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SGC Conference
4th May 2014

News from the SSEF laboratory:

Research findings, exceptional treasures and gemmological 'oddities'

Dr. Michael S. Krzemnicki

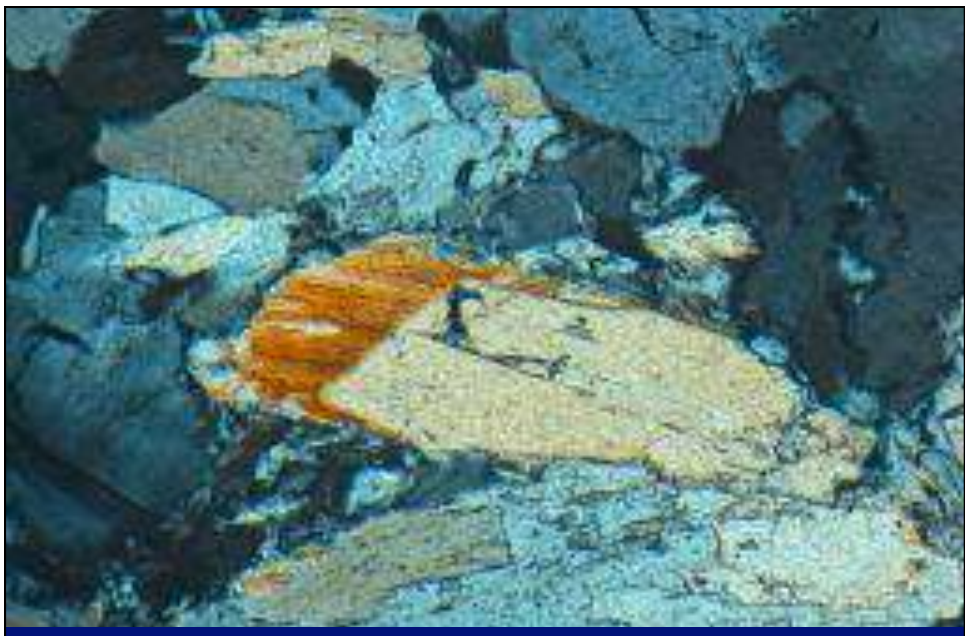
Swiss Gemmological Institute SSEF

Photos © M.S. Krzemnicki, SSEF, except where indicated otherwise

Jadeite from Kazachstan

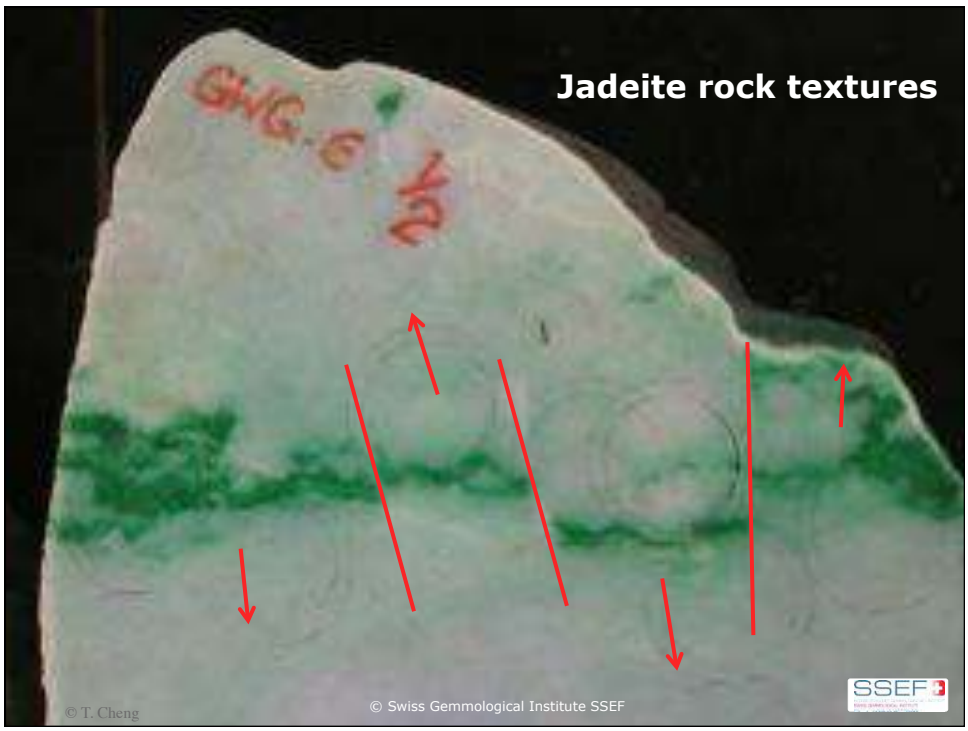
Jadeite-Jade from Kazachstan
A petrological and petrographical analysis

Bachelor thesis of Kristina Ernst
University Basel



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

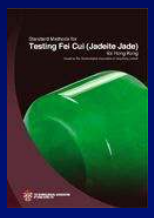
Black chromite grain with fibrous kosmochlor (green) and surrounded by fine granular colourless jadeite and greenish larger richterite (amphibole) formed during retrograde Ca-supply. Photo © L. Franz, University Basel



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.



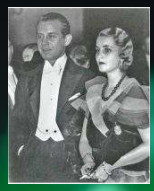
HOKLAS
The Hong Kong Laboratory Accreditation Scheme (ISO 17025; 2006)

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)

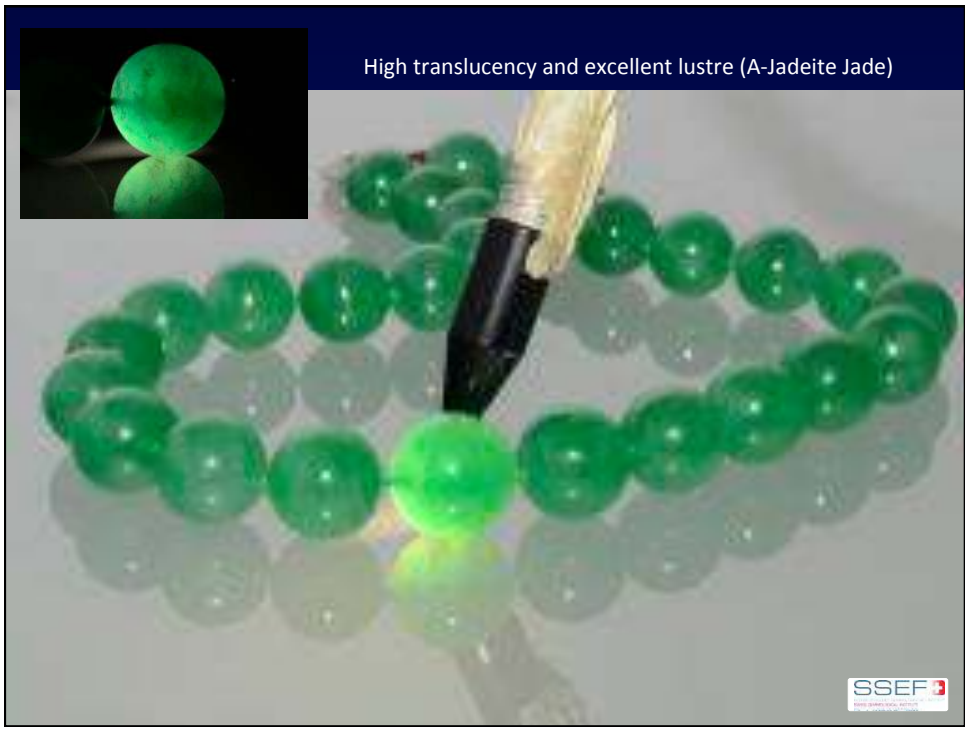
© Swiss Gemmological Institute SSEF

The Hutton-Mdivani Jadeite necklace



Sotheby's Hong Kong April 2014
Sold for world record 27.4 mio US$

SSEF Test Report 73188 + Appendix


High translucency and excellent lustre (A-Jadeite Jade)
SSEF

Treated Jadeite-Jade (B + C –type)
SSEF

Dyed opal from Ethiopia

Dyed opal from Wollo, Ethiopia

© Swiss Gemmological Institute SSEF

Dyed opal from Ethiopia

© Swiss Gemmological Institute SSEF

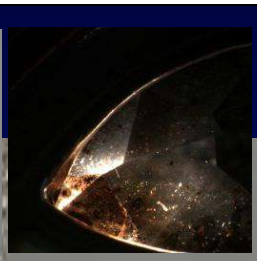
Treated brown star sapphire (Thailand)

Brown artificial resin in large cavity at the backside

Fractures with air bubbles and Pb-glass filling showing air bubbles and „flash“ effects

© Swiss Gemmological Institute SSEF

Smoked Topaz ☺



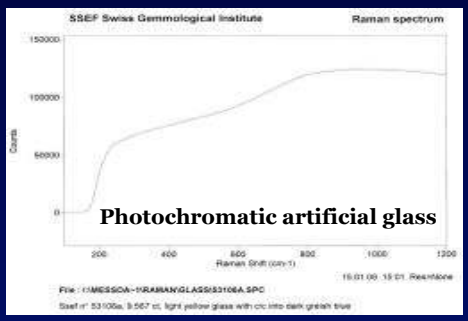
Jewellery in the barbecue ??

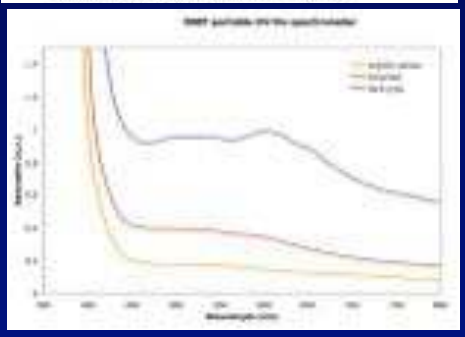
A stone from a very distant star…

Reversible colour change
when exposed to sunlight

© Swiss Gemmological Institute SSEF

…or rather from a "starlet"…





© SSEF Swiss Gemmological Institute

Exceptional colour change garnet

140 ct

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

Exceptional colour change garnet

Colour change and Usambara effect !!

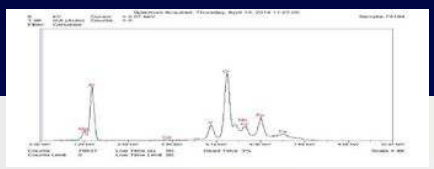
The classical source: Spessartine from Kunene, Namibia

21.13 ct

Spessartine from Nigeria

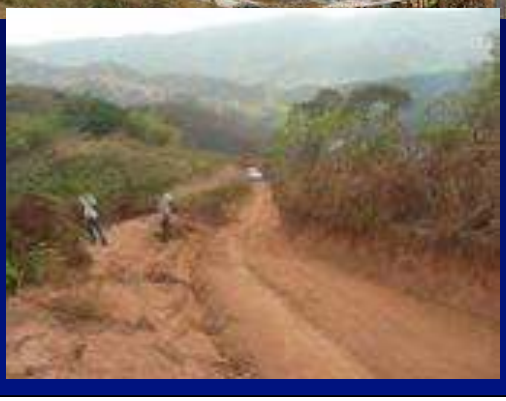
Spessartine from Mogok

Spinel from Mahenge



Each Spinel > 40 ct

Epangko spinel mines (near Mahenge)



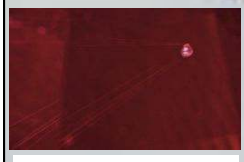
Spinel from Tajikistan (historic Kuh-i-Lal mine)

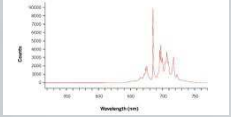
Christie's Geneva Sale, May 2014
Lot 177

From 61.50 ct to 202.67 ct

With freshwater cultured pearls

© Christie's

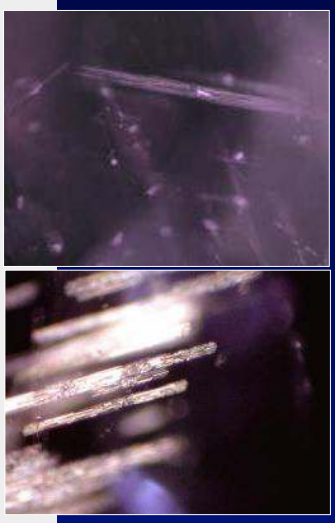




With engravings of
ten Mughal Emperors of the 17th
and beginning 18th Century

Spinel from Vietnam (Luc Yen)

41.99 ct

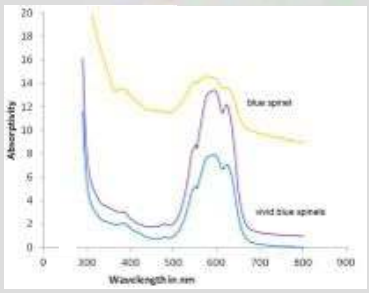


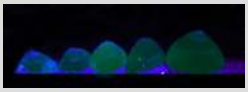
Characteristic inclusions in Vietnamese spinels

Spinel from Vietnam (Luc Yen)

Blue Co-spinel from Vietnam:
A spectroscopic study

Bachelor thesis of Carina Hanser
University Freiburg i. Br. (Germany)





greenish reaction under UV light

Verneuil synth. spinel

Blue Co-spinel from Vietnam:
A spectroscopic study

Bachelor thesis of Carina Hanser
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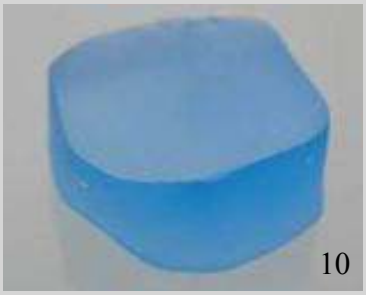
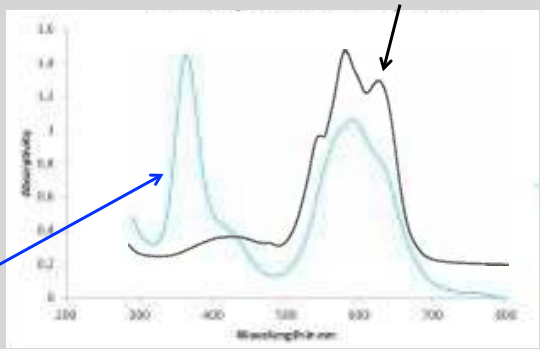


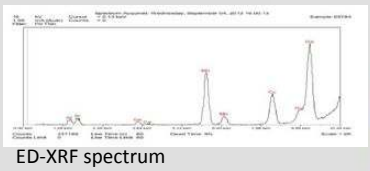
Sample from SSEF collection
Produced by Djeva SA (Switzerland)

dark blue Co-bearing
synthetic spinel (Verneuil)

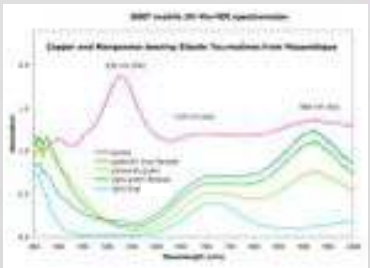


light blue Ni-bearing
synthetic spinel (Verneuil)

Unheated Cu-bearing tourmaline from Mozambique



ED-XRF spectrum

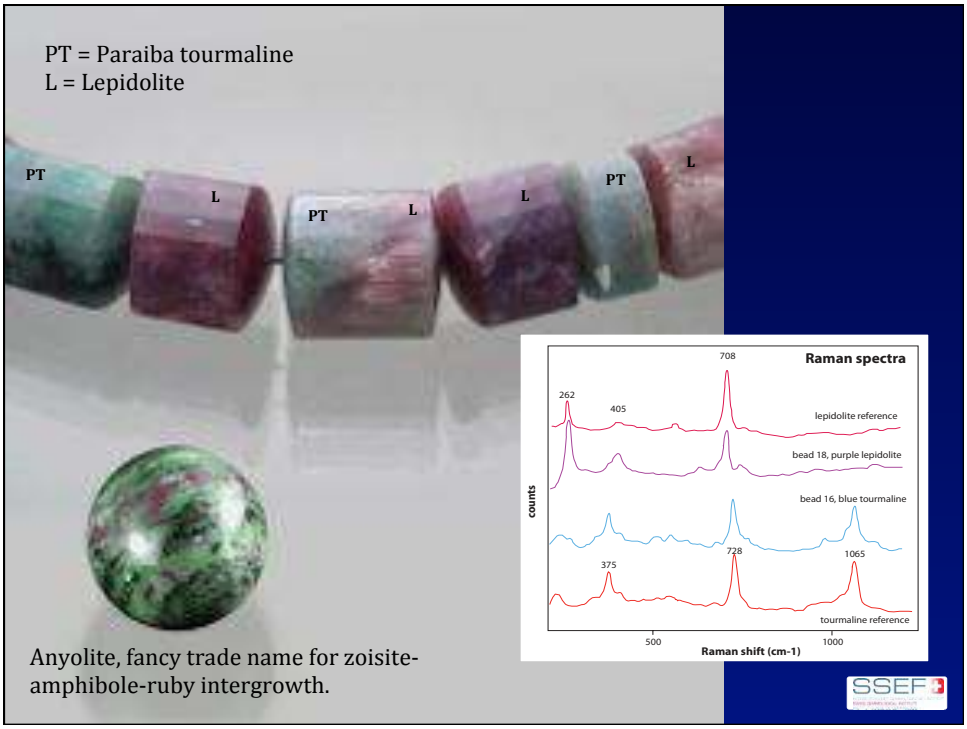


UV-Vis-NIR spectra

40.96 ct

Paraiba-tourmaline intergrown with lepidolite mica

PT = Paraiba tourmaline
L = Lepidolite

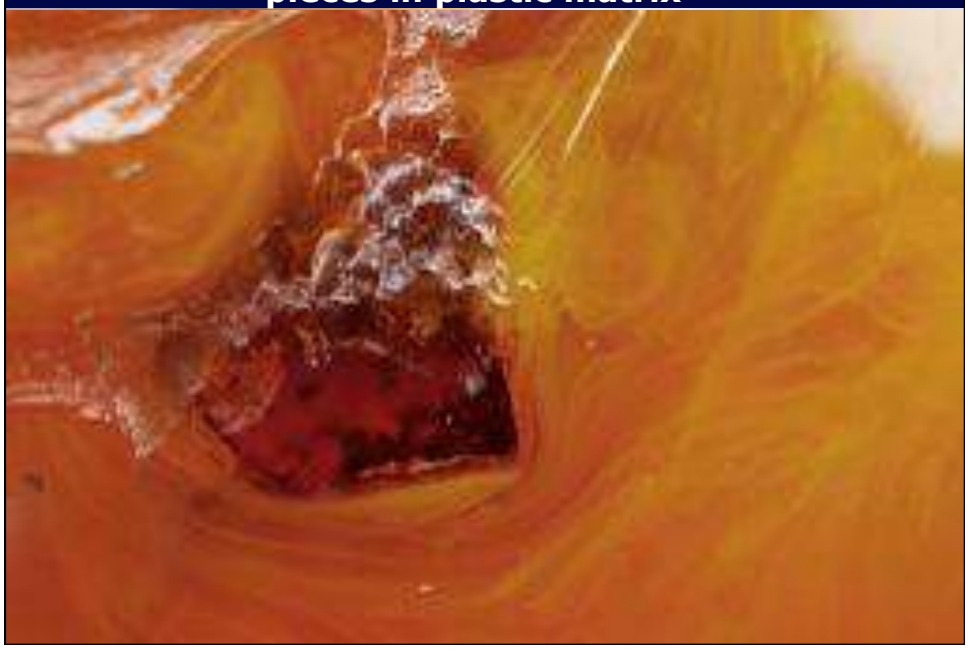


Anyolite, fancy trade name for zoisite-amphibole-ruby intergrowth.

Amber ?

© Swiss Gemmological Institute SSEF

Man-made product of small natural resin pieces in plastic matrix



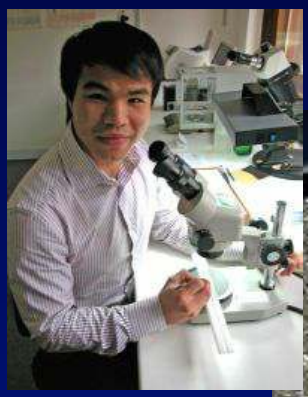
Problem solved at SSEF…

© Swiss Gemmological Institute SSEF

SSEF

Diamond testing

diamond testing at SSEF



Diamond grader and
gemmologist Luc Phan @ SSEF

Vacheron Constantin:
Diamonds tested by SSEF

Imagine how to sort out imitations, synthetic diamonds, and HPHT treated diamonds from these melée diamonds ??

Automated Spectral Diamond Inspection ASDI

Check http://www.ssef.ch/asdi

SSEF

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.

What a nice antique emerald parure

containing Zambian emeralds

Unfortunately fake ...

containing Zambian emeralds

Quiz: 109 Emeralds, 6 grossularite garnets and one fluorite.

Renaissance Necklace

© Swiss Gemmological Institute SSEF

And what's up with the Royals…

© Swiss Gemmological Institute SSEF

The Württemberg Parure

a historic pink topaz jewellery set

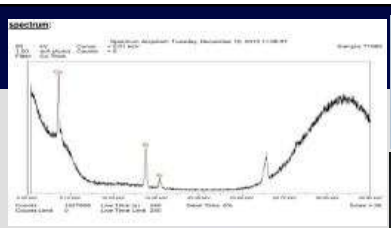
Pearl and emerald tiara

© Swiss Gemmological Institute SSEF

Beware of hair-styling !
»3 Wetter Taft«
SSEF

Saltwater natural pearl
33.15 ct (132.60 grains)
half-drilled
16.5 – 17.4 mm diameter
SSEF Test Report 72642
(Estimate: £80,000 - 120,000
Hammer Price £ 680,000
Lot: 1903
Woolley & Wallis sale 1st May 2014
SSEF

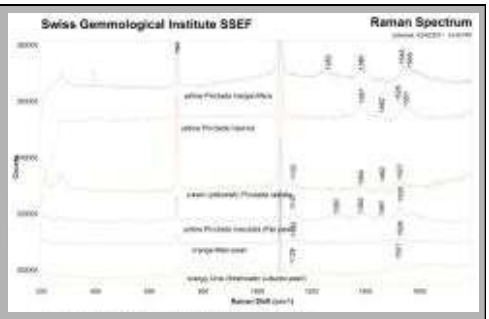
Abalone pearl



168.78 ct

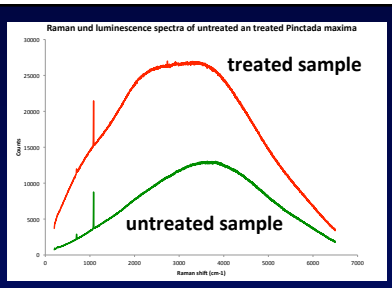
159.75 ct

306.461 ct (1225.84 grains)
Length approx. 83 mm



Pinctada maculata:

Pipi pearl oyster



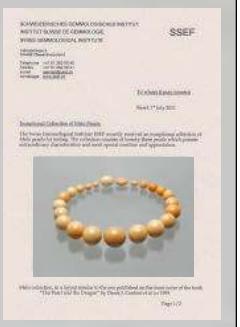
New pearl treatment:

There was only a slight increase in yellow seen when comparing the treated samples with the untreated ones submitted to SSEF.

However, as we have not seen the original colour of the treated samples, we do not know how strongly this treatment has affected their colour.

© Swiss Gemmological Institute SSEF

Melo pearls



Unpolished Melo pearl

Melo pearl with cavity filled with artifiial resin

Air bubbles and slight negative profile of filled cavities at the Melo surface

White LWUV reaction of filled cavities

© Swiss Gemmological Institute SSEF

Distinguishing natural from cultured pearls:

Internal structure of a natural pearl

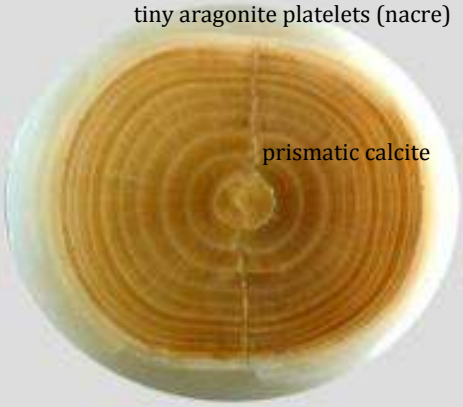
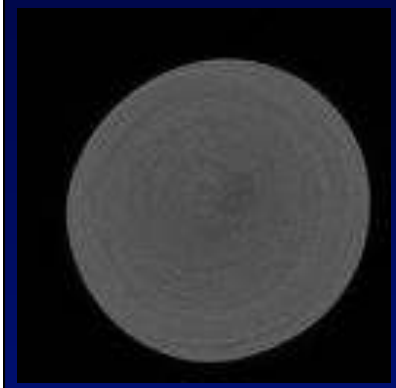
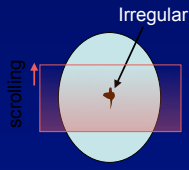


Photo © H.A. Hänni, SSEF

Pinctada radiata

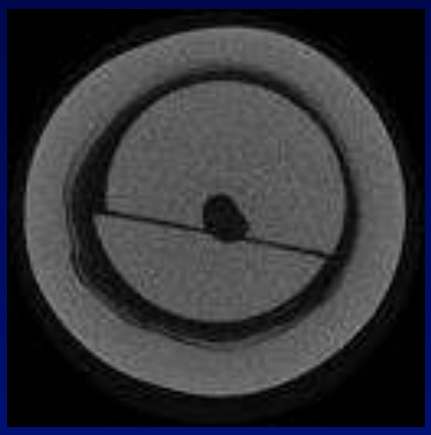
X-ray Microtomography of a beadless CP

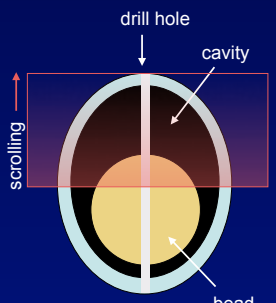




Beadless freshwater cultured pearl from China (*Unio*)
Sample mxt-1

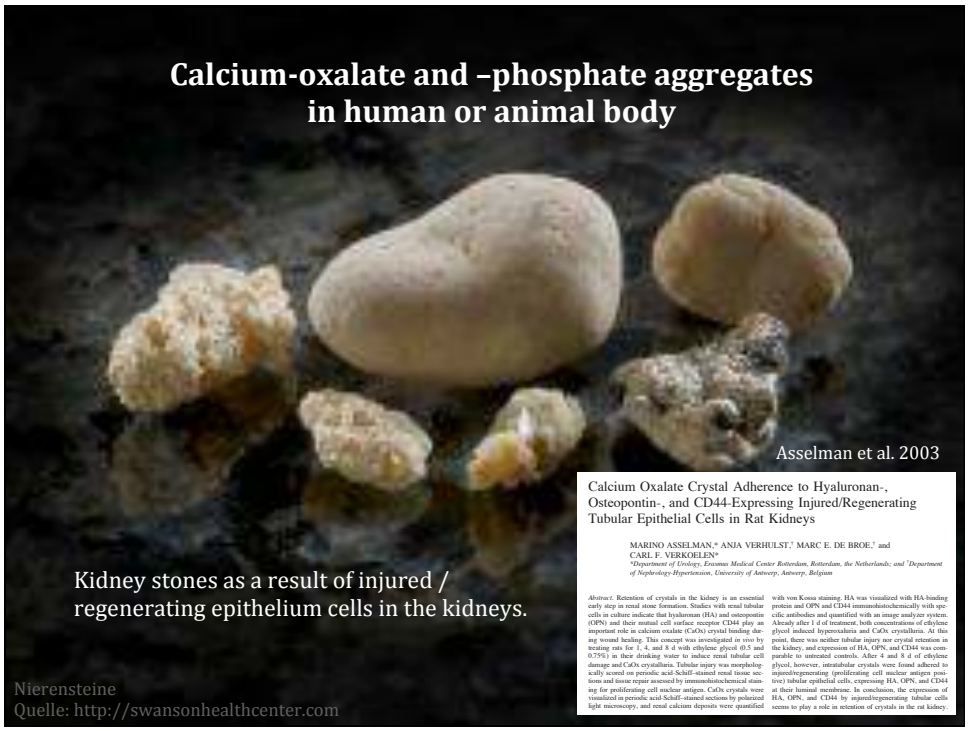
Cultured pearl with a bead





Beaded cultured pearl from *Pinctada maxima*
Sample MXT 14b (5 microns resolution)

Calcium-oxalate and –phosphate aggregates in human or animal body



Asselman et al. 2003

Calcium Oxalate Crystal Adherence to Hyaluronan-, Osteopontin-, and CD44-Expressing Injured/Regenerating Tubular Epithelial Cells in Rat Kidneys

MARINO ASSELMAN,* ANJA VERHULST,† MARC E. DE BROE,† and CARL F. VERKOELEN*
*Department of Urology, Erasmus Medical Center Rotterdam, Rotterdam, the Netherlands; and †Department of Nephrology-Hypertension, University of Antwerp, Antwerp, Belgium

Abstract. Retention of crystals in the kidney is an essential early step in renal stone formation. Studies with renal tubular cells in culture indicate that hyaluronan (HA) and osteopontin (OPN) and their mutual cell surface receptor CD44 play an important role in calcium oxalate ($CaOx$) crystal binding during wound healing. This concept was investigated *in vivo* by treating rats for 1, 4, and 8 d with ethylene glycol (0.5 and 0.75%) in their drinking water to induce renal tubular cell damage and $CaOx$ crystalluria. Tubular injury was morphologically scored on periodic acid-Schiff–stained renal tissue sections and tissue repair assessed by immunohistochemical staining for proliferating cell nuclear antigen. $CaOx$ crystals were visualized in periodic acid-Schiff–stained sections by polarized light microscopy, and renal calcium deposits were quantified with von Kossa staining. HA was visualized with HA-binding protein and OPN and CD44 immunohistochemically with specific antibodies and quantified with an image analyzer system. Already after 1 d of treatment, both concentrations of ethylene glycol induced hyperoxaluria and $CaOx$ crystalluria. At this point, there was neither tubular injury nor crystal retention in the kidney, and expression of HA, OPN, and CD44 was comparable to untreated controls. After 4 and 8 d of ethylene glycol, however, intratubular crystals were found adhered to injured/regenerating (proliferating cell nuclear antigen positive) tubular epithelial cells, expressing HA, OPN, and CD44 at their luminal membrane. In conclusion, the expression of HA, OPN, and CD44 by injured/regenerating tubular cells seems to play a role in retention of crystals in the rat kidney.

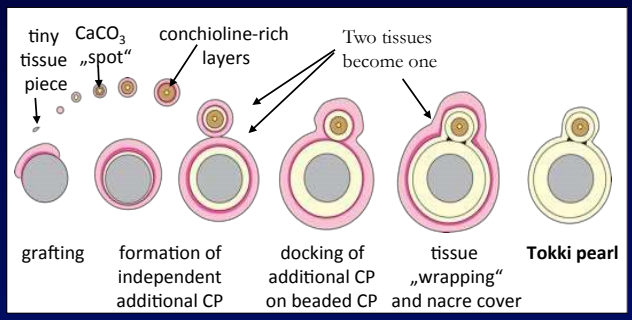
Kidney stones as a result of injured / regenerating epithelium cells in the kidneys.

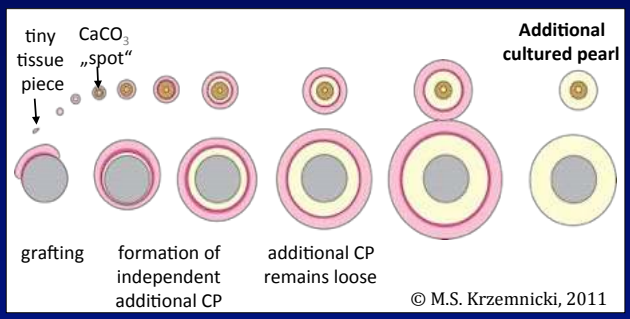
Nierensteine
Quelle: http://swansonhealthcenter.com

Tokki Cultured pearls

Photo © H.A. Hänni, SSEF

Formation model for Tokki cultured pearls





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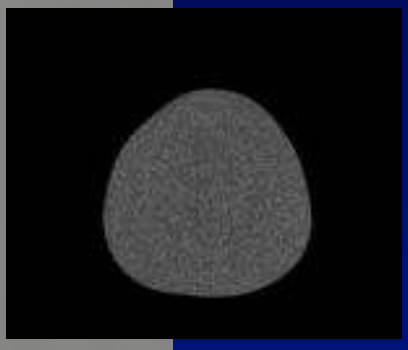
Loose additional cultured pearl (Tokki)

Sample mxt 37_20



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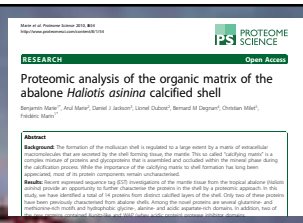
Genetic investigations on shells:

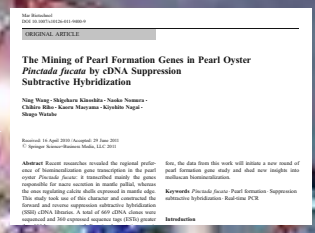
Marie et al. 2010



Proteomic analysis of the organic matrix of the abalone *Haliotis asinina* calcified shell

Fundamental knowledge about biomineralisation

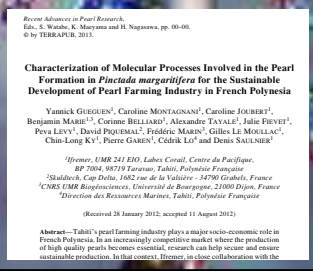
Wang et al. 2011



The Mining of Pearl Formation Genes in Pearl Oyster *Pinctada fucata* by cDNA Suppression Subtractive Hybridization

Optimization of pearl farming by genetic methods

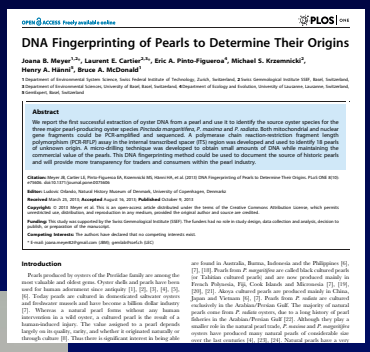
Gueguen et al. 2013



Characterization of Molecular Processes Involved in the Pearl Formation in *Pinctada margaritifera* for the Sustainable Development of Pearl Farming Industry in French Polynesia

Identification of shell species from the DNA of pearls

Collaboration between SSEF an the Institute for integrative Biology (ETH Zurich) under supervision of Prof. Bruce McDonald



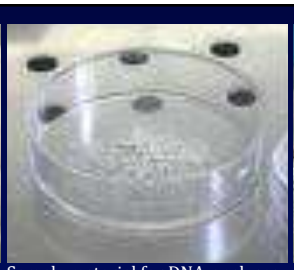
DNA Fingerprinting of Pearls to Determine Their Origins

Blind test with 18 pearls from

- Pinctada radiata,
- Pinctada maxima
- Pinctada margaritifera

(mixed in the picture)

Sampling

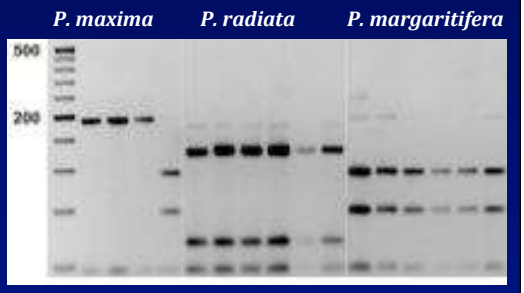


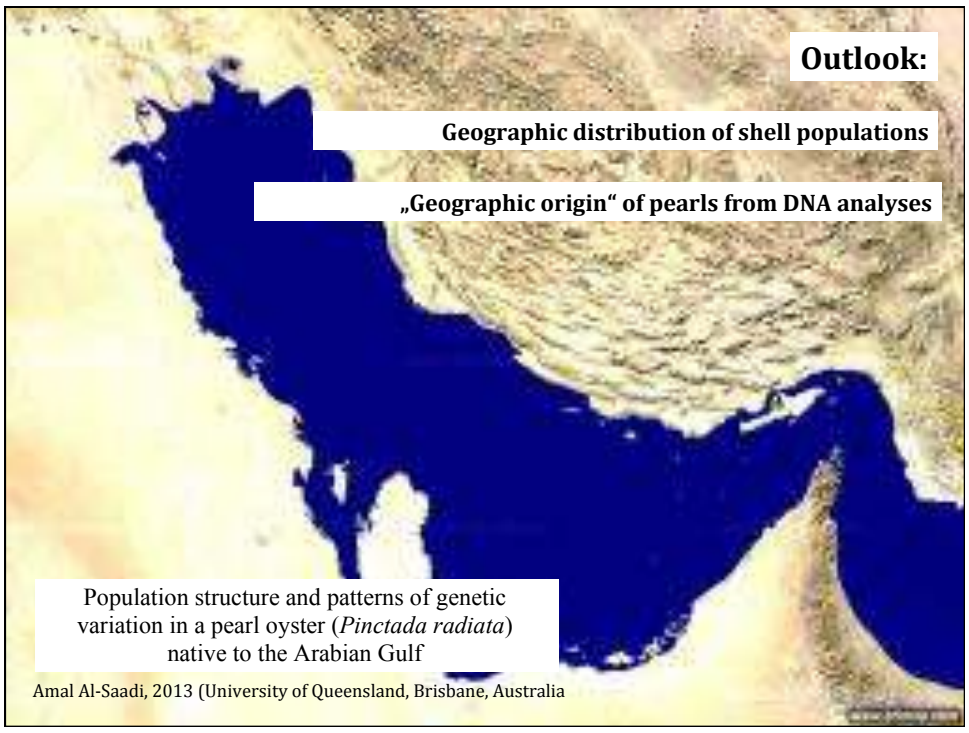
Sample material for DNA-analyses

Dr. Joana Meyer, Head of Project

Findings of the DNA-Study:

- Identification of shell species is generally possible (enough organic material)
- DNA can be analysed even when pearl is dryed out after years of wearing.
- Tiny sample from drill hole is usually sufficient.





Outlook:

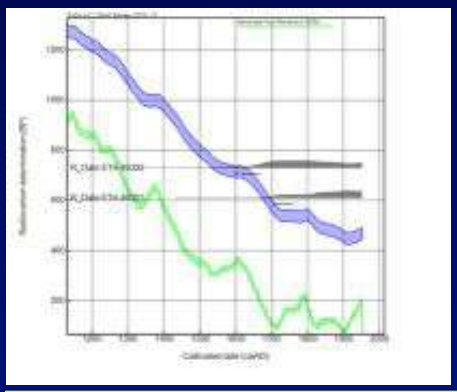
Geographic distribution of shell populations

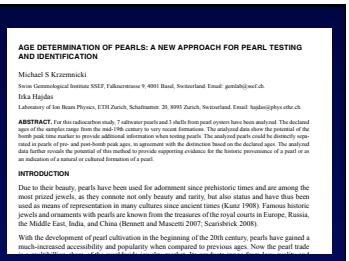
„Geographic origin" of pearls from DNA analyses

Population structure and patterns of genetic variation in a pearl oyster (*Pinctada radiata*) native to the Arabian Gulf

Amal Al-Saadi, 2013 (University of Queensland, Brisbane, Australia

^{14}C age dating of Pearls





AGE DETERMINATION OF PEARLS: A NEW APPROACH FOR PEARL TESTING AND IDENTIFICATION

Michael S Krzemnicki

Swiss Gemmological Institute SSEF, Falknerstrasse 9, 4001 Basel, Switzerland. Email: gemlab@ssef.ch.

Irka Hajdas

Laboratory of Ion Beam Physics, ETH Zurich, Schafmattstr. 20, 8093 Zurich, Switzerland. Email: hajdas@phys.ethz.ch.

ABSTRACT. For this radiocarbon study, 7 saltwater pearls and 3 shells from pearl oysters have been analyzed. The declared ages of the samples range from the mid-19th century to very recent formations. The analyzed data show the potential of the bomb peak time marker to provide additional information when testing pearls. The analyzed pearls could be distinctly separated in pearls of pre- and post-bomb peak ages, in agreement with the distinction based on the declared ages. The analyzed data further reveals the potential of this method to provide supporting evidence for the historic provenance of a pearl or as an indication of a natural or cultured formation of a pearl.

INTRODUCTION

Due to their beauty, pearls have been used for adornment since prehistoric times and are among the most prized jewels, as they connote not only beauty and rarity, but also status and have thus been used as means of representation in many cultures since ancient times (Kunz 1908). Famous historic jewels and ornaments with pearls are known from the treasures of the royal courts in Europe, Russia, the Middle East, India, and China (Bennett and Mascetti 2007; Scarisbrick 2008).

With the development of pearl cultivation in the beginning of the 20th century, pearls have gained a much-increased accessibility and popularity when compared to previous ages. Now the pearl trade

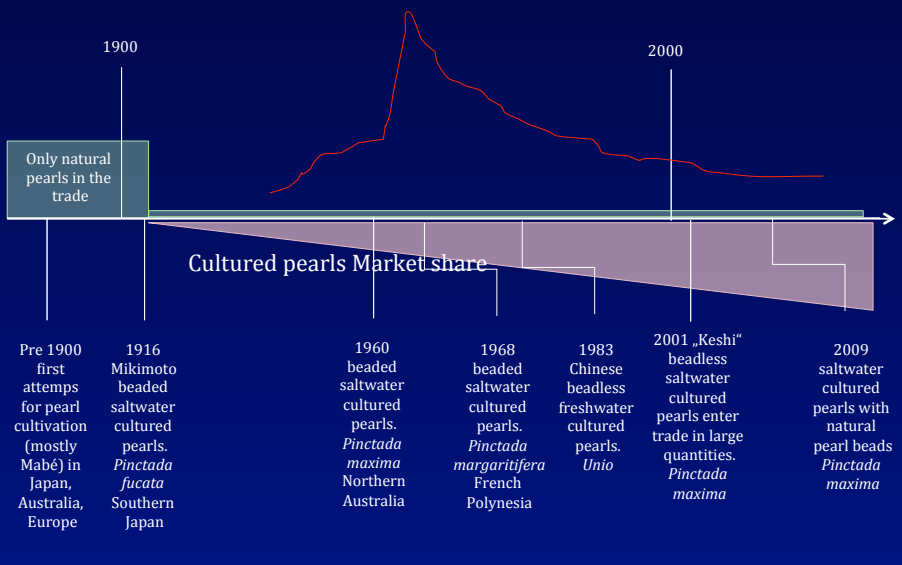
Krzemnicki & Hajdas, 2013 (Radiocarbon)

Figure 4. Calibrated of 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 ΔR=190±180 yrs.

To confirm a documented historical provenance of a pearl.

^{14}C Age dating of Pearls:

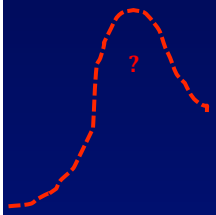
as an additional test to support distinction between natural and cultured pearls

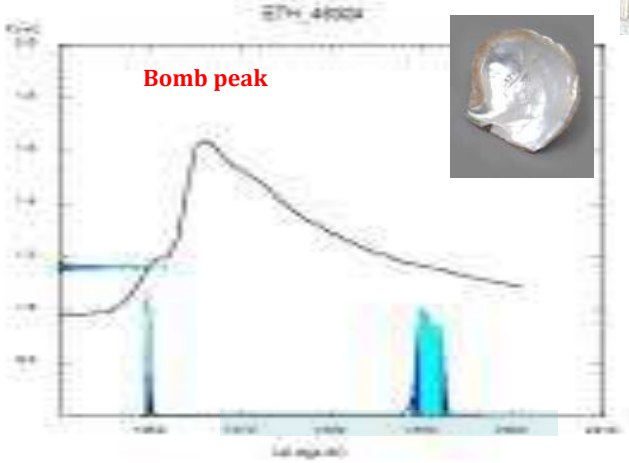


^{14}C age dating of Pearls:

Shell of *Pinctada maxima* from the Philippines, collected in 1990 (pers. comm. H.A. Hänni)

Kim Jong Boom ??





Visit at Paspaley in North Australia

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…

Visit to Mogok: January 2014

Jade market in Mandalay

Baw mar sapphire mine

„Kanase“ looking for spinels, rubies and sapphires, washed from gravels in carstic marbles at Inn Chauk

Thank you for your attention