee Hsiu Fen, *Leeuwarden, The Netherlands*
Lee Tak Fai, Eric, *Kowloon, Hong Kong*
Leedham, Laura, *Oldbury, West Midlands*
Lei Yaxiu, *Xi'an, Shanxi, P.R. China*
Leung Ying, *Tsing Yi, Hong Kong*
Li Mei-Hui, *Taichung, Taiwan, R.O. China*
Li Wen Xin, *Beijing, P.R. China*
Li Wenqing, *Beijing, P.R. China*
Li Yi-Chen, *Taichung, Taiwan, R.O. China*
Liang Lu, *Taiyuan, Shanxi, P.R. China*
Lin Feiyu, *Beijing, P.R. China*
Liu Chen Pu, *Beijing, P.R. China*
Liu Hongwei, *Tianjin, P.R. China*

Liu Mengzhuo, *Beijing, P.R. China*
Liu Xiaoyu, *Shenzhen, Guangdong, P.R. China*
Liu Yinghui, *Beijing, P.R. China*
Liu Yuecong, *Beijing, P.R. China*
Mak Yee Ki, *Tuen Mun, Hong Kong*
Matthews, Timothy, *Knoxville, Tennessee, USA*
Meissirel, Mathilde, *Canterbury, Kent*
Men, Oxana, *Athens, Greece*
Millet, Angélique, *Ville d'Avray, France*
Nijzink-Brandt, Saskia, *Arnhem, The Netherlands*
O'Sullivan Walter, Lauren, *San Francisco, California, USA*
Ovesen, Hasanthi, *London*
Pan Shenchao, *Shanghai, P.R. China*
Pan Yongyi, *Shenyang, Liaoning, P.R. China*
Perkkio, Maria, *Helsinki, Finland*
Qin Wenjie, *Shanghai, P.R. China*
Routledge, Susannah, *Reading, Berkshire*
Rykova, Elena, *Paris, France*
Saleem, Melanie, *Manchester, Greater Manchester*
Sapault, Jordan, *Antony, France*
Schuler-Immoos, Gertrud, *Lucerne, Switzerland*
Shekarriz, Toktam, *Hampstead, Quebec, Canada*
Sun Chen, *Wuhan, Hubei, P.R. China*
Sun Yitian, *Beijing, P.R. China*
Swaving, Christine, *The Hague, The Netherlands*
Tang Boli, *Hanzhong, Shanxi, P.R. China*
Tsai Chi-Chieh, *Taichung, Taiwan, R.O. China*
Tseng Yen-Chun, *Changhua, Taiwan, R.O. China*
Wang Chengbo, *Taian, Shandong, P.R. China*
Wang Xinyi, *Danjiangkou, Hubei, P.R. China*
Wong Man Ho, *Kowloon, Hong Kong*
Wu Min, *Chongqing, P.R. China*
Wu Wei Ran, *Beijing, P.R. China*
Wu Zhe, *Beijing, P.R. China*
Xie Ena, *Beijing, P.R. China*
Xu Jing, *Hangzhou, Zhejiang, P.R. China*
Xu Ting, *Shaoxing, Zhejiang, P.R. China*
Xu Yan, *Beijing, P.R. China*
Xue Cen, *Shanghai, P.R. China*
Yang Qiujing, *Singapore*
Yang Xiao, *Zibo, Shandong, P.R. China*
Yang Yufan, *Guiyang, Guizhou, P.R. China*
Ye Fangqi, *Beijing, P.R. China*
Yiu King San, Sunny, *Tuen Mun, Hong Kong*
Zhang Cheng, *Beijing, P.R. China*
Zhang Di, *Baoding, Hebei, P.R. China*
Zhang Guoqing, *Nanning, Guangxi, P.R. China*
Zhang Hanyan, *Wuhan, Hubei, P.R. China*
Zhang Jie, *Jinan, Shandong, P.R. China*
Zhang Yun, *Weihai, Shandong, P.R. China*
Zhao Hong, *Beijing, P.R. China*
Zhao Jia Hui, *Beijing, P.R. China*
Zhou Si Si, *Beijing, P.R. China*
Zhu Younan, *Beijing, P.R. China*

Foundation Certificate in Gemmology

Qualified

Allen, Tara, *Carlsbad, California, USA*
Ardon, Troy, *Carlsbad, California, USA*
Arrive, Elodie, *Annecy, France*
Bassil, Sophie-Marie, *Malakoff, France*
Batisse, Sylvia, *Gallardon, France*
Bealey, Philip, *Ilfracombe, Devon*
Bernard, Amy, *South Darenth, Kent*
Blanchard, Alain, *Paris, France*
Boemo, Julien, *Lorraine, France*
Borreill, Daniel, *Serralongue, France*
Boubouillon, Yasmine, *Cretail, France*
Brown, Gareth, *Bristol*
Campbell, Rosanna, *London*
Cederlund, Johanna, *Lannavaara, Sweden*
Chan Meng-Hua, *New Taipei City, Taiwan, R.O. China*
Chan San San, *San Wan, Hong Kong*
Chan Shih, Sally, *Flushing, New York, USA*
Chan Tsz Ying, *Yuen Long, Hong Kong*
Chan Wing Chi, *Tsuen Wan, Hong Kong*
Chan Yee Ha, *Tsuen Wan, Hong Kong*
Chang Cheng-Yi, *Taichung, Taiwan, R.O. China*
Chau Hoi Yim, *Tsing Yi, Hong Kong*
Chen Chun-Yi, *New Taipei City, Taiwan, R.O. China*
Chen Mei Zhen, *Ngau Tau Kok, Hong Kong*
Chen Po Chuan, *Taipei, Taiwan, R.O. China*
Chen Xiao Mei, *Kowloon, Hong Kong*
Chen Yaqing, *Hanzhong, Shanxi, P.R. China*
Cheng Xiang, *Shanghai, P.R. China*
Chetwynd, Doreen, *Leicester*
Cho Shuk Ping, *Hunghom, Hong Kong*
Choi Hon Por, *North Point, Hong Kong*
Chong Oi Lin, *Sheung Shui, Hong Kong*
Chow Hiu Yan, *Central, Hong Kong*
Chui Kwan Fung, *Kowloon, Hong Kong*
Cisamolo, Marie-Cecile, *London*
Cohen, Jason, *East Barnet, Hertfordshire*
Craig, Deborah, *Sundbyberg, Sweden*
Crispino, Gary, *Albany, California, USA*
Desile-Dejean, Celine, *Yangon, Myanmar*
Desmortiers, Patricia, *Paris, France*
Ding Qian, *Guiyang, Guizhou, P.R. China*
Dong Yiping, *Guilin, Guangxi, P.R. China*
Dubinsky, Emily, *New York, New York, USA*
Egre, Virginie, *Paris, France*
Fong Yee Kan, *Kowloon, Hong Kong*
Fong Lap Kit, *Yuen Long, Hong Kong*
Foskett, Emily, *London*
Foxwell, Kim, *Twickenham, Middlesex*
Fung Hoi Ching, *Yuen Long, Hong Kong*
Gallegos, Jenefer, *London*
Gandhi, Hemang, *London*

Garnier, Georgina, *London*
Guicheney Mahler, Jean Philippe, *Garches, France*
Guo Xiaocheng, *Longyan, Fujian, P.R. China*
Hall, Lucy, *London*
Hou Fei-Feng, *Taipei, Taiwan, R.O. China*
Huang Kaixi, *London*
Huang Li-Lien, *Taichung, Taiwan, R.O. China*
Huang Lingxi, *Guilin, Guangxi, P.R. China*
Huang Tien Hua, *Taoyuan, Taiwan, R.O. China*
Huang Wenjie, *Guilin, Guangxi, P.R. China*
Hui Sin Kam, *Tseung Kwan O, Hong Kong*
Ito, Claire, *New York, New York, USA*
Jayawardhana, Jayamini, *Ratnapura, Sri Lanka*
Jiang Rongxian, *Guangzhou, Guangdong, P.R. China*
Jones, Oliver, *Bern, Switzerland*
Kadigamuwa, Nethmin, *Hounslow, Middlesex*
Kang Zhiyuan, *Shanghai, P.R. China*
Katsurada, Yusuke, *Tokyo, Japan*
Kwan Sin Yi, *Tseung Kwan O, Hong Kong*
Kyaw Zay Yar Naing, *Yangon, Myanmar*
Kyle, Jennifer, *Montreal, Quebec, Canada*
Lai Xiaolin, *Guangzhou, Guangdong, P.R. China*
Lai Cheng, *Guilin, Guangxi, P.R. China*
Lai Ka Man, *London*
Lam Lai Yuen, *Tseung Kwan O, Hong Kong*
Lawton, Lesley, *Nantwich, Cheshire*
Lee Yan Ho, *Taipo, Hong Kong*
Legros, Maria, *London*
Leleu, Cédric, *Levallois-Perret, France*
Li Hung Mui, *Mong Kok, Hong Kong*
Li Jing, *Surbiton, Surrey*
Li Mei-Hui, *Taichung, Taiwan, R.O. China*
Li Tsung Han, *Hsinchu, Taiwan, R.O. China*
Li Wenjie, *Guangzhou, Guangdong, P.R. China*
Li Xiaoyi, *Vancouver, British Columbia, Canada*
Li Yikun, *Guilin, Guangxi, P.R. China*
Li Zhen, *Guilin, Guangxi, P.R. China*
Li Zhixiang, *Guangzhou, Guangdong, P.R. China*
Liang, Shr-Hua, *Taichung, Taiwan, R.O. China*
Liao Yi Chen, *Taipei, Taiwan, R.O. China*
Lin Moqing, *Central, Hong Kong*
Lin Ta Wei, *Taichung, Taiwan, R.O. China*
Lin Wen Yu, *Taipei, Taiwan, R.O. China*
Lin Yu Ju, *Taipei, Taiwan, R.O. China*
Lin Yu Ping, *Pingzhen, Taoyuan, Taiwan, R.O. China*
Liscouet, Marie-Solène, *Saint Cloud, France*
Liu Bingjie, *Shanghai, P.R. China*
Liu Can, *Shanghai, P.R. China*
Liu Chien-Yu, *Hsinchu, Taiwan, R.O. China*
Liu Jiamin, *Guilin, Guangxi, P.R. China*
Liu Ying, *Shanghai, P.R. China*
Liu Yuli, *Shaoyang, Hunan, P.R. China*
Liu Zhiyu, *London*
Lo Ching-Hui, *Taipei, Taiwan, R.O. China*
Lodha, Rahul, *Kalwa, India*
Long Songyun, *Guilin, Guangxi, P.R. China*
Louie Rayki Man Yam, *San Po Kong, Hong Kong*
Lu Yi-Lun, *Taichung, Taiwan, R.O. China*
Lusher, Lila, *Whangarei, Northland, New Zealand*
Ma Sin Yue, *Kowloon, Hong Kong*
Machen, Andrea, *West Byfleet, Surrey*
Mak Ka Lun, *Mongkok, Hong Kong*
Mak Ka Wai, *Shatin, Hong Kong*
Man Sui Wan, Joy, *Shatin, Hong Kong*
May, Eric, *Verbier, Switzerland*
Moe Kyaw, *Fishkill, New York, USA*
Mok Ka Yan, Noelle, *Kowloon, Hong Kong*
Molon, Valentina, *London*
Monnin, Antony, *Morteau, France*
Moulton-Cox, Amy, *Whangaparaoa, New Zealand*
Mutsaers, Gerard, *Dieren, The Netherlands*
Naing Min Phone, *Yangon, Myanmar*
Nazz, Marzena, *Jersey City, New Jersey, USA*
Ng Wai Fong, *Kowloon, Hong Kong*
Ng Siu Lun, *Kwun Tong, Hong Kong*
Nicolson, Kirsty, *Portland, Dorset*
Nigam, Pooja, *London*
Odake, Shoko, *Tokyo, Japan*
Pageaut, Thierry, *Courbouzon, France*
Paing Kyaw Thet, *Yangon, Myanmar*
Pear, Bradley, *Bloomfield, Michigan, USA*
Peens, Ruley, *Johannesburg, Gauteng, South Africa*
Peng Mingqiang, *Guilin, Guangxi, P.R. China*
Praill, Gregory, *Hockley, Essex*
Qin Qiaohong, *Guilin, Guangxi, P.R. China*
Reeder, Nicola, *Royston, Hertfordshire*
Regan, Karen, *Dublin, R.O. Ireland*
Renfro, Nathan, *Carlsbad, California, USA*
Rocchi, Natalia, *London*
Rodrigues, Suelle, *Utrecht, The Netherlands*
Rong, Zhen, *Shanghai, P.R. China*
Ryan, Veronica, *London*
Sangsawong, Supharart, *Bangkok, Thailand*
Saruwatari, Kazuko, *Tokyo, Japan*
Sawyer, Nicola, *Bristol*
Schwartz, Virginia, *Carlsbad, California, USA*
Scott, Louisa, *London*
Shen Fangqing, *Shanghai, P.R. China*
Shen Qi, *Shanghai, P.R. China*
Shen Jiamin, *Guilin, Guangxi, P.R. China*
Shi Yan, *Guilin, Guangxi, P.R. China*
Sit Mei Mei, *Central, Hong Kong*
Soo See Sheng, *Singapore*
Soonthorntantikul, Wasura, *Bangkok, Thailand*
Stancliffe, Sarah, *London*
Stephan, Michaela, *McLean County, Illinois, USA*

Su Liping, *Guilin, Guangxi, P.R. China*
Sun I-Shan, *Taichung, Taiwan, R.O. China*
Sutton, Stephen, *Tonbridge, Kent*
Tam Hee Lan, *Tuen Mun, Hong Kong*
Tang Kwok Ying, *Tai Po, Hong Kong*
Tay Meng Leong, *Singapore*
Tsai Chi-Chieh, *Taichung, Taiwan, R.O. China*
Tsao Wen Ting, *Taipei, Taiwan, R.O. China*
Tse Siu Fung, *Kwun Tong, Hong Kong*
Tseng Yi Ming, *Taipei, Taiwan, R.O. China*
Van Hoecke, Audrey, *London*
Velickaite, Akvile, *London*
Venville, Sarah, *Auckland, New Zealand*
Wang Shuang, *Guilin, Guangxi, P.R. China*
Waters, Renee, *Market Harborough, Leicestershire*
Whittington, Flora, *St Helier, Jersey, Channel Islands*
Williams, Kathryn, *Dover, Kent*
Williamson, Anna, *Hamilton, New Zealand*
Wong Tsz Ting, *Tseung Kwan O, Hong Kong*
Wong Surjit, *Brooklyn, New York, USA*
Wright, William, *London*
Wu Bin, *Guilin, Guangxi, P.R. China*
Wu Kun Tse, *Taoyuan, Taiwan, R.O. China*
Xin Cuihong, *Shanghai, P.R. China*
Xu Yanfei, *Guilin, Guangxi, P.R. China*
Yang, Qiankun, *Shanghai, P.R. China*
Yang Jingwen, *Shanghai, P.R. China*
Yang Ya-Chu, *Taipei, Taiwan, R.O. China*
Yang Yi-En, *Taipei, Taiwan, R.O. China*
Yang Jia Sin, *Taipei, Taiwan, R.O. China*
Yano Yukari, *Singapore*
Yau Ka Ki, *North Point, Hong Kong*
Yazawa, Emiko, *Woodside, New York, USA*
Yin Yunan, *Shanghai, P.R. China*
Yu Ning, *Foshan City, Guangdong, P.R. China*
Yu Xinyuan, *Changsha, Hunan, P.R. China*
Yuan Wei, *Guilin, Guangxi, P.R. China*
Zhang Baijie, *Shanghai, P.R. China*
Zhang Meng, *Shanghai, P.R. China*
Zhang Shi, *Guilin, Guangxi, P.R. China*
Zheng Long, *Guangzhou, Guangdong, P.R. China*
Zhou Xinyi, *Guilin, Guangxi, P.R. China*
Zhu Ying, *Shanghai, P.R. China*
Zuo Tenglong, *Zhengzhou, Henan, P.R. China*

Diamond Diploma Examination

Qualified with Distinction

Barber, Simon, *London*
Chai Jing, *Guangzhou, Guangdong, P.R. China*
Glenn, Alison, *Chertsey, Surrey*
Hartstone, Bradley, *New Barnet, Hertfordshire*
Herold, Doerte, *Zurich, Switzerland*
Ji Ang, *Chatham, Kent*
Kanevskij, Aleksandr, *London*
Lowther, Joan, *Stockholm, Sweden*
Mendes, Isabella, *Berkhamstead, Hertfordshire*
Porter, Rex, *Hook, Hampshire*
Stancliffe, Sarah, *London*
Sternbeck, Julie Louise, *Wakefield, West Yorkshire*
Wong Ching Man, *Discovery Bay, Hong Kong*

Qualified with Merit

Chan Yin Tong, *Kwun Tong, Hong Kong*
Khoo Shoew Peng, Penny, *Yuen Long, Hong Kong*
Li Ying, *Guangzhou, Guangdong, P.R. China*
Meng Fang, *Beijing, P.R. China*
Van Eerde, Christa, *London*
Woodcock, Olga Faye, *Basingstoke, Hampshire*
Xue Ru, *Beijing, P.R. China*
Yu Chunchao, *Beijing, P.R. China*

Qualified

Aggarwal, Lisa, *Northolt, Middlesex*
Bai Xuemei, *Guangzhou, Guangdong, P.R. China*
Barnett, Faye, *Birmingham, West Midlands*
Byrne, Amie, *Solihull, West Midlands*
Chan Sum Yi, *Kowloon, Hong Kong*
Chan Yong Yong, Angela, *Hunghom, Hong Kong*
Chan Lai Yi, *Ho Man Tin, Hong Kong*
Cheng Hin Wah, *Aberdeen, Hong Kong*
Choi Wai Hung, *Sham Shui Po, Hong Kong*
Choi Lai Shan, *Kowloon, Hong Kong*
Chu Chi Ting, *Sheung Shui, Hong Kong*
Chung Kit Shuen, *Kwun Tong, Hong Kong*
Cousins, Julian, *Faversham, Kent*
Deng Yufei, *Shanghai, P.R. China*
Du Jialin, *Beijing, P.R. China*
Kong Fanbo, *Beijing, P.R. China*
Kwok Men Yee, *Kam Tin, Hong Kong*
Lai Shan Shan, *Kowloon, Hong Kong*
Lam Tik Nga, *Pok Fu Lam, Hong Kong*
Lam Ching Yee, *Fanling, Hong Kong*
Lam Man Yee, Maria, *Kowloon, Hong Kong*
Lau Fung Shan, *Tuen Mun, Hong Kong*
Lau Chui Ting, *Tin Shui Wai, Hong Kong*
Lee Hsiu Fen, *Leeuwarden, The Netherlands*
Lee Sze Hang, Florence, *Kwai Chung, Hong Kong*
Leung Wai Yee Jouie, *Tai Po, Hong Kong*
Li Wai Hon, *Shek Tong Tsui, Hong Kong*
Lo Man Sze, *Tai Po, Hong Kong*
Lui Kai Yin, *Kwai Chung, Hong Kong*
Lutumba, Salomon, *Coventry, West Midlands*
Men, Oxana, *Athens, Greece*
Ng Wan Yuen Eoroy, *Kowloon, Hong Kong*

Ng Koon Hei, *Lai Chi Kok, Hong Kong*
Ngo, Peter, *London*
Panfil, Alexandra, *London*
Santarsiere, Miguel Angel, *Folkestone, Kent*
Sharpley-Fanner, Harriet, *London*
Shaw, Rebecca, *Huddersfield, West Yorkshire*
Si Cong, *Beijing, P.R. China*
Skinner, Jasmine, *Birmingham, West Midlands*
So Shuk Man, *Shatin, Hong Kong*
Sze Hoi Lee, *Kowloon, Hong Kong*
Tong Hoi Yum, Louise, *Sham Shui Po, Hong Kong*
Tsai Sung Fung, *Sai Ying Pun, Hong Kong*
Tsang Pui Yee, *Tsuen Wan, Hong Kong*
Tsui Yuen Shan, *Ma On Shan, Hong Kong*
Wang Sida, *Beijing, P.R. China*
Wong Hoi Ting, *Tai Po, Hong Kong*
Wong Wai Yin, *Sheung Shui, Hong Kong*
Wu Muyun, *Beijing, P.R. China*
Wu Jiahui, *Beijing, P.R. China*
Yan Xiaolan, *Fuzhou, Fujian, P.R. China*
Zhao Wen Ting, *To Kwa Wan, Hong Kong*
Zhu Di, *Beijing, P.R. China*

MEMBERSHIP

At a meeting of the Council of the Association held on 12 June 2014, the following were elected to membership:

Fellowship and Diamond Membership (FGA DGA)

Craddock, Natalie, *Birmingham, West Midlands*
Green, Edward, *Edinburgh, Midlothian*
Matthews, Timothy, *Knoxville, Tennessee, USA*
Wang Linlin, *London*

Fellowship (FGA)

Choquette, Carolyne, *Laval, Quebec, Canada*
Haeringer, Manuelle, *Provence-Alpes-Côte d'Azur, France*
Harris, Natalie, *Merstham, Surrey*
Hayashi, Hidenori, *Tokyo, Japan*
Heilio, Saara, *Bromley, Kent*
Huang Mulin, *Beijing, P.R. China*
Hughes, E. Billie, *Bangkok, Thailand*
Kajita, Yukio, *Tokyo, Japan*
Kolator, Barbara, *London*
Mak Yee Ki, *Tuen Mun, Hong Kong*
Manorotkul, Wimon, *Bangkok, Thailand*
Peng Hsiang-Chieh, *New Taipei City, Taiwan, R.O. China*
Pino, Orazio, *Liguria, Italy*
Schuler-Immoos, Gertrud, *Lucerne, Switzerland*
Van Heesewijk, Jacqueline, *Ripley, Surrey*
Wang Kai, *Guangzhou, Guangdong, P.R. China*
Wang Minmin, *Guangzhou, Guangdong, P.R. China*
Wang Xiaojuan, *Beijing, P.R. China*
Yamagishi, Shoji, *Kanagawa, Japan*
Yang Jiong, *Taian, Shandong, P.R. China*
Yoda, Takahiro, *Tokyo, Japan*
Zhang Tianyang, *Guangzhou, Guangdong, P.R. China*
Zheng Fangyi, *Shanghai, P.R. China*

Diamond Membership (DGA)

Avraam, Zoey, *London*
Bratek, Elizabeth Jane, *Harold Hill, Essex*
Choi Wai Hung, *Kowloon, Hong Kong*
Cousins, Julian, *Faversham, Kent*
Fortunato, Claudio, *London*
Lin Huaxia, *Guangzhou, Guangdong, P.R. China*
Selant, Sabbir, *Preston, Lancashire*
Wilson, Naomi, *Selly Oak, West Midlands*
Yuan Chih-Chung, Joe, *Zhengzhou, Henan, P.R. China*

Associate Membership

Abramowitz, Lauren, *Glendale, Arizona, USA*
Atkins, Roy, *Newhaven, East Sussex*
Avallon, Elena, *Stockholm, Sweden*
Barker, Bill, *Scotsdale, Arizona, USA*
Brady, Aoife, *London*
Brakovic, Marin, *Koper, Slovenia*
Caplan, Evan, *Los Angeles, California, USA*
Chaput, Aurelie, *London*
Clarke, Barry, *London*
Delaye, Aline, *Singapore*
Dholakia, Anil B., *Franklin, North Carolina, USA*
Dieu de Bellefontaine, Mary, *Billericay, Essex*
Fitzgerald, Alison, *Sevenoaks, Kent*
Gargour, Karim, *Beirut, Lebanon*
Goldingay, Raymond, *St John, Jersey, Channel Islands*
Griffin, Patricia, *Yarra Glen, Victoria, Australia*
Gunn, Timothy, *London*
Hall, Samuel, *Heathfield, East Sussex*
Jebb, Loraine, *Hillsborough, Co. Down, Northern Ireland*
Kinoshita, Yoshio, *Montreal, Quebec, Canada*
Knuckey, Samantha, *Prestbury, Cheshire*
Komatsu, Hiroshi, *Tokyo, Japan*
Lazzarelli, Herve Nicolas, *Geneva, Switzerland*
Llopis Lopez, Manuel, *València, Spain*
Marsh, Clare, *Swadlingcote, Derbyshire*
Mastroianni, Carol, *West Melbourne, Victoria, Australia*
Mathieu, Eloise, *London*
Mehdi, Jonathan, *Bushey, Hertfordshire*

Merk, Roger, *San Diego, California, USA*
Olivares Salmon, Elka, *Gibraltar*
Poultney, Sue, *Ashford, Kent*
Pragnell, Charles, *Stratford-upon-Avon, Warwickshire*
Ralph, Jolyon, *Mitcham, Surrey*
Reedie, Kathryn, *London*
Remy-Clarke, Helene, *London*
Renshaw, Mark, *Wakefield, West Yorkshire*
Salem, James, *Kings Langley, Hertfordshire*
Shaikh, Nasiruddin, *London*
Sim Hwa San, *Singapore*
Stone-Sundberg, Jennifer, *Portland, Oregon, USA*
Thierrin-Michael, Gisela, *Jura, Switzerland*
Thompson, Don, *Billings, Montana, USA*
Tiamiyo, Soulikifouli, *Cotonou, Benin*
Traisirichok, Thunyathorn, *Chiang Mai, Thailand*
Watanabe, Koichiro, *Tokyo, Japan*
Yawata, Keiko, *Kanagawa, Japan*

Gold Corporate Membership

Berganza Ltd, *London*
IGR Reports, *London*
George Pragnell Ltd, *Stratford-upon-Avon, Warwickshire*

Corporate Membership

J Co Gems Ltd, *London*
Scarab Antiques, *Ashford, Kent*

Gem-A Photographic Competition 2014

Gilalite aggregates in rock crystal by Michael Hügi FGA. Winner of the 2013 competition.

Submit your photographs for the 2014 Photo Competition and you could win a year's FREE Gem-A Membership. Current Gem-A members may enter the contest under any of the following four categories:

1. **Natural:** Digital photograph or photomicrograph with minimal post-production work (may include basic cropping, contrast and minor hue and saturation adjustments).
2. **Treated:** Digital photograph or photomicrograph with significant post-production work (such as background manipulation, HDR and contrast masking).
3. **Synthetic:** Computer-rendered 3D models of gemstones, crystals, crystal structures, images from microtomography, etc.
4. **Melange:** This category covers any gem-related image that doesn't fit in the above, and may include such things as photos of a spectrum, a scanning electron microscope image, mining, cutting, etc.

The subjects may include any type of gem material (including organics, and synthetics and simulants), crystals or cut stones, and internal or other features of these. Jewellery settings may be included, even wearers, but the gem or gems must be the main subject. In the case of categories 1, 2 and 4, the original photo as taken, with no cropping or manipulation whatsoever, must also be submitted to us.

Please submit all entries to editor@gem-a.com by FRIDAY 19 SEPTEMBER 2014, taking care to read the Rules of Entry first. For more information and for Rules of Entry, please visit www.gem-a.com/membership/photographic-competition.aspx.

Learning Opportunities

CONFERENCES AND SEMINARS

South American Symposium on Diamond Geology
3–7 August 2014
Patos de Minas, Minas Gerais, Brazil
www.simposiododiamante.com.br/apresentacao.htm

25th Colloquium of African Geology (CAG25)
11–16 August 2014
Dar es Salaam, Tanzania
www.cag25.or.tz
Note: Field trips will include visits to the Merelani tanzanite mines and the Williamson diamond mine.

Northwest Jewelry Conference 2014
15–17 August 2014
Bellevue, Washington, USA
www.northwestjewelryconference.com

Dallas Mineral Collecting Symposium
22–23 August 2014
Dallas, Texas, USA
www.dallassymposium.org

International Jewellery London
31 August–2 September 2014
London
www.jewellerylondon.com/show-highlights/seminars/#

21st General Meeting of the International Mineralogical Association (IMA2014)
1–5 September 2014
Johannesburg, South Africa
www.ima2014.co.za
Sessions of interest:
- The Geology of Gems and their Geographic Origin
- Cratons and Diamonds
- Pegmatites and Pegmatite Mineralogy
- Africa: A Mecca of Kimberlite, Alkaline Rock and Carbonatite Geology
- Certification of Geological Materials/Analytical Fingerprint of Minerals
- Computed Tomography—Pushing Frontiers in Imaging of the Third and Fourth Dimensions
- Modern Luminescence Methods and their Application to Mineralogy
- Mineral Inclusions—Their Genesis and Fate

Field trips of interest:
- Cullinan Diamond Mine and Tswaing Tour
- Namibian Pegmatites and Industrial Minerals

Compiled by Brendan Laurs and Diane Flora

International Conference on Diamond and Carbon Materials
7–11 September 2014
Madrid, Spain
www.diamond-conference.elsevier.com

Kimberley Diamond Symposium
11–13 September 2014
Kimberley, South Africa
http://rca.co.za/conferences/kimberley
Note: Field trips will be organized to kimberlite pipes and fissure mines, alluvial diamond deposits, old tailings dumps and historical places of interest in and around Kimberley.

11th India International Gold Convention 2014
12–14 September 2014
Pune, India
www.goldconvention.in/programmee.html

Manufacturing Jewelers' and Silversmiths' Association Jeweler's Bench Conference & Trade Fair
13–14 September 2014
Warwick, Rhode Island, USA
www.mjsa.org/events_and_programs/jewelers_bench_conference_and_trade_fair/2014_conference_sessions

Institute of Registered Valuers Loughborough Conference
13–15 September 2014
Loughborough
www.jewelleryvaluers.org/Loughborough-Conference

77th Annual International Appraisers Conference (IAC'14)
14–17 September 2014
Savannah, Georgia, USA
www.appraisers.org/Education/conferences/ASA-Conference

Asian Jewelry & Related Arts
20 September 2014
Rubin Museum of Art, New York, New York, USA
www.rubinmuseum.org/asianjewelry
www.jewelryconference.com

World of Gems IV
20–21 September 2014
Rosemont, Illinois, USA
http://gemguide.com/events/world-of-gems-conference

National Association of Jewelry Appraisers 42nd ACE-It Mid-Year Conference
22–23 September 2014
Rosemont, Illinois, USA
www.najaappraisers.com/html/conferences.html

Goldsmiths' Fair
22 September–5 October 2014
London
www.goldsmithsfair.co.uk/events

30th International Conference on Ore Potential of Alkaline, Kimberlite and Carbonatite Magmatism
29 September–2 October 2014
Antalya, Turkey
http://alkaline2014.com

Portland Jewelry Symposium
6 October 2014
Portland, Oregon, USA
www.portlandjewelrysymposium.com

Geological Society of America Annual Meeting
19–22 October 2014
Vancouver, British Columbia, Canada
http://community.geosociety.org/gsa2014
Sessions of interest:
- Gemological Research in the 21st Century
- Pegmatites I Have Known and Loved

Gem-A Conference 2014
1–2 November 2014
London
www.gem-a.com/news--events/gem-a-conference-2014.aspx

GIT 2014: The 4th International Gem and Jewelry Conference
8–9 December 2014
Bangkok, Thailand
www.git2014.com

Jaipur Jewellery Show
20–23 December 2014
Jaipur, India
www.jaipurjewelleryshow.org/Seminars.aspx

Antwerp Diamond Trade Fair
25–27 January 2015
Antwerp, Belgium
www.antwerpdiamondfair.com/EN/the-adtfnews.html

International Diamond School: The Nature of Diamonds and their Use in Earth's Study
27–31 January 2015
Bressanone-Brixen, Italy
www.indimedea.eu/diamond_school_2015.htm

The Original Miami Beach Antique Jewelry Series 2015
28–29 January 2015
Miami Beach, Florida, USA
www.originalmiamibeachantiqueshow.com/TheShow/JewelrySeries.aspx

Association for the Study of Jewelry and Related Arts 10th Annual Conference
2–3 May 2015
Chicago, Illinois, USA
www.asjra.net/event.html

Society of North American Goldsmiths' 44th Annual Conference
20–23 May 2015
Boston, Massachusetts, USA
www.snagmetalsmith.org/conferences/impact-looking-back-forging-forward

9th International Conference on New Diamond and Nano Carbons
24–28 May 2015
Shizuoka, Japan
www.ndnc2015.org

EXHIBITS

Asia

A Little Clay on the Skin: New Ceramic Jewellery
Until 9 November 2014
World Jewelry Museum, Seoul, South Korea
www.wjmuseum.com/eng/e_exhibition.html

Europe

All that Glisters: 18th Century Steel Jewellery
Until 10 August 2014
Bantock House Museum, Wolverhampton
www.wolverhamptonart.org.uk/events/all-that-glisters

Staffordshire Hoard
Until 24 August 2014
Birmingham Museum, Birmingham
www.bmag.org.uk/events?id=1997

Splendours of the East: Ancient Golden Jewellery from Goa
Until 7 September 2014
Museu Nacional de Arte Antiga, Lisbon, Portugal
www.museudearteantiga.pt/pt-PT/destaques/ContentDetail.aspx?id=662

From the Coolest Corner: Nordic Jewellery
Until 21 September 2014
Röhsska Museum, Gothenburg, Sweden
www.coolestcorner.no

Gemmes, une Brillante Histoire
Until 5 October 2014
Musée de Saint-Antoine-l'Abbaye, France
www.musee-saint-antoine.fr/825-expositions.htm

Jewellery by Winfried Kruger
Until 19 October 2014
Schmuckmuseum, Pforzheim, Germany
www.schmuckmuseum.de

Kevin Coates: A Bestiary of Jewels
20 August–19 October 2014
The Harley Gallery, Welbeck, Worksop, Nottinghamshire
www.harleygallery.co.uk/exhibition/bestiary-jewels

Shine 2014 – Young Emerging Design Talent
12 September–24 November 2014
The Goldsmiths' Centre, London
www.goldsmiths-centre.org/whats-on/exhibitions/shine-2014-young-emerging-design-talent

Treasures of the Middle Ages: Archaeological Finds from Poland
20 September 2014–15 March 2015
Museen Stade, Poland
www.museen-stade.de/schwedenspeicher/vorschau-ausstellungen

Splendor et Gloria. Cinco Joias Setecentistas de Exceção
24 September 2014–4 January 2015
Museu Nacional de Arte Antiga, Lisbon, Portugal
http://www.museudearteantiga.pt/Data/Documents/2014/Comunicado_SplendorGloria.pdf

L'Oro nei Secoli dalla Collezione Castellani
Until 2 November 2014
Basilica di San Francesco, Arezzo, Italy
www.museistataliarezzo.it/mostre-eventi

"Iron Urge". Jewellery and Objects Made Out of Iron
Until 11 May 2015
The Estonian Museum of Applied Art and Design, Tallinn, Estonia
www.etdm.ee/en/exhibitions

An Adaptable Trade: The Jewellery Quarter at War
Until 27 June 2015
Museum of the Jewellery Quarter, Birmingham
www.bmag.org.uk/events?id=3307

North America

100 Rings: Contemporary Studio Jewelry of Peter Schmid and Atelier Zobel
14–31 August 2014
Patina Gallery, Santa Fe, New Mexico, USA
www.patina-gallery.com/exhibits/exhibit_sched_14.php

Unique by Design: Contemporary Jewelry in the Donna Schneier Collection
Until 31 August 2014
The Metropolitan Museum of Art, New York, New York, USA
www.metmuseum.org/about-the-museum/press-room/exhibitions/2014/donna-schneier

Protective Ornament: Contemporary Armor to Amulets
Until 7 September 2014
National Ornamental Metal Museum, Memphis, Tennessee, USA
http://craftcouncil.org/event/protective-ornament-contemporary-armor-amulets

Multiple Exposures: Jewelry and Photography
Until 14 September 2014
Museum of Arts & Design, New York, New York, USA
http://madmuseum.org/exhibition/multiple-exposures

Bulgari: 130 Years of Masterpieces
Until 5 October 2014
Houston Museum of Natural Science, Houston, Texas, USA
www.hmns.org/index.php?option=com_content&view=article&id=687&Itemid=722

Fabergé: Jeweller to the Tzars
Until 5 October 2014
Montreal Museum of Fine Arts, Quebec, Canada
http://faberge.mbam.qc.ca

Remarkable Contemporary Jewellery
Until 30 November 2014
Montreal Museum of Fine Arts, Quebec, Canada
http://wsimag.com/fashion/9308-remarkable-contemporary-jewellery

***Gems & Gemology* celebrates 80 years, Featuring the Artistry of Harold and Erica Van Pelt**
Until December 2014
Gemological Institute of America, Carlsbad, California, USA
www.gia.edu/gia-museum-gems-gemology-anniversary

From the Village to Vogue: The Modernist Jewelry of Art Smith
Until 7 December 2014
Dallas Museum of Art, Texas, USA
www.dma.org/art/exhibitions/Art-Smith

Cartier: Marjorie Merriweather Post's Dazzling Gems
Until 31 December 2014
Hillwood Estate, Museum & Gardens, Washington DC, USA
www.hillwoodmuseum.org/whats/exhibitions/cartier-marjorie-merriweather-posts-dazzling-gems

Arts of Islamic Lands: Selections from the al-Sabah Collection, Kuwait
Until 4 January 2015
Museum of Fine Arts, Houston, Texas, USA
www.mfah.org/exhibitions/al-sabah-collection

René Lalique: Enchanted by Glass
Until 4 January 2015
The Corning Museum of Glass, Corning, New York, USA
www.cmog.org/collection/exhibitions/lalique

The Life and Times of Robert Ebendorf, Jeweler and Metalsmith
Until 18 January 2015
Racine Art Museum, Wisconsin, USA
www.ramart.org/content/life-and-times-robert-w-ebendorf-jeweler-and-metalsmith

Hollywood Glamour: Fashion and Jewelry from the Silver Screen
9 September 2014–8 March 2015
Museum of Fine Arts, Boston, Massachusetts, USA
www.mfa.org/exhibitions/hollywood-glamour

Arthur Koby Jewelry: The Creative Eye
Until 5 October 2015
Kent State University Museum, Kent, Ohio, USA
www.kent.edu/museum/exhibits/exhibitdetail.cfm?customel_datapageid_2203427=3506741

Gold and the Gods: Jewels of Ancient Nubia
Until 14 May 2017
Museum of Fine Arts, Boston, Massachusetts, USA
www.mfa.org/exhibitions/gold-and-gods

Gemstone Carvings: Crystals Transformed Through Vision & Skill
On display (closing date to be determined)
Houston Museum of Natural Science, Houston, Texas, USA
www.hmns.org/index.php?option=com_content&view=article&id=481&Itemid=502

Australia and New Zealand

Wunderrūma: New Zealand Jewellery
Until 28 September 2014
The Dowse Art Museum, Lower Hutt, New Zealand
http://dowse.org.nz/exhibitions/detail/wunderruma-schmuck-aus-neuseeland

Afghanistan: Hidden Treasures from the National Museum, Kabul
Until 16 November 2014
Western Australian Museum, Perth, Australia
http://museum.wa.gov.au/museums/perth/afghanistan-hidden-treasures

A Fine Possession: Jewellery and Identity
Opens 20 September 2014 (closing date to be determined)
Powerhouse Museum, Sydney, Australia
www.powerhousemuseum.com/exhibitions/coming.php

OTHER EDUCATIONAL OPPORTUNITIES

The Great Australian Opal Tour
24–30 September 2014
Australia
www.wj.com.au/artman5/publish/article_647.shtml

Montreal School of Gemmology Rough Diamond Grading Course
27 September–4 October 2014 (in French)
4–11 October 2014 (in English)
Montreal, Quebec, Canada
www.ecoledegemmologie.com/en/c/12

Gem-A Workshops
www.gem-a.com/education/workshops.aspx

Understanding Gemstones
28 August and 7 November 2014: London

Understanding Practical Gemmology
29 August 2014: London
14 November 2014: Birmingham

Understanding Diamond Grading
25 September 2014: London
26 November 2014: Birmingham

Understanding Diamond Simulants
26 September 2014: London

Investigating Gemstone Treatments
3 October 2014: London
17 October 2014: Birmingham

Investigating Ruby, Sapphire and Emerald
17 October 2014: London

Gem-A Diamond Grading and Identification Course
10–14 November 2014
London
www.gem-a.com/education/lab-classes-and-workshops/diamond-grading-and-identification.aspx

Gemstone Safari
5–22 January 2015
Tanzania
www.free-form.ch/tanzania/gemstonesafari.html

Montreal School of Gemmology Intensive 6-month FGA Preparatory Course
10 January–25 June 2015 (in French and English)
Montreal, Quebec, Canada
www.ecoledegemmologie.com/en/c/9

Montreal School of Gemmology Gem and Jewellery Appraisal Course
6–29 July 2015 (in English and French)
Montreal, Quebec, Canada
www.ecoledegemmologie.com/en/c/10

New Media

Gemstones of Western Australia

J. Michael Fetherston, Susan M. Stocklmayer and Vernon C. Stocklmayer, 2013. Geological Survey of Western Australia, Mineral Resources Bulletin 25, East Perth, Western Australia, 306 pages, illus., www.dmp.wa.gov.au/GSWApublications, ISBN 978-1741684490. AUS$50 or free PDF version.

Perhaps the best way to illustrate the comprehensive nature of *Gemstones of Western Australia* is to describe how it has been so thoroughly and masterfully compiled. When I interviewed first-author Mike Fetherston about this compilation of all currently known Western Australian gem occurrences, he revealed that, for him, the book was a labour of love. It was a work over two years in the making, with the onerous and time-consuming task of compiling and verifying the accuracy of historically reported gem and mineral localities. This was achieved through field visits, personal knowledge of the deposits or, in difficult cases, by using high-resolution geo-referenced Landsat image mosaics to locate evidence of past mining activity. For co-authors Susan Stocklmayer and her husband Vernon, the book represents the realization of a dream to bring together, for the first time under one cover, information about Western Australia State's better- and lesser-known gem wealth—to build a compendium of information that was previously scattered about as specialist articles throughout the geological and gemmological literature. Another significant task the team undertook as part of the project was visiting lapidary clubs and factories around the state to photograph examples of the state's gems and ornamental stones.

The following list of gem materials and precious metals that are covered (listed in order of appearance), each in its own chapter, includes many rare and unusual stones: diamond, beryl group, tourmaline group, tourmalite and warrierite, feldspar group, topaz, minor pegmatite gems (lepidolite, petalite, spodumene, phenakite), quartz group, opal, chalcedony group, fossil wood, pearls, gold and silver, andalusite and chiastolite, chrysoberyl and alexandrite, corundum, copper gemstones (turquoise, malachite, chrysocolla, azurite), diopside, fluorite, garnet group, gaspeite, iron-rich gemstones (hematite, specularite, turgite, pyrite, marcasite, tiger eye, tiger iron), prehnite, rhodonite, variscite, carbonate group, Chinese writing stone, epidote group (epidote, zoisite, clinozoisite, thulite, unakite), grunerite, jade, mookaite, orbicular granite, siliceous decorative stones (aventurine, fuchsite), serpentine and talc, tektites, and decorative stones from the Kununurra region (zebra stone, ribbon stone, okapi stone, primordial stone and astronomite).

Each of these materials is presented in a tried-and-true format, beginning with its physical properties, a description of the material and its workability, its geological setting, plus the location of occurrences, deposits or mines in Western Australia. Useful tables of physical and gemmological properties abound throughout as highlighted boxes, making this book a valuable reference, and all gem localities are shown on geological maps within their relevant chapters. Production data are also given where available. Information is as detailed as historical publications and other sources allow, and a comprehensive bibliography is provided at the end of each chapter. Mines and prospects are also listed in an appendix table together with their map coordinates, which means they can be loaded into a GPS, enabling an enthusiastic fossicker to head directly to the locality (with permission from the owner, as appropriate).

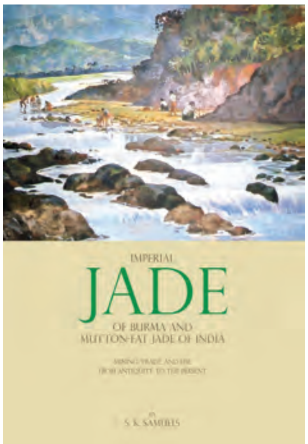
Naturally, diamond is 'first cab off the rank' with quite a high level of detail presented. Today, diamond is the focus of one of Western Australia's major industries, having grown from nothing in the last three decades. This chapter includes general diamond exploration techniques followed by those specifically relating to the discovery of the Western Australian deposits, commencing with the Argyle AK1 lamproite pipe in October 1979. Regional locality maps showing the North Kimberley and Central Western diamond regions, with detailed geological maps of the Argyle AK1, Aries and Ellendale 9 pipes, plus photographs of mine workings, crystals and cut stones, make for a most interesting read. The current status of each pipe is discussed, including its geological setting, exploration results and, where applicable, grade and production data, which also makes the chapter an important compendium for the exploration geologist.

A chapter titled 'Prospecting for Gemstones' covers important matters such as safety and survival in the bush, outback travel, mining rights, and how to access useful state databases of geological maps, exploration reports, mineral deposits and exploration titles. Another chapter, titled 'Aspects of the Gemstone Industry', explains the lapidary and gemmological terminology used in the book.

As an avid gem fossicker, lapidarist, gemmologist and geologist, I find that this book covers all my spheres of interest and, as such, will likely be of interest to all, from amateur hobbyist to professional. Whenever the opportunity presents itself for travel into the Western Australian countryside, for either work or pleasure, this Bulletin will surely be my trusty companion along the way.

Dr Robert R. Coenraads

Imperial Jade of Burma and Mutton-Fat Jade of India



S. K. Samuels, 2014. SKS Enterprises Inc., Tucson, Arizona, USA, 262 pages, illus., hardcover, www.sksent.com/books.htm, ISBN 978-0972532341. US$65.

This book tells the story of Burmese jadeite, using fables and actual history, from ancient times to the present. It also covers the Chinese influence and fascination with jade. This is, of course, a monumental task. The history, mining, cutting and appreciation of jade are as complicated and complex as the histories—both ancient and modern—of Burma and China combined. Samuels also includes various influences from India and the West. Being Burmese himself, Samuels adds a unique local colloquial perspective on the jade trade.

The opening chapters provide an interesting discussion of historic events in both Burma (now Myanmar) and China, combined with various aspects of the Chinese passion for jade. In the context of this discussion, Samuels often jumps to modern information, including 2012 auction results, to emphasize his various points. In a concise and accurate narrative, the many centuries of Chinese and Burmese trade in jadeite are discussed up to the time of British influence (i.e., chapter 8, titled 'The British Arrive'). This is followed by 'The Jade Trade, British Times to Ne Win Era'. A multitude of historical anecdotes, regulations, maps and photographs are included.

The next chapter provides a well-illustrated look at the Ne Win era (1962–1988), when this Burmese politician and military commander broke off most relations with the West, effectively isolating the country. During this time, the Burmese jade and gem auctions came into being to raise foreign currency. The next chapters cover smuggling and dangers of the jade trade. This is followed by descriptions of the area in Kachin State where much of the jadeite is found; Samuels devotes a chapter to a personal trip he took to Myitkyina to visit the jade mines and includes over 20 of his own photos.

The following chapter discusses the difference between jadeite and nephrite. Their complex mineralogies are discussed, but not always well explained. Samuels seems to prefer using *jade* when he's actually referring to *jadeite*. This is likely out of local custom, as one does not often hear the word *jadeite* in Burmese markets.

The following chapters cover jade examination, especially the effect of treatments, followed by the history and techniques of cutting and carving. The last few chapters cover sanctions and the Burmese economy. Curiously, a chapter on maw-sit-sit and another on 'mutton-fat' jade of India are placed in between the above chapters.

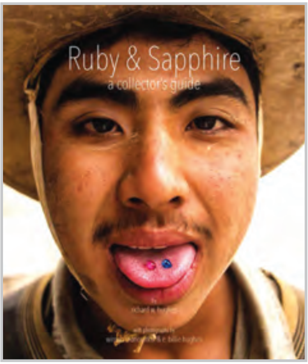
Also included are an appendix on Myanmar gemstone laws and an errata sheet, as well as a folded map of the Lonkin/Hpakan jadeite mining district.

I agree with Samuels' statement that in "America most people cannot distinguish among the various types of Jade....but it is not true in the Orient". Most westerners are quite ignorant of the beauty and rarity of fine jadeite.

Samuels offers a credible, albeit a bit disjointed, examination of Burmese jadeite. With better editing, layout and photographic reproductions, a second edition could be much improved. However, I recommend purchase of this edition for anyone who is curious or serious about jade.

William Larson

Ruby & Sapphire—A Collector's Guide



Richard W. Hughes, 2014. Gem and Jewelry Institute of Thailand, Bangkok, 384 pages, illus., hardcover, www.git.or.th/library_book/Default.aspx, ISBN 978-6169145035. US$99.

Richard Hughes has once again masterfully crafted a tome that will be the ruby and sapphire reference-of-choice for decades to come. Though it follows his original 1997 work titled *Ruby & Sapphire*, this new book is entirely different yet equally enthralling.

Hughes begins with an introduction to what he calls "humanistic gemology", focusing on "the relationship between gems and the people and places from which they come" rather than on just the science of gemmology. He supports this focus throughout the book with fascinating stories and beautiful photographs from his extensive travels to gem sources. In many cases he was accompanied by his wife and daughter who were not only his travel companions, but also contributors in content review and photography. He was also supported in concept, design, and funding by the Gem & Jewelry Institute of Thailand, a non-profit governmental organization with a mandate to serve society as a whole.

The reader is immediately immersed in the rich history of ruby and sapphire with a colourful fresco of a bejewelled maiden from 5th- and 6th-century wall paintings found along the steep mountain paths leading to the ancient Sri Lankan fortress of Sigiriya. Hughes states that it is likely that the first rubies and sapphires traded in early Greco-Roman times came from Sri Lanka. He elucidates that our instinctual and primal attraction to colourful rocks and minerals led to their use as objects of adornment and thus also as items of value. The size-to-value ratio of gems made them the perfect transportable currency for early commerce and trade that often required months or even years of travel. Gems and jewellery are still the most highly sought-after form of transportable wealth that exists today.

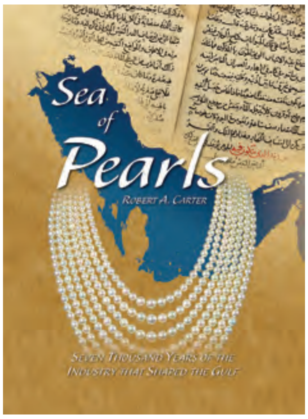
Hughes goes on to dissect the psyche of collecting into two primordial instincts. One is defined by a purely basic emotional connection, and the other supports our need to understand the rational, analytical and clinical attributes of what we are collecting. "At once, it is emotion and erudition. What could be better?" This is why people collect any object they ultimately deem to be worthy of their time and attention. When focusing on gems, it is helpful to have a better understanding of their geographical origin, so as to know the people and the cultures from which they emanate. He then balances that section with an easy-to-understand lesson on how the geological forces of plate tectonics and volcanism created the gems we find in some of the most remote places on the planet. Then he switches back again to an ancient folk tale about the 'Valley of the Serpents' where gems, in a remote mountainous area guarded by poisonous snakes, are picked up by birds. This legend can be heard, in various forms, at almost every major historical gem-mining locality around the globe and even appears in the tale of Sinbad the Sailor in *One Thousand and One Nights*. Hughes beautifully combines lore and emotion with fact and reality. He also explains how gems became associated with supernatural powers and how human fascination and appreciation for gems and jewellery has evolved over the centuries. Throughout the book, the reader is treated to inspiring and informative quotes from famous gem authors, miners, merchants and enthusiasts such as Albert Ramsay, Ambrose Bierce, Otto Ehlers, Sir Henry Yule, Annie Dillard and others. Hughes also delights the reader with his own poetic prose throughout: "In our world, so much that is beautiful is ephemeral. We grow old, our clothes wear out, styles come and go. Gems have both immediate magic and eternal beauty."

The largest portion of the book focuses on the many lands in which ruby and sapphire are found. The first stop on the tour of producing countries is Afghanistan, followed by others ranging from India to Madagascar, Myanmar to Sri Lanka, Laos to Tanzania and many more. Magnificent photos of the people, their homelands and the mining sites accompany each chapter. The featured photos are clearly focused on the people, pleasantly reminding us of their importance in bringing these gifts of nature from the earth for the world to enjoy. Many photos cover a full page and a few landscape shots are given well-deserved two-page spreads. Hughes also gives the geological and social history of each country. Along with their gemstone wealth, homage is duly paid to the ethnic and biological diversity found in each of these amazingly rich lands. Every known ruby and sapphire deposit is covered in exacting detail. In separate sidebars, Hughes shares his own thoughts and experiences at specific deposits he has personally visited. In many of these excerpts he adds delightful stories. One of my favourites is his explanation of how Lake Nyasa in Malawi earned its name through a "glorious linguistic screw-up".

What sets this book apart even more are the two final chapters, which focus on the value of creating a collector's library and compiling a wonderful selection of photographs. The generous bibliography of books that Hughes recommends is an invaluable reference. Photos speak a thousand words, and the 'Portfolio' that follows collects together thumbnail images of many of the photos of gems and jewellery featured throughout the book, providing another valuable resource that is a wonderful parting gift, delighting the senses one last time.

Edward Boehm

Sea of Pearls: Seven Thousand Years of the Industry that Shaped the Gulf



Robert A. Carter, 2012. Arabian Publishing Ltd., London, 364 pages, illus., hardcover, www.oxbowbooks.com/oxbow/sea-of-pearls.html, ISBN 978-0957106000. £95.00.

This beautifully and lavishly illustrated work fills a gap in the gemmological and jewellery literature by detailing the development over the past 7,000 years of one of the largest and most important pearl fishing areas in the world. Covering not only the pearl industry, the book details the development of the Gulf States, and the important role that pearls played in their economic, political and social development through the ages. These progressions are charted from both the Persian and Arabian sides of the Gulf.

Starting in the Neolithic period, Carter shows how pearls have a far longer history in the gem world than most people realize. For example, he describes the discovery of two drilled pearls in a burial cairn at As-Sabiyah, in modern-day Kuwait, a site that has been dated to between the 3rd and 4th millennium BC, potentially demonstrating that pearls are one of the earliest gem materials. From this ancient starting point, Carter takes the reader through to modern times using stories and factual documents to immerse the reader in a "sea of pearls".

Subsequent chapters work through the early times of Islamic development (up to 1330), then into the Portuguese influences that were felt up to around 1650. After that date, Carter charts the rise of the modern Arab powers, and how "pearls were part of a universal language of luxury and diplomacy", playing a significant role in the interactions between the various ruling powers, conquerors and other political entities. These chapters also cover some of the great pearls from history, including such examples as the Durr Yatimah, a 10th-century pearl reputed to weigh in excess of 12 g.

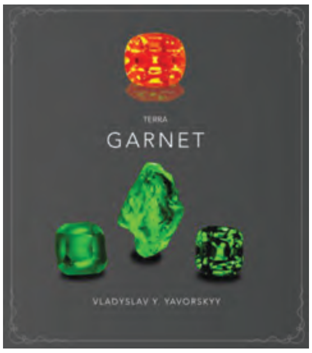
At its height, Carter reports that there were over 300 different pearl fisheries in the Gulf area, centred around the island of Bahrain, and that this area was more productive than all the seas of India and Yemen. As with all industries and markets, there are times of boom and recession, and the pearl trade in the Gulf was no exception. In the period leading up to 1912, the Gulf region supplied between 65% and 80% of the world's pearls and, in most cases, the surrounding economies were built entirely on pearl markets and trading. This continued until the start of World War I, when the market fell from a record high to an all-time low within 12 months, closely followed by a subsequent, but smaller crash in 1921. The end of Gulf control over the market came, as detailed by Carter, in 1924 with the introduction of cultured pearls. It is with this, and the subsequent recovery of Gulf pearls into a position of importance (albeit not at the previous level), that Carter ends the book.

Beyond the main body of the book, Carter also provides two interesting appendices. The first covers the technical side of the industry, defining over 50 terms relating to pearls and pearl production—and a further 80 different designations of pearl types—showing how widespread and influential the pearl trade has become over the centuries. The second appendix charts annual pearl production in the Gulf from 1602 to 1943, giving the valuation in rupees for the various areas, allowing the reader to build a picture of the development of the industry in the region.

In summary, this book provides a valuable reference to one of the most historically important and interesting areas of pearl fishing in the world.

Andrew S. Fellows

Terra Garnet



Vladyslav Yavorskyy, 2014. Self-published by Vladyslav Yavorskyy, 201 pages, illus., hardcover, www.garnetbook.com, ISBN 978-0615925332. US$100.

This is another great collaboration between Vladyslav Yavorskyy and Richard W. Hughes, and just like the book *Terra Spinel – Terra Firma*, it does not disappoint. It is written by Hughes and Jonas Hjornered in a captivating style.

The book is about Yavorskyy's enchanting pursuits of tsavorite, malaia, rhodolite, mandarin, demantoid and colour-change garnet, and is illustrated with wonderful photographs. Yavorskyy starts by telling the enticing story of how he fell in love with garnets on his first trip to Tanzania over 20 years ago. Tanzania is where he purchased his first vibrant malaia and tsavorite crystals, which left him and others spellbound. Malaia garnet comes from the Umba Valley, and was found by 'accident' in the mid-1960s when miners were looking for sapphires. When they discovered that these stones were not sapphire, they were cast out (malaia is the Swahili word for 'outcast'). Yavorskyy speaks enthusiastically of Tanzania's garnet wealth, as well as its wildlife and other gem deposits, allowing the reader to re-live his experiences as if accompanying him on his journeys.

There are also sections describing other countries, including Nigeria, Madagascar, Russia, Namibia, Myanmar and Sri Lanka. Yavorskyy illustrates the cultures and garnets from those countries with vibrant photographs. In many cases, the garnets are depicted in their rough, pre-formed and fully-faceted states.

This photographic odyssey is a book for anyone who is enthusiastic about gems and the countries where they are found.

Mia Dixon

Dallas Mineral Collecting Symposium 2013 DVD

BlueCap Productions, Honolulu, Hawaii, www.bluecapproductions.com, 3-DVD set, 307 minutes, NTSC format. US$19.99.

Rob Lavinsky of the mineral dealership The Arkenstone once again hosted the Dallas Mineral Collecting Symposium, held 23–24 August 2013, in Dallas, Texas, USA. An experienced line-up of eight speakers covered a wide range of topics, from mineral dealer Brice Gobin enthusiastically recounting a rather dangerous expedition to the Democratic Republic of Congo, to MinDat.org founder Jolyon Ralph discussing one the world's largest online mineral databases, to Dr Robert Downs of the University of Arizona describing geological analysis by the Mars rover *Curiosity*.

There were three presentations with a greater focus on gemmological topics. Daniel Trinchillo, principal of Fine Minerals International, Edison, New Jersey, USA, has been a co-owner of the Pederneira tourmaline mine in Minas Gerais, Brazil, for the past 14 years. Trinchillo's team has invested fresh capital and ideas into this mine, which has been worked since the 1940s, and was rewarded with a number of incredible tourmaline-bearing pockets. The mine is famous for its elongate, multi-coloured, pencil-like tourmalines, and the team took painstaking steps to reassemble many of the crystals that had been broken over geologic time or by mining processes. The resulting matrix specimens are stunning. Although discoveries have recently dwindled, Trinchillo is revaluating the mine's complicated pegmatite geology with the assistance of Dr Federico Pezzotta of the Natural History Museum of Milan, Italy, and is optimistic about its future.

The first trips by a 'westerner' to visit the former Soviet Union's vast gem wealth provided rewarding and frightening experiences, as recounted by Peter Lyckberg, Luxembourg. Much like Gobin's Congo talk, Lyckberg relates just how dangerous the gem and mineral business can be in the field. Excursions starting the mid-1980s took him to the beryl and topaz mines near Volodarsk, Ukraine, and the emerald and alexandrite mines in the Ural Mountains, among other localities. Lyckberg's slides and knowledge of these localities are unparalleled for this time period.

William Larson of Palagems.com, Fallbrook, California, USA, reminisced about his long association (including ownership) with the Himalaya tourmaline mine in San Diego County, California. Although much less structured than the other talks at the Symposium, Larson's unequalled experience in the field combined with his clear passion for the topic made for a fun trip down memory lane.

All the speakers are well-known in the mineral collecting community, and many jokes and side-bar comments would be best appreciated by viewers who are also involved in this area. Examples include Larson's aforementioned talk, Dave Wilber's personal recount of his 60 years of mineral collecting and especially Gene Meieran's review of Wayne Thompson's *Ikons* book on exceptional contemporary mineral specimens.

Overall this DVD set includes an entertaining and informative international line-up of speakers from the mineral collecting business. The audio/video quality and editing are very good, and I recommend this DVD set to anyone with an interest in gem and mineral collecting.

Keith Mychaluk

OTHER BOOK TITLES

Coloured Stones

Agates
By Johann Zenz, 2014. Bode Verlag GmbH, Salzhemmendorf-Lauenstein, Germany, 656 pages, ISBN 978-3925094842. €89.

Exquisite Agates
By Dietrich Mayer, 2013. Bode Verlag GmbH, Salzhemmendorf-Lauenstein, Germany, 424 pages (in German and English). €58.

Diamond

Diamonds
By Ian Smillie, 2014. Polity, Cambridge, 204 pages, ISBN 978-0745672304. £12.99 softcover or Kindle edition, or £40.00 hardcover.

Clarity, Cut, and Culture: The Many Meanings of Diamonds
By Susan Falls, 2014. NYU Press, New York, New York, USA, 224 pages, ISBN 978-1479810666. US$20.40 Kindle edition, $24.00 softcover or $75.00 hardcover.

***Proceedings of 10th International Kimberlite Conference*, Vol. 1**
Ed. by D. Graham Pearson, Herman S. Grütter, Jeff W. Harris, Bruce A. Kjarsgaard, Hugh O'Brien, N.V. Chalapathi Rao and Steven Sparks, 2013. Special issue of the *Journal of the Geological Society of India*, Springer, New Delhi, India, 350 pages, ISBN 978-8132211693. US$199.00 eBook or $259.00 hardcover.

***Proceedings of 10th International Kimberlite Conference*, Vol. 2**
Ed. by D. Graham Pearson, Herman S. Grütter, Jeff W. Harris, Bruce A. Kjarsgaard, Hugh O'Brien, N.V. Chalapathi Rao and Steven Sparks, 2013. Special issue of the *Journal of the Geological Society of India*, Springer, New Delhi, India, 296 pages, ISBN 978-8132211723. US$199.00 eBook or $259.00 hardcover.

Gem Localities

***Apatite—The Great Pretender* (MINERAL Monograph No. 17)**
Ed. by John Rakovan, Gloria A. Staebler, Donald A. Dallaire and David W. Bunk, 2013. Lithographie Ltd., Denver, Colorado, USA, 128 pages, ISBN 978-0983632337. US$35.00 softcover.

The Collector's Guide to the Minerals of New York State
By Steven C. Chamberlain and George W. Robinson, 2013. Schiffer Publishing Ltd., Atglen, Pennsylvania, USA, 96 pp., ISBN 978-0764343346. US$19.99 softcover.

Crystalline Treasures—The Mineral Heritage of China
By Guanghua Liu, Robert M. Lavinsky, Eugene S. Meieran, Harrison H. Schmitt, Thomas P. Moore and Wendell E. Wilson, 2013. The Mineralogical Record Inc., Tucson, Arizona, USA, 104 pages. Free eBook at www.chinacrystallinetreasures.com/companion-book or US$20.00 softcover.

Finding Gems and Gold in North Carolina
By D.L. Polat, 2014. Self-published, 13 pages, ASIN B00K9WZZB. US$0.99 Kindle edition.

***Gem Mining: Forefront Collections* [Myanmar]**
By John Aungkyi Young, 2013. CLF Publishing, 152 pages, ISBN 978-0989940832. US$12.00 softcover.

***Nevada—Jackpot!* (MINERAL Monograph No. 18)**
Ed. by Janet H. Clifford, Robert B. Cook, Gloria A. Staebler and David W. Bunk, 2013. Lithographie Ltd., Denver, Colorado, USA, 128 pages, ISBN 978-0983632344. US$35.00 softcover.

Utah's Gems
By Richard J. Dalrymple, 2014. CreateSpace Independent Publishing Platform, 332 pages, ISBN 978-1496171429. US$55.00 softcover.

Compiled by Brendan Laurs and Diane Flora

Rockhounding Pennsylvania and New Jersey
By Robert Beard, 2013. FalconGuides, Guilford, Connecticut, USA, 288 pages, ISBN 978-0762780938. US$16.95 softcover.

General Reference

***Exotic Gems,* Vol. 3**
By Renee Newman, 2014. International Jewelry Publications, Los Angeles, California, USA, 136 pages, ISBN 978-0929975481. US$19.95 softcover. (Reviewed in May 2014 *Gems & Jewellery.*)

Gemstones and Jewelry
By Alan Beggerow, 2014. Self-published, 63 pages, ASIN B00I8HE7AQ. US$1.99 Kindle edition.

***The Handbook of Gemmology,* 2nd Edition**
By Geoffrey Dominy, 2014. Amazonas Gem Publications, Canada, 860 pages, ISBN 978-0991888214. US$39.95 for single-format download or $49.95 for multiple formats.

How to Buy Gemstones and Gemstone Jewelry @ Lowest Possible Price!
By Donald DiCaprio, 2014. PMS Publishing Co., 112 pages, ASIN B00KE8R9OS. US$4.29 Kindle edition.

Nature Guide: Gems
By Ronald Louis Bonewitz, 2013. DK Publishing, New York, USA, 224 pages, ISBN 978-1465402189. US$14.95 softcover.

Jewellery and Objet d'Art

Fred Harvey Jewelry: 1900–1955
By Dennis June, 2013. Schiffer Publishing Ltd., Atglen, Pennsylvania, USA, 176 pages, ISBN 978-0764344480. US$39.99 hardcover.

Going for Gold: Craftsmanship and Collecting of Gold Boxes
By Tessa Murdoch and Heike Zech, 2014. Sussex Academic Press, East Sussex, 256 pages, ISBN 978-1845194659. £50.00 hardcover.

Jewellery Design and Development: From Concept to Object
By Norman Cherry, 2013. A&C Black Visual Arts, London, 144 pages, ISBN 978-1408124970. £24 softcover.

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