The beauty of colour

Dr. Michael S. Krzemnicki
Swiss Gemmological Institute SSEF

Photos © M.S. Krzemnicki, SSEF, except where indicated otherwise
Mineral identification by chemical analysis (e.g. EMP) and structural analysis (XRD, FTIR, Raman)

© Swiss Gemmological Institute SSEF

Jadeite rock textures

Complex textures unveil a complex geological formation.

© T. Cheng © Swiss Gemmological Institute SSEF
Black chromite grain with fibrous kosmochlor (green) and surrounded by fine granular colourless jadeite and greenish larger richterite (amphibole) formed during retrograde Ca-supply. Photo © L. Franz, University Basel

Jadeite from Kazachstan

Itmurundy
Jadeite grain with brownish omphacite ongrowth (Ca metasomatism) in jadeite-jade from Kazakhstan. Photo with crossed polarizers. © K. Ernst, University Basel

Gemtrade Nomenclature

CIBJO:  
The World Jewellery Confederation

Jade
is a general term describing two different minerals (jadeite and nephrite) in their massive form, as polycrystalline, quasi-monomineralic rocks. The term jade is usually used as a suffix after the mineral name.

HOKLAS
The Hong Kong Laboratory Accreditation Scheme (ISO 17025; 2006)

Fei Cui 翡翠
is a granular to fibrous polycrystalline aggregate. It is composed of jadeite as major mineral. It may consist of other minor minerals such as omphacite, kosmochlor, amphibole and feldspar.

New addition 2013 to include omphacite- and kosmochlor-jade into the Fei Cui definition (GAHK)
The Kashmir - Madagascar challenge!

Kashmir sapphires

Treasured by the Maharadja

The Maharaja of Jammu and Kashmir, circa 1900
www.kashmirphotos.org/history.html
The Kashmir - Madagascar challenge!

Madagascar sapphire
Cobalt-bearing Zirconia as sapphire imitation

Attractive blue colour

Kyanite as sapphire imitation

Strong pleochroism
Paraiba-tourmaline intergrown with lepidolite mica

Anyolite, fancy trade name for zoisite-amphibole-ruby intergrowth.

PT = Paraiba tourmaline
L = Lepidolite
Smoked Topaz ☺

Jewellery in the barbecue ??

Exceptional colour change garnet

Member of the pyrope – spessartine series with chromium and vanadium traces

140 ct
Exceptional colour change garnet

Colour change and Usambara effect !!

Ruby testing at SSEF
Introduction

Jade, (since (thousand (of (years (of (a (mythical (stone (appreciated (in (Far (East (and (in (the (high (cultures (of (native (Americans, (is (currently (again (rising (high (and (is (sought (after (at (auctions (in (Hong (Kong (and (elsewhere. ()

Ruby necklace of the Tsar...
...and Queen Marguerita’s brooch

Emerald brooch of Queen Marguerita of Savoy (1851-1926), and was given to her by her mother the Duchess of Genoa at the occasion of her marriage to Crown Prince Umberto I in 1868.

This brooch is actually the centre-piece of her emerald necklace.

Quiz: 109 Emeralds, 6 grossularite garnets and one fluorite.
The Swiss Gemmological Institute SSEF has been receiving large quantities of saltwater pearls for certification in recent weeks. These pearls are generally characterised by an almost perfect appearance. The pearls are often accompanied with reports describing them as natural pearls, but their appearance has raised doubt amongst many natural pearl dealers. Having tested these pearls with the most advanced technology, including X-ray radiography, X-ray luminescence, X-ray micro tomography and radiocarbon age dating (see Krzemnicki et al. 2009; or SSEF Facette No. 17, www.ssef.ch, news section), we see that many of these pearls are actually beadless cultured pearls.

Fig. 2: Typical selection of these beadless cultured pearls from the Pinctada maxima (South Sea). © SSEF 2010

Fig 1: Necklace of beadless cultured pearls with an almost perfect and appealing appearance, tested recently at SSEF. © SSEF 2010

© Swiss Gemmological Institute SSEF, Newsletter May 2010

The arrival of large quantities of these "new" saltwater pearls, whose quality is far better than that of many natural pearls treasured since centuries, represents a great danger to the natural pearl market. This especially because we have reliable information, that some individuals are purposely selecting those cultured pearls with the most intriguing and potentially confusing internal structures (using radiography) from the large stocks they purchase from pearl farms, so as to later introduce them onto the natural pearl market.
Radiocarbon Dating of Pearls:

- **1900**: Only natural pearls in the trade
- **1916**: First attempts for pearl cultivation (mostly Mabe) in Japan, Australia, Europe
- **1960**: Beaded saltwater cultured pearls, *Pinctada maxima* Northern Australia, *Pinctada fucata* Southern Japan
- **1980**: Beaded saltwater cultured pearls, *Pinctada margaritifera* French Polynesia
- **1980**: Chinese beadless freshwater cultured pearls, *Unio*
- **2001**: ‘Kashi’ beadless saltwater cultured pearls enter trade in large quantities, *Pinctada maxima*
- **2009**: Saltwater cultured pearls with natural pearl beads, *Pinctada maxima*

**Recent shells:**

Shell from *Pinctada maxima* (Silverlip pearl oyster) from the Philippines, collected 1990 (pers. comm. H.A. Hänni)

OneSigma [1959.61(Aug) - 1959.81(Oct)] 0.092576
[1989.67(Sep) - 1992.10(Feb)] 0.907424

TwoSigma [1959.47(Jun) - 1960.07(Jan)] 0.118790
[1988.98(Dec) - 1992.65(Aug)] 0.881210

Note: 300 years of INTCAL04 data have been prepended to this data set.

Calibration of 1.162000±0.004000 with SH1.14c dataset
Smoothing: 1.000000


© Swiss Gemmological Institute SSEF
Radiocarbon Dating of Pearls:

Figure 4. Calibrated ages of two historic pearls ETH-46322 and ETH-46323 that were formed before the bomb peak. Both pearls originate from the Arabian Gulf, and were calibrated using marine calibration curve INTCAL09 (Reimer et al. 2009) and $\Delta R=190\pm180$ yrs.

Sample ETH-46319, a large pearl from Pinctada maxima (Fig. 3) - although declared being pre-1950 - reveals a historic age of 1623-1781AD (2 sigma probability). From the information of the collector, the measured $^{14}C$ age is possible, but unfortunately not well documented. However, despite the unknown accuracy of the historic age, the age provided by the radiocarbon age determination allowed us in this specific case, to unambiguously identify the sample as a natural pearl, although previous testing with radiography and X-ray computed µ-tomography was not conclusive. The fact, that cultured pearls from Pinctada maxima of such large size were only produced commercially after the “bomb peak” and the pre-bomb radiocarbon age helped to resolve the problem. For the seven more recent pearls and shell samples, which formed distinctly after the bomb-peak, the calculated and corrected radiocarbon ages are in four cases quite well matching with the “declared” ages (ETH-46324, ETH-46325, ETH-38493, ETH-46326), whereas the cultured pearl from Japan (ETH-46327) with a declared age of 1982 and the two cultured pearls from Indonesia (ETH-46320, ETH-46321) from 2009 reveal older ages. This again might indicate some variability in reservoir ages of this region that affects our results. Nevertheless, the pearls detect bomb $^{14}C$, which shows the potential of $^{14}C$ for detection of this time marker.

Conclusions

This study has shown that radiocarbon age determination can provide additional and valuable information when testing pearls. We can distinguish two very different scopes. In the case of antique jewellery and treasures, age determination may support evidence for their historic provenance (e.g. sample ETH-46322). This can be of high importance, especially in the case of pearls of iconic significance in cultural history. A pearl set in a historic jewellery...
New cultured pearl product

Group A
1st generation

Group B
2nd generation

1st generation
2nd generation

See publication in the next Australian Gemmologist...
Visit at Paspaley in North Australia

Introduction

Jade, (since thousand of years, a mythical stone appreciated in Far East and in the high cultures of native Americans, is currently again rising high and is sought after at auctions in Hong Kong and elsewhere.

Peter Bracher from the Paspaley family in front of the Paspaley IV, the main vessel, on which the grafting of wild shells is carried out.
Harvesting a natural pearl from *Pinctada maxima*...

...and fishing in the Kimberleys
Thank you for your attention