09 GEMOLOGICAL Abstracts

COLORED STONES AND ORGANIC MATERIALS

Einige Gedanken zu Jadeit-Jade [Some thoughts about jadeite-jade]. H. A. Hänni [h.a.haenni@freesurf.ch], *Gemmologie: Zeitschrift der Deutschen Gemmologischen Gesellschaft*, Vol. 57, No. 1–2, 2008, pp. 5–12 [in German].

This article addresses three issues: Why is jadeite not transparent? Why is most jadeite green? Why is the chemical composition not always constant? The answer to the first question is the polycrystalline structure of jadeite: Light is scattered at the grain boundaries. The transparency of the stone is essentially influenced by the size and homogeneity of the grains, and can be clearly enhanced by filling of the pores. The answer to the other two questions can be found in the fact that jadeite, $NaAlSi_2O_6$, forms a solid-solution series with kosmochlor, $NaCrSi_2O_6$. Isomorphic replacement of Al by Cr in jadeite correlates with increasing green color. Jadeite also forms a solution series with omphacite, a Ca- and Fe-bearing clinopyroxene. Variations in jadeite composition are due to isomorphic replacement by kosmochlor and omphacite components. A new standard introduced in Hong Kong allows for small amounts of these impurities in jadeite, as long as a specific gravity of 3.4 and a refractive index of 1.688 are not exceeded. This type of jadeite is called *Fei Cui* in China. *RT*

The geochemistry of gem opals as evidence of their origin. E. Gaillou [eloise.gaillou@cnrs-imn.fr], A. Delaunay, B. Rondeau, M. Bouhnik-le-Coz, E. Fritsch, G. Cornen, and C. Monnier, *Ore Geology Reviews*, Vol. 34, 2008, pp. 113–126.

The authors provide evidence that the geologic and geo-

This section is designed to provide as complete a record as practical of the recent literature on gems and gemology. Articles are selected for abstracting solely at the discretion of the section editors and their abstractors, and space limitations may require that we include only those articles that we feel will be of greatest interest to our readership.

Requests for reprints of articles abstracted must be addressed to the author or publisher of the original material.

The abstractor of each article is identified by his or her initials at the end of each abstract. Guest abstractors are identified by their full names. Opinions expressed in an abstract belong to the abstractor and in no way reflect the position of Gems & Gemology *or GIA.*

graphic origin of opals can be deduced from the concentrations of the main impurities (defined as >500 ppm) and trace elements (<500 ppm) they contain. Based on a study of 77 gem-quality opals and 10 host rocks from 10 countries, they concluded that the chemical composition of an opal is genetically linked to that of its host rock. This conclusion appears to hold true for both forms of play-of-color opal (amorphous opal-A and poorly crystalline opal-CT), regardless of the amount of weathering the host rock has endured. The Ba and rare-earth element (REE) concentrations of the gem opals and their host rocks were nearly identical, suggesting that the opals were derived from fluids that circulated through those same rocks. Opals from sedimentary environments were shown to have relatively high Ba concentrations (118–300 ppm) and "typical" REE patterns (depletion from light REE to heavy REE, without any noticeable Eu or Ce anomalies). Opals with volcanic origins had lower Ba concentrations (<110 ppm) and typical REE patterns, along with a negative anomaly for Eu and, depending on oxidation conditions, a positive or negative anomaly for Ce. Geochemical data for Mexican opals from volcanic host rocks and Australian opals from sedimentary sources are used to illustrate these relationships.

While there are sufficient differences in geochemical signatures to determine opal provenance at the regional scale, identifying more specific geographic sources (such as mines) within the same geologic setting requires further study. With additional geochemical data on more samples, along with other observations such as inclusion analysis, the approach described here could be developed into a method for fingerprinting the provenance of play-of-color opals. Other observations linked a high iron concentration (>1000 ppm) to suppressed luminescence and darker colors (from yellow to brown) in opal. Green luminescence in opal is associated with minute amounts of uranium (<1 ppm).

KAM

Identification visuelle des différents ivoires [Visual identification of different types of ivory]. I. Reyjal, *Revue de Gemmologie*, No. 164, June 2008, pp. 22–27 [in French].

Ivory is defined as material originating from the dentition of one of seven animal species: elephant, mammoth, warthog, hippopotamus, walrus, sperm whale, and narwhal. The visual characteristics of ivory from each of these sources are described, including size, color, polish, growth patterns and lines, and Schreger angles (the angles between the cross-hatched lines seen in cross section). These characteristics help identify ivory and distinguish its origin. Two frequent ivory substitutes are also described: the endosperms of tagua palm trees (vegetable or palm ivory) and the casques of helmeted hornbill birds (hornbill ivory). *RT*

Inside rubies. C. P. Smith, C. R. Beesley, E. Q. Darenius, and W. M. Mayerson, *Rapaport Diamond Report*, Vol. 37, No. 47, 2008, pp. 140–148.

Fine-quality Burmese rubies set the standard by which rubies from other parts of the world are judged. However, Burmese rubies recently became a subject of U.S. legislation—the Tom Lantos Block Burmese JADE (Junta's Anti-Democratic Efforts) Act of 2008.

Dealers prohibited from supplying Burmese rubies to the U.S. market are looking for alternate ruby sources, and the authors indicate there are about 20 other countries. These deposits are concentrated in two regions where major orogenic episodes have occurred. One of these events produced the Himalayas and several associated mountain chains ~55 million years ago (Ma); this ruby-bearing region extends from Afghanistan, Pakistan, and Tajikistan, into Nepal and east to Myanmar and Vietnam. The other event, the Pan-African Orogeny (800–450 Ma), is responsible for ruby deposits in southern India, Sri Lanka, Madagascar, and East Africa. Rubies that formed during orogenic episodes are typically related to metamorphic growth conditions, with the finest-quality stones hosted by marbles. However, some deposits have a magmatic origin; that is, the rubies formed in the mantle and then were transported to the surface during eruptive events.

One of the authors (CPS) devised a ruby classification scheme to differentiate rubies' geologic origins—metamorphic or magmatic—based on their gemological features. The latter pages of the article illustrate this scheme, with photomicrographs of (1) internal features that differentiate stones from various localities and (2) the principal treatments used on rubies. *AB*

Weight of production of emeralds, rubies, sapphires, and tanzanite from 1995 through 2005. T. R. Yager, W. D. Menzie, and D. W. Olson, *U.S. Geological Survey Open-File Report 2008-1013,* 2008, 9 pp., http://pubs.usgs.gov/of/2008/1013.

Estimating colored stone production is inherently difficult due to the nature of the industry (e.g., lack of government oversight or reporting, significant variations in the quality of rough, and countless small-scale mining operations). These factors also undermine effective regulation, and colored stones—like diamonds—have the potential to fund armed conflict and illegal activities. This paper marks the first attempt by the U.S. Geological Survey (USGS) to establish global production statistics by country for emerald, ruby, sapphire, and tanzanite. A table for each gem shows the inferred production of rough (in kilograms) from 1995 through 2005. The study estimates the carat weight of imports to the U.S. from the top five countries of origin. It also discusses various influences on gem production, such as new and declining gem sources, mining operations and technology, and other market factors such as enhancement processes and political pressures. The authors' sources include annual USGS Mineral Questionnaires returned from producing countries, export data, company reports, and the trade literature. The paper acknowledges that the monetary value of production is even more difficult to estimate because of complex and rapidly changing market variables. Nevertheless, the authors provide for each gem variety: (1) the systems used to value them, (2) the average per-carat values for rough, and (3) the highly variable price ranges for cut goods. *ERB*

DIAMONDS

A colourless natural diamond showing strong orange and mixed coloured fluorescence images. T. Lu, T. Odaki, K. Yasunaga, and H. Uesugi [info@agt.jp], *Australian Gemmologist*, Vol. 23, No. 4, 2008, pp. 337–340.

A 0.31 ct type Ia colorless brilliant-cut diamond was characterized by standard gemological testing, fluorescence imaging, and UV-Vis-NIR, IR, Raman, and photoluminescence (PL) spectroscopy. The sample displayed strong orange fluorescence to long-wave UV radiation, and it showed mixed-color fluorescence when exposed to the ultra-short-wave radiation of the DiamondView. The UV-Vis-NIR absorption spectrum and PL emissions revealed a weak band at 480 nm and a distinct Ni-related doublet in the PL spectrum at 883 and 885 nm. The authors suggest that for this diamond, which did not have the defects that typically produce the 480 nm band, Ni might be a component in the 480 nm band defect and might also play a role in the orange long-wave fluorescence. *RAH*

The iciest ice. M. Kerawala, *CIM Magazine*, Vol. 3, No. 7, 2008, pp. 70–73.

Canada's Diavik diamond mine (operated by a Rio Tinto subsidiary as a joint venture with Harry Winston Diamond Corp.) is undergoing a $700 million expansion to extend its life to 2020 or beyond. This article offers a glimpse of the mine's history and its plans for the decade ahead.

The Diavik mine is located on East Island in the Northwest Territories. The site's entire infrastructure—including an airstrip, housing, and amenities for workers—had to be built from scratch, starting in 2001. While air travel is used year-round, heavier loads can only be delivered during a two-month span when the winter road is open for truckers. This road services three diamond mines and various exploration projects in the region; over 85% of it traverses lake ice and must be constantly monitored. It takes approximately 15 hours to reach Diavik from Tibbitt (a 373 km trip). Shipments must be carefully planned in advance to ensure that all the year's supplies are delivered during those two months.

Safety and environmental savvy are critical to management of the Diavik mine. To help support the community, two-thirds of Diavik employees are local residents, with half of that group being aboriginals. Due to safety concerns in the frigid temperatures, workers are not required to perform any task they deem to be unsafe. Diavik recycles heat from its power plants for use in its shop, processing plants, and housing.

Diavik has already started augmenting the existing infrastructure to support the transition to underground production, which is expected to be completed by 2012. Further development will also take place at an adjacent pipe, where open-pit mining is just beginning and production is expected in late 2009. Diavik plans to continue drilling at a nearby site to better define an unmined pipe. The company also budgeted $10 million in 2008 for an aggressive exploration program on its claim block around the mine site. *Joshua Sheby*

A Northern Star: Canada's first diamond mine celebrates a milestone. D. Zlotnikov, *CIM Magazine*, Vol. 3, No. 7, 2008, pp. 40–43.

In late 2008, the Ekati mine in Canada's Northwest Territories (NWT) celebrated its 10th anniversary of operation. Under its current plan, the mine can remain active until 2020. However, this could be extended to 2040 as long as operating costs are low enough ($50/tonne ore) to exploit less-accessible diamond-bearing pipes. The key to this is maintaining current efficiencies while developing additional cost-saving steps with minimal impact on the environment. Ekati runs entirely on diesel power, though wind and hydropower are being investigated as energy alternatives. To reduce fuel consumption and greenhouse gas emissions, Ekati has implemented several measures, such as installing motion-sensing light switches in offices, recycling waste heat from generators, and minimizing the idling time of vehicles.

To ensure that northern residents benefit from the diamond wealth being extracted, Ekati has four Impact Benefit Agreements with aboriginal landowners and a Socio-Economic Agreement with the Northwest Territories government. Although Ekati is only contractually obligated to spend 70% of its money within the NWT, it consistently exceeds that amount (e.g., 81% in 2007). In fact, diamond mining and processing now account for 40% of the NWT's gross domestic product. Besides spending money within the community, Ekati hires and trains NWT natives (67% of its workforce, 39% of whom are local aboriginals). The mine also encourages local schoolchildren to complete their education by showing them opportunities awaiting them at the mine after they finish school. As a result, more high school students are graduating and actively seeking higher education. In supporting the environment and the community, Ekati has played a significant role in the Northwest Territories.

Joshua Sheby

The origin of cratonic diamonds—Constraints from mineral inclusions. T. Stachel [tstachel@ualberta.ca] and J. W. Harris, *Ore Geology Reviews*, Vol. 34, 2008, pp. 5–32.

Mineral inclusions in diamonds provide unique information on both (1) the physical and chemical environment deep in the earth's mantle, and (2) the conditions under which diamonds form. This article reviews the geologic origin of diamonds formed in the mantle beneath continental cratons on the basis of geochemical data for nearly 5,000 silicate, oxide, and sulfide mineral inclusions. These different kinds of inclusions are conventionally divided into three categories that represent their principal mantle source rocks. Peridotitic inclusions appear to be related to rocks of peridotite composition that originated by melt extraction in Archean equivalents of mid-ocean ridges or similar shallow, low-pressure environments. Eclogitic inclusions broadly reflect more basaltic source compositions, again in shallow environments along subduction zones. Websteritic inclusions are less well defined, but they appear to originate from pyroxenitic source rocks intermediate in composition between peridotite and eclogite. Geothermometry data suggest that diamonds with all three types of inclusions formed and then were kept under similar thermal conditions in the mantle. Depths of formation are believed to have been <200 km, with the diamonds precipitating from upward-percolating carbonate-bearing melts/fluids. *JES*

GEM LOCALITIES

Ambre mésoaméricain [Mesoamerican amber]. G. L. Cattaneo [ambar@ambarweb.it], *Revue de Gemmologie*, No. 165, 2008, pp. 9–16 [in French].

This article reports on Mesoamerican amber from the Dominican Republic and central Chiapas, Mexico. Dominican and Mexican ambers come from related leguminous *Hymenaea* trees. The estimated ages of these ambers vary from 20 to 17 Ma (Miocene) and 30 to 20 Ma (Oligocene to Miocene) for Dominican amber, and 26 to 22 Ma (Oligocene to Miocene) for Mexican amber. Mesoamerican amber contains no succinic acid and is therefore classified as retinite. Mesoamerican ambers come in many natural colors, mainly different shades of yellow but also some rarer orange-"cognac," "cognac," and "cherry"-red hues. Most Mesoamerican amber has a high degree of transparency and, unlike Baltic amber, does not need to be clarified. However, the presence of organic (and rarely inorganic) inclusions may result in low-quality brownish yellow to brown to blackish brown specimens. Dominican and Mexican ambers can have a beautiful green-blue or blue-violet-green fluorescence, best seen with reflected light (especially sunlight). Rare "blue" amber is mined only at La Cumbre in the Dominican Republic, where the average annual yield does not exceed 25 kg. Its intense fluorescence in reflected light suggests the presence of perylene hydrocarbons.

Since 1996, a rare variety of red amber has been mined almost exclusively in Chiapas, and 2007 production was estimated at no more than 10 kg. The red color is due to an external oxidation layer caused by contamination from percolated water saturated with iron compounds. Some rare green amber from Chiapas (<0.6 kg mined annually) is said to be colored by the effects of colloidal dispersion of organic particles present in the "amber macromolecule."

The majority of Dominican amber is mined from secondary deposits and occurs in layers of lignite or carbonaceous clay interspersed with beds of sandstone. Mexican amber comes from primary deposits and occurs in lenses of lignite interspersed with carbonaceous layers.

FP

Color-change apatite from Kazakhstan. A. A. Zharinov, V. V. Ponomarenko [mineralvvp@yandex.ru], and I. V. Pekov, *Rocks & Minerals*, Vol. 83, No. 2, 2008, pp. 148–151.

Large crystals of apatite exhibiting a distinct color change have been produced from the Akzhailyau Mountains of Kazakhstan. The area is located in the Semipalatinsk region in the eastern part of the country near the border with China. These mountains consist of three parallel ridges that attain a maximum elevation of ~1500 m. The apatite is found in quartz-feldspar pegmatite bodies that are associated with granites comprising a large exposed pluton. Pegmatites were first found in the area in the mid-1940s, and some 200 sizeable bodies have produced large crystal-filled pockets containing quartz, feldspar, micas, apatite, and several rare minerals. One large pegmatite pocket measured about 4 × 4 × 4 m in volume. The prismatic apatite crystals measure up to 6 cm long, and vary from translucent to transparent. They appear yellowish brown in daylight, pink under incandescent light, and greenish yellow in fluorescent light. Possible inclusion minerals in the apatite are monazite, albite (cleavelandite), muscovite, and dark smoky quartz. Electron microprobe analysis revealed the presence of various rare-earth elements (Ce, Nd, La, Sm, and Pr) in the apatite, which may account for the color-change behavior. Stones up to 15 ct have been faceted from this material. *JES*

Opali di fuoco del Brasile [Fire opals from Brazil]. F. Caucia, C. Ghisoli, and V. Bordoni, *Rivista Gemmologica Italiana*, Vol. 3, No. 3, 2008, pp. 179–188 [in Italian].

While most fire opals come from the well-known Mexican deposits, they are also mined from a number of smaller deposits in Oregon (Opal Butte), Indonesia, and Ethiopia. In the 1970s, fire opals were discovered in Brazil: near Campos Grande (in Rio Grande do Sul State), São Geraldo do Araguaia (Pará State), and Castelo do Piauí (Piauí State). The authors studied a number of yellow-to-red fire opals from Brazil by standard gemological techniques, powder X-ray diffraction, scanning electron microscopy, and LA-ICP-MS, and the results were compared with data for fire opals from other sources. Measurements of SG and RI alone were not diagnostic of origin, and Fe was confirmed as the cause of the orange bodycolor. *RT*

Ornamental variscite: A new gemstone resource from Western Australia. M. Willing [margotwilling@iinet.net.au], S. Stöcklmayer, and M. Wells, *Journal of Gemmology*, Vol. 31, No. 3/4, 2008, pp. 111–124.

This article provides an in-depth characterization of variscite from Woodlands Station, Western Australia, including its geologic occurrence and mineralogical associations. Data obtained from standard gemological testing and petrographic thin section analysis, as well as SEM-EDS, XRD, EDXRF, and Vis-NIR reflectance spectroscopy, are summarized in numerous figures and tables.

The authors include an overview of variscite occurrences and mining worldwide, which is supplemented by a detailed look at archeological finds from the Neolithic period and the Roman Empire (when it was often referred to as *callais* or *callainite*). Despite the long history of variscite mining, there are few sources of ornamental-quality material, and most of the goods on the market come from stockpiled rough mined in Nevada or Utah. The Woodlands Station deposit represents an important new source of variscite, and its distinctive textural characteristics yield attractive *objets d'art*.

The variscite is hosted in siltstone and occurs in two textures: fibrous and equigranular. Color photos illustrate the wide range of its appearance. Reflectance spectroscopy indicates that while Cr^{3+} is the main chromophore, variscite can also incorporate vanadium in several oxidation states. X-ray diffraction analysis confirms it to be "Meßbach-type" in association with metavariscite, a dimorph of variscite. Inclusions of elemental gold form a rare feature: discrete platelets or granules that are easily visible in dark green variscite. Matrix material was shown to consist of iron oxides, quartz, crandallite, and alunite. *ES*

The Woodlands variscite–gold occurrence in the north Gascoyne region of Western Australia. E. H. Nickel, R. M. Hough, M. R. Verrall, E. Hancock, A. M. Thorne, and D. Vaughan, *Australian Journal of Mineralogy*, Vol. 14, No. 1, 2008, pp. 27–36.

The Woodlands variscite occurrence, near Mt. Egerton, is located in an area of phosphate mineralization within a zone ~0.5 m thick that can be traced for at least 1 km; it consists of several thin seams 10–50 mm thick. Viewed in hand specimen, the variscite is typically bluish green with irregular yellowish brown patches consisting mostly of crandallite, making it attractive gemological material. The color of the variscite varies from white to dark bluish green and appears to depend on grain size. EDXRF and SEM-EDS analyses of the variscite show an appreciable but variable Si content, 1–3 wt.% Fe, up to 0.2 wt.% Cr, and up to 0.4 wt.% V. Gold is observable in some of the variscite from the main vein, with an overall content of 17 ppm Au. The paragenesis is also discussed. *RAH*

Winza rubies identified. A. Peretti [adolf@peretti.ch], F. Peretti, A. Kanpraphai, W. P. Bieri, K. Hametner, and D. Günther, *Contributions to Gemology*, No. 7, 2008.

The authors present the results of a characterization study of gem rubies and sapphires from a relatively new locality near the village of Winza in central Tanzania. Since high-quality rubies were accidentally discovered in this remote region in the fall of 2007, artisanal miners have recovered stones at the surface or in vertical shafts from an area covering several square kilometers.

This report begins with a summary of the region's geology. The rubies occur in association with amphibolites as rhombohedra or as tapered prismatic euhedral and subhedral crystals up to several centimeters long in a garnet-pargasite host rock. Weathering of the host rock near the surface distributed loose corundum crystals in the soil. Most are red to purplish red (occasionally violet or blue). In many instances, the corundum displays internal color zones with banded or irregular areas that are blue, pink, or both. Solid inclusions identified include apatite, chlorite, garnet, pargasite, pyrite, spinel, and talc. Whitish particle clouds and both primary and secondary fluid inclusions are also common, as is crystallographic growth zoning. Especially distinctive in Winza rubies are flat or needle-like inclusions, the latter exhibiting unusual curved or spiral patterns in some cases.

Minor and trace-element data obtained by LA-ICP-MS analysis showed small amounts of Ni (up to ~25 ppm), an unusual trace element in natural corundum. Multiple analyses along the traverses of color-zoned crystals correlated trace-element contents with coloration. Heating experiments on Winza rubies using traditional techniques were not very successful, producing orange coloration and diminishing transparency. Heat treatment appears to be detectable by infrared spectroscopy. *JES*

INSTRUMENTS AND TECHNIQUES

Identification of taaffeite and musgravite using a non-destructive single-crystal X-ray diffraction technique with an EDXRF instrument. A. Abduriyim [ahmadjan@gaaj-zenhokyo.co.jp], T. Kobayashi, and C. Fuduka, *Journal of Gemmology*, Vol. 31, No. 1/2, 2008, pp. 43–54.

Taaffeite ($Mg_3Al_8BeO_{16}$) and musgravite ($Mg_2Al_6BeO_{12}$) are mineral species that belong to the taaffeite mineral group. Both are optically uniaxial and have hexagonal lattices, and they have similar chemical compositions and crystal structures. Because of these shared characteristics, they cannot be distinguished through standard gemological testing. Taaffeite and musgravite are differentiated only by their symmetries (hexagonal vs. trigonal, respectively) and different lattice-cell constants. Techniques with high resolution and accuracy—such as single-crystal and powder X-ray diffraction, electron microprobe analysis, and Raman spectroscopy—are also effective in distinguishing the minerals. This article describes an EDXRF instrument modified for use as a single-crystal X-ray diffraction apparatus. It operates using a special rotating and tilting stage that nondestructively determines diffraction patterns to distinguish the minerals according to their symmetries, unit-cell dimensions, and space groups. *GL*

Magnetic susceptibility, a better approach to defining garnets. D. B. Hoover [dbhoover@aol.com], C. Williams, B. Williams, and C. Mitchell, *Journal of Gemmology*, Vol. 31, No. 3–4, 2008, pp. 91–103.

Using a new, nondestructive method of gem testing, the authors demonstrate how the major end-member composition of any garnet can be confidently predicted by plotting its RI against measured magnetic susceptibility. On this diagram, eight end-member garnets are plotted so that any unknown sample can be placed in the appropriate ternary area. This method shows how previous methods of identifying garnets (e.g., by their color, RI, and absorption spectrum) are inadequate to correctly identify mineral compositions within the garnet group. Magnetic susceptibility measurements (as opposed to determination of the unit cell dimensions) can be carried out with inexpensive equipment available to most gemologists and mineralogists. *RAH*

Specular reflectance infrared spectroscopy—A review and update of a little exploited method for gem identification. T. Hainschwang [thomas.hainschwang@gemlab.net] and F. Notari, *Journal of Gemmology*, Vol. 31, No. 1/2, 2008, pp. 23–29.

Vibrational spectroscopy, which comprises Raman and infrared spectroscopy, is a very important tool in gemological analysis. However, Raman systems are expensive, and infrared spectroscopy may require destructive sectioning or powdering of the investigated material. This article describes an alternative: specular reflectance infrared spectroscopy. This method detects only those peaks due to major compositional components of a material. Because of this sensitivity to chemical composition and molecular coordination, such a spectrum serves as a fingerprint of a material.

The authors have been building an extensive database of specular reflectance FTIR spectra since 2001. Any material can be rapidly identified if the matching reference spectrum is available. Even in the absence of a reference spectrum, an experienced user can obtain significant clues to a material's identity by relating its major peaks to those of a mineralogical group. The technique is also useful for identifying jewelry-mounted gemstones or very small surface-reaching inclusions. Its speed, precision, and relatively low cost make it an important tool for gemological laboratories. *GL*

JEWELRY HISTORY

The innovative techniques and unusual materials of Art Nouveau jewelry. Y. J. Markowitz and S. Ward, *Antiques*, Vol. 174, No. 1, 2008, pp. 56–63.

During the Art Nouveau movement (roughly, from the 1890s up to the First World War), a small group of avant-garde European artists helped redefine and revolutionize the design and fabrication of what had become a tired and predictable art form. Complex adornments were often fabricated from parts that could be assembled to fit elaborate armatures that allowed the wearer to display the piece in different ways (e.g., as either a brooch or a hair ornament). Metal treatments such as oxidation were also used to achieve different effects and act as a foil for enamels and other materials.

Part of the innate charm of Art Nouveau jewels is their use of unusual and often inexpensive materials in artistic designs produced with consummate technical skill. Horn was first used by René Lalique at the Salon of the Société des Artistes Français in 1896, and was quickly adopted by other Continental jewelers, including Gaillard, Vever, and Aucoc. Lalique and Gaillard were noted for treating some portions of their designs to produce a delicate iridescent "bloom" on the surface of the horn. Other "unusual" materials included glass and enamel, which were sometimes combined masterfully by Lalique. Detailed photos complement the descriptions of fabrication and manufacturing techniques. Each item is analyzed in terms of construction, materials, finish, and design.

The jewelry in this article is from an exhibition titled "Imperishable Beauty: Art Nouveau Jewelry," which was at the Museum of Fine Arts in Boston in 2008 and will be on view at the Cincinnati Art Museum from October 24, 2009, to January 25, 2010. *JEC*

Rocks solid. S. Cooperman, *Forbes*, December 8, 2008.

Art Deco jewelry has always been popular among serious collectors, but it may also have investment possibilities. The cachet of Art Deco has been on the rise since the late 1970s, following a long period when it was out of favor (with some pieces even being disassembled for resale). Despite its increasing popularity, auction houses have repeatedly underestimated the value of the pieces, as evidenced by their sales prices being well above their auction estimates. Demand is expected to stay high, since Art Deco was an era of limited production when jewelry craftsmanship was at its peak.

The introduction of platinum enabled Cartier to start the monochrome or "white-on-white" trend, and Van Cleef adopted it for its innovative "invisible" settings. Baguette-, trapezoid-, and trillion-cut stones were introduced during this period. When color came into vogue, the "fruit-salad" style was created, incorporating contrasting gem materials such as "crystal," turquoise, malachite, lapis lazuli, coral, onyx, and jade; pieces with Cartier's "tutti-frutti" style are still among the most sought-after designs. The discovery of King Tut's tomb in 1922 also had an impact on the period, which saw Van Cleef depicting pharaohs and Cartier using scarabs. Art Deco pieces without colored stones and diamonds also exist, created by independent jeweler-artists whose unconventional designs were entirely outside the realm of the traditional motifs established by the big jewelry houses. Signed Art Deco pieces command a premium at auction, but unsigned work with fine craftsmanship should not be dismissed. Collectors must be patient now that Art Deco jewelry is getting harder to find.

Michele Kelley

Study of the provenance of Belgian Merovingian garnets by PIXE at IPNAS cyclotron. F. Mathis [francois.mathis@ulg.ac.be], O. Vrielynck, K. Laclavetine, G. Chene, and D. Strivay, *Nuclear Instruments and Methods in Physics Research B*, Vol. 266, 2008, pp. 2348–2352.

A 2002 road excavation in the Walloon area of Belgium uncovered a 5th century cemetery containing 436 tombs. Archeological excavations led to the discovery of about 60 jewels inlaid with red garnets. The PIXE technique was used to analyze the garnets, utilizing a 3.1 MeV proton beam at the IPNAS cyclotron of the University of Liege, Belgium. The garnets had a mostly homogeneous composition and thus were probably from a single source. The study confirms that PIXE in external-beam mode is a powerful tool for evaluating the provenance of archeological garnets. *DAZ*

JEWELRY RETAILING

A diamond is forever . . . but the hard-hit jewelry industry is in a state of flux. S. Buxbaum, *The Secured Lender*, November/December 2008, pp. 64–66.

Traditional retail jewelers have been affected more severely than many others by the economic downturn. However, the industry is also witnessing a deep competitive shift toward internet sellers. The author chronicles the success of internet retailer Blue Nile and quotes a prediction by the Jewelers Board of Trade that many mid-market independent stores will probably go out of business during the next five years. Lenders who take jewelry in secured lending transactions must be aware that its value can be subjective, influenced by fashion and workmanship. *RS*

Economic downturn: A challenge or opportunity? *Jewellery News Asia*, No. 293, 2009, pp. 50–52.

Manufacturers of stylish jewelry made from alternative (non-precious) metals have an opportunity to gain sales among hard-pressed middle-income consumers in Asia. In addition, manufacturers of such products may find it easier to keep bank financing while gold hovers at a near-record price. Manufacturers are warned against discounting too deeply, because they may need ample profit margins to survive the economic downturn. *RS*

Romancing the stone. K. Field [kfield@chainstoreage.com], *Chain Store Age*, November 2008, pp. 29–31.

Blue Nile, the internet diamond seller, has seen its sales increase from $14 million in 1999—its first year of operation—to $319 million in 2007. According to CEO Diane Irvine, the company operates on a 22% gross margin, compared to an average of 50% for a typical brick-and-mortar jeweler. While the company acknowledged difficulties as the economy deteriorated in the fall of 2008, Irvine said it could remain profitable and poised for growth. *RS*

SYNTHETICS AND SIMULANTS

Effect of seed sizes on growth of large synthetic diamond crystals. C. Zhang [dndzcy@hpu.edu.cn], R. Li, H. Ma, S. Li, and X. Jia, *Journal of Materials Science and Technology*, Vol. 24, No. 2, 2008, pp. 153–156.

The authors grew synthetic diamond crystals via the temperature-gradient method (high pressure and high temperature) using seed crystals ranging from 0.5 to 2.5 mm. All were grown using the same temperature gradient, at 5.5 GPa and 1550 K, in a cubic anvil apparatus. The carbon source was high-purity graphite, and the catalyst/solvent was a Ni-Mn-Co alloy (ratio of 70:25:5 by weight). The growth surface was the (111) face. The diffusion of carbon in the metal solvent was simulated and analyzed by finite element analysis (FEA).

The authors demonstrated that by increasing the seed size and keeping all other variables constant, the crystals grew at a faster rate. However, larger seeds correlated to a decrease in the quality of crystals produced. With a 1.0 mm seed, the resulting diamond had no metal inclusions. A 1.8 mm seed led to a few small, sheet-like metal inclusions, while a 2.5 mm seed resulted in large, blocky metal inclusions. FEA was used to simulate and report on the carbon diffusion process, since actual diamond growth under these conditions cannot be observed *in situ*. FEA showed that the carbon super-concentration at the seed surface is inhomogeneous—it increases symmetrically about the center of the growth surface, where it is lowest. The slower growth rate at the center of the crystal explains why metal inclusions tend to be concentrated there and not on the edges—the growing crystals simply enwrap the molten metal solvent, which quenches to form solid inclusions when the experiment is terminated. It also explains why a larger growth surface, with a greater difference in carbon concentration and consequently a greater difference in growth rate from center to rim, leads to larger metal inclusions. *JS-S*

L'ambra: i falsi (Parte V) [Amber: The fakes (Part V)]. G. L. Cattaneo [ambar@ambarweb.it] and F. Talami, *Rivista Gemmologica Italiana*, Vol. 3, No. 3, 2008, pp. 189–195 [in Italian].

A considerable number of materials that imitate genuine amber play an important role in the amber market. With the development of plastics, a series of synthetic polymers have been used, especially celluloid, Bakelite, methacrylate (i.e., acrylic glass, Plexiglas, or Perspex), polystyrene, and polyester. Early examples of imitation resins are found in Victorian and Edwardian jewelry dating back as far as 1870. Specific gravities, refractive indices, and characteristic odors produced by hot point testing are given for these materials. During the 1960s to 1980s, a simulant called Polybern was produced in East Germany, Poland, and Lithuania. It was composed of amber fragments and polyester. Frequently, amber fragments are also processed to form "pressed" amber (reconstructed amber). Last, immature natural resins called copal are used as substitutes for genuine amber. Today, most of this material comes from Colombia and Madagascar, with ages of 80–1,000 years (compared to Baltic amber, at 40–50 million years). Inclusions are not conclusive for separating natural, untreated amber from its many simulants. Although natural inclusions (mostly insects and spiders) are highly prized, these can be artificially introduced into both natural amber and amber substitutes. *RT*

TREATMENTS

Enhanced optical properties of chemical vapor deposited single crystal diamond by low-pressure/high-temperature annealing. Y.-F. Meng, C.-S. Yan, J. Lai, S. Krasnicki, H. Shu, T. Yu, Q. Liang, H.-k. Mao, and R. J. Hemley [hemley@gl.ciw.edu], *Proceedings of the National Academy of Sciences*, Vol. 105, No. 46, 2008, pp. 17620–17625.

Single-crystal chemical vapor deposition (SC-CVD) synthetic diamond was grown at very high growth rates (up to 150 μm/hour) by microwave plasma–assisted techniques. The resulting gem-quality SC-CVD synthetic "plates" had faces up to ~1 cm^2 and ranged from 0.2 to 6.0 mm thick. The addition of a small amount of nitrogen to the synthesis gas (CH_4) produced optically homogeneous, hydrogen-containing type IIa brown crystals with low nitrogen content (<10 ppm) and strong, broad UV-visible absorption. The crystals were annealed in a hydrogen environment at low pressure (<300 torr, less than half of atmospheric pressure) and high temperature (up to 2200°C) for several hours without graphitization.

The low-pressure, high-temperature (LPHT) annealing enhanced the optical properties of the SC-CVD crystals, observed as significant decreases in the intensity of spectral features in the UV, visible, and infrared absorption and photoluminescence spectra. Decreases in sharp spectral features indicate a reduction of nitrogen-vacancy-hydrogen defects during annealing, which the authors ascribe to an increase in the relative concentration of nitrogen-vacancy centers in annealed material. The hydrogen-assisted alteration of defect structures in SC-CVD crystals with LPHT annealing is different from the alteration of natural brown type IIa diamonds during HPHT annealing, where decreases in optical absorption are caused by the removal of defects associated with plastic deformation.

The authors note that LPHT annealing of SC-CVD synthetic diamonds to enhance their optical properties can be performed in CVD growth chambers as a post-growth treatment, and is unconstrained by crystal size. LPHT-annealed SC-CVD synthetics may have technical and scientific applications such as in quantum computing. Of gemological interest are the relatively large, gem-quality specimens produced and their decolorization by LPHT treatment. *Emily V. Dubinsky*

Pre-harvest colour-treated akoya unveiled. *Jewellery News Asia*, No. 284, 2008, pp. 60–62.

Tanabe Pearl Farm of Mie, Japan, announced a new treatment process to produce pink, green, blue, and lavender akoya cultured pearls by injecting a colored liquid into the oysters. The developer of the process, Tomokazu Tanabe, claimed the colors were not dyes but "a combination of man's efforts and nature's power." Thus far, the treated akoyas form only a very small percentage of Tanabe's production, and none have been marketed. A Japanese laboratory, the Gem Science Academy of Tokyo, has provided several techniques for identifying them. Their UV-Vis-NIR reflectance spectra are much different from those of untreated or conventionally dyed akoya cultured pearls. In addition, X-radiographs can detect the metallic compounds that were injected into the oysters. *RS*

Visually distinguishing A-jadeite from B-jadeite. J. Li [geoli@vip.sina.com], X. Liu, Z. Zhang, Y. Luo, Y. Cheng, and H. Liu, *Journal of Gemmology*, Vol. 31, No. 3/4, 2008, pp. 125–131.

After first discussing the distinctions between A-jadeite and B-jadeite in the context of the Chinese gem trade, the authors describe visual skills that can aid in the separation of these two types. A-jadeite is defined as material that has been carved and polished, with minimal wax applied to enhance the luster. Mild acid is considered acceptable as a bleaching agent, provided it does not damage the jadeite's structure; also, iron-containing A-jadeite may be heated to give it a red color. B-jadeite has been processed with strong acid, and the resulting pores filled with wax or polymer resin. C-jadeite (bleached and dyed) is not addressed.

Visual distinctions are described, illustrated with color photos, and discussed in terms of: (1) surface luster or comparative reflectance differences, (2) distribution of color on the surface, (3) internal inclusion patterns, (4) internal behavior of light resembling the adularescence of moonstone, (5) microfractures and their relationship to color distribution, and (6) item size and quality and the intricacy of the carving. For example, the internal yellow glow found in A-jadeite distinguishes it from B-jadeite, which exhibits a white-blue reflection. The underlying reasons for this effect, as well as other observations listed above, are discussed in detail. Careful attention to these features is required for an accurate determination, though the potential for error still exists and advanced laboratory equipment may be required. *ES*

MISCELLANEOUS

Artisanal diamond cooperatives in Sierra Leone: Success or failure? E. A. Levin [enquiries@ddiglobal.org] and A. B. Turay, *Diamond Development Initiative Policy Brief*, June 2008, 4 pp.

In Sierra Leone, a U.S.-led attempt to establish diamond mining and marketing cooperatives is an apparent failure. Between 1999 and 2005, the five cooperatives funded by the Integrated Diamond Management Program, under the U.S. Agency for International Development (USAID), produced 320 stones weighing a total of 60.37 carats, valued at $4,390. This NGO report alleges that there were many reasons for the failure, including USAID's withdrawal of funding for most of the cooperatives, the working of sites with unproven diamond resources, the lack of mining expertise, delays (the country's civil war had not yet ended when the program began), theft, and weather problems. The report recommends that future projects include surveys to study whether the lands actually contain diamonds, pay more attention to local hierarchies in setting up the cooperatives, give adequate training to the diamond diggers, and provide mechanized mining equipment where needed. *RS*

Diamonds, development and democracy. N. Oppenheimer, *World Policy Journal*, Fall 2008, pp. 211–217.

While diamonds and other commodities have fueled civil war and conflict in a number of African nations, these natural resources can assist with growth and development if governments and their citizens choose that direction. The author, chairman of the De Beers Group, notes successes in Botswana, pointing out that well-managed diamond resources have moved that nation from being one of the world's poorest 40 years ago, to one of the most successful economies in Africa today. Botswana can serve as a roadmap for other African countries to establish functioning, effective democracies; deploy natural resources into public goods; and form innovative 50/50 partnerships between government and large investors. The report stresses that, while the West often views Africa as a single entity, it is a continent of 54 separate nations, each with its own strengths and weaknesses. The author ends with a report on the effectiveness of the Kimberley Process. *RS*

Eco-friendly production: The first step to sustainability. *Jewellery News Asia*, No. 290, 2008, pp. 56–57.

Jewelry manufacturers in Hong Kong are preparing for potential future environmental regulations by building cleaner and more efficient factories. Industry officials say that implementing waste reduction strategies would produce the best results in large-scale plants that process large quantities of precious material. New strategic equipment includes air showers for catching gold dust and laser-welding machines that work at rates of seconds instead of minutes. While eco-friendly production is more costly, saving valuable materials can sometimes pay for the equipment in a matter of months and improve long-term cost effectiveness. *AB*

Jadeite auction results suggest cooling trade, market. *Jewellery News Asia*, No. 243, 2009, pp. 63–64.

The October 2008 Myanma Gems, Jade, and Pearl Emporium saw record low business, with 59.5% of the lots selling, bringing in a total of $163 million. However, some top jade lots did sell for much more than their pre-sale reserve. One was estimated at $101,000 but sold for $868,000. Another, estimated at $25,500, sold for $399,000. In 2008, Myanmar's government sold 12,829 tonnes of jade for a total of $720 million. *RS*

Why China manufacturers are optimistic despite global slowdown. *Jewellery News Asia*, No. 290, 2008, pp. 81–84.

During the global financial crisis, Chinese diamond jewelry manufacturers have turned their attention from exporting to the United States to creating branded jewelry lines for their domestic market. Several polished diamond wholesalers observed that Chinese consumers are broadening their preferences to include diamonds above 0.50 ct and SI clarity, both of which had been a difficult sell there. The manufacturers are also establishing closer ties to local retailers in promoting their branded diamond jewelry pieces, noting the need to pay more attention to fashion trends and changes in the retail environment. *RS*