Facette

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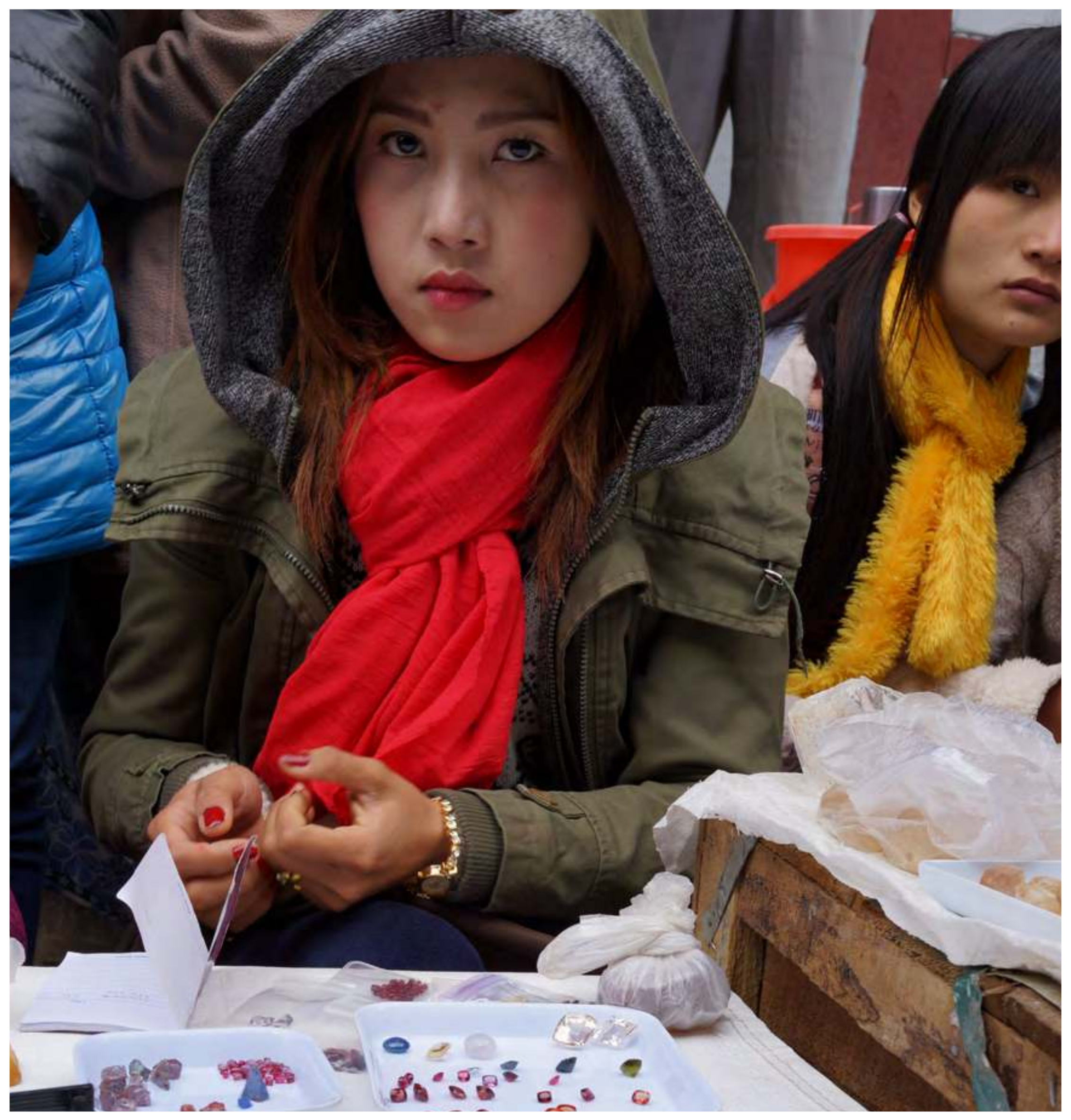

PADPARADSCHA / NEW EMERALDS / TREATMENTS
DIAMOND RESEARCH / PEARL ARTICLES / SSEF AT AUCTION
SSEF COURSES / LECTURES / ON-SITE TESTING

SSEF

SCHWEIZERISCHES GEMMOLOGISCHES INSTITUT
SWISS GEMMOLOGICAL INSTITUTE
INSTITUT SUISSE DE GEMMOLOGIE

Dear Reader

It is my great pleasure to present you the 24th issue of the SSEF Facette, the annual magazine of the Swiss Gemmological Institute SSEF. Starting as a humble leaflet with a few black & white pages in a very basic layout, the Facette has evolved in recent years into a – what I consider – very informative bulletin with plenty of information about recent research findings and activities at SSEF, presented to you in a simple but modern design.

I am happy to say that the last year has been very successful for SSEF, with more clients, new services and wider outreach than ever. We are also happy to see that the international gem and jewellery market has gained momentum and is in a much better shape compared to only a few years ago.

Having said this, it is important to know that we measure our success not only in business numbers, but much more so in the amount of research projects and collaborations which were launched or concluded in the past few months, all bringing in new valuable and trade-relevant findings. The results of these activities are presented to you in the following pages. They cover a wide range of topics about coloured stones, diamonds and pearls, and also information related to our services.

As in previous years, you will find in this SSEF Facette a colourful mix of trade relevant news: good news, such as newly discovered gem deposits which may have a great potential for the gem trade, but also 'bad' news which address (treatment) issues which are challenging the market now and in future. As we live in an ever-changing world, I think it is crucial to always keep both of these sides in view. With the SSEF Facette, it is our aim to explain to you in detail our position and our scientific-based strategies to handle such issues within the laboratory. Our aim is to always stay at the forefront of gemmological research and consequently, to be able to offer you services at the highest level of confidence and integrity.

I hope that the following pages provide you not only with relevant new information on gems, but also lots of reading pleasure.

At this point, I would like to wish you a very successful 2018 with sparkling gems and gemmy reflections about our lives and the beauty we can bring to other peoples' lives through our profession.

Dr. Michael S. Krzemnicki
Director SSEF

COVER PHOTO ▷

Dealer at the Mogok morning cinema market in Myanmar.

Photo: S. Hänsel, SSEF

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PADPARADSCHA-LIKE FANCY SAPPHIRES WITH UNSTABLE COLOURS

△ **Figure 1:** Fancy sapphire recently found in Madagascar showing an unstable colour, shifting from pinkish orange (padparadscha-like) to pink after a fading test. Photo: SSEF

Colour and the stability of colour centres

The colour of corundum varieties is commonly related to the presence of colouring trace elements, such as chromium (for the red of rubies) and iron combined with titanium (for the blue of sapphires). As such, the equation is very simple: the more of these traces are present, the deeper saturated or dark the colour may be. Yellow sapphires are more complex as they can owe their colour to various causes, including so-called colour centres. Such colour centres are in fact structural defects at an atomic level, which when activated absorb certain parts of light (for yellow sapphires mainly in the blue range of the visible spectrum), thus resulting in different shades of yellow.

It has been known for many years that some of these (naturally formed) yellow colour centres in corundum are not stable, resulting in a slowly fading yellow colour upon exposure of the gemstone to daylight. Similar colour centres which are unstable under normal daylight are in fact not so rare in mineralogy. Known examples include certain (Alpine) amethyst crystals and this phenomenon can be quite dramatic for Maxixe-type (irradiated blue) beryl. It has also been described for (untreated) hackmannite, a rare sulphur-bearing variety of sodalite, which can be coloured stunningly purple by placing the stone under a UV lamp for a few minutes, before the colour fades out again (rather quickly) under daylight.

The case of yellow sapphires

The effect of fading in daylight and reactivation by UV radiation is known in scientific literature as reversible photochromism or tenebrescence. Interestingly, this effect has already been reported for synthetic corundum and observed in our own in-house colour-stability studies on a small number of natural yellow sapphires from Sri Lanka (see Figure 2, and Hughes 1998). In all our studies, this group of yellow sapphires consistently gained slight brownish yellow to marked yellow tones after UV exposure, which under normal light conditions would fade out over a period of several days. It has to be said that all these tenebrescent natural yellow sapphires do not fade out completely after applying a fading test. They did not become colourless but just showed a noticeable reduction in their yellow colour saturation.

△ **Figure 2:** Yellow sapphire of >50 ct with unstable (reversible colour), seen before fading test (left), after fading test (middle), and after exposure to UV radiation (right). Photos: J. Xaysongkham, SSEF

As a consequence of this, it is our normal procedure at SSEF to test the colour stability of (metamorphic) yellow sapphires – always with the permission of the client. The result of the fading test (colour considered stable or colour unstable) is then disclosed in the comment section of our SSEF reports.

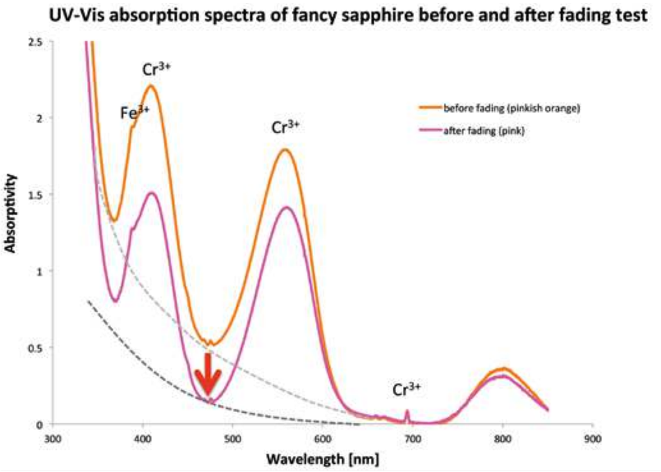
The case of padparadscha with unstable (reversible) colour

In the past year, a new corundum deposit emerged near the small town of Ambatondrazaka in Central-East Madagascar (see last SSEF Facette, No. 23, page 15, and ICA InColor No. 35, Spring 2017, pages 44-47). This new site has produced an impressive range of sapphires – mainly blue of partly excellent beauty and size – but also a range of other fancy colours, including subtle pinkish orange stones, a colour variety known and highly appreciated in the trade as padparadscha.

However, part of these stones show a distinct change of colour over time shifting from a distinct pinkish orange to just pink in the course of weeks. Similar to the above mentioned yellow sapphires, the colour of these stones with unstable colours can be restored after a short exposure to UV light, so that they become pinkish orange again (at least until they start to slowly fade out again in daylight). In other terms, the stable colour of these stones is in fact pink (chromium-related), and the superposed unstable colour is yellow (due to an unstable yellow colour centre), resulting – if activated - in an overall orange to pinkish orange colour of the stone (Figure 3).

The reason for this quite unusual colour change (instability) of this new material from Madagascar is very similar to the above mentioned yellow sapphires. Their subtle padparadscha colour is in fact a mix of a weak chromium-related absorption (resulting in a pink colour) superposed by broad absorption bands due to yellow colour centres. In cases where such a colour centre is not stable, it results in the observed shift of

△ **Figure 3:** Fancy sapphire from Ambatondrazaka (Madagascar) showing pink colour (actually the chromium-related stable colour of this stone), which shifts to pinkish orange after activation of the yellow colour centre, and subsequently returns to pure pink after fading (back to stable colour). Photos: V. Lanzafame, SSEF



△ **Figure 4:** UV-Vis absorption spectra (normalised) of a fancy sapphire from Madagascar with unstable colour before (pinkish orange colour) and after (pink colour) fading test. Apart from absorption bands by chromium and small peak by iron (Fe^{3+}), these two spectra demonstrate that the underlying yellow colour centre (schematically drawn with a light grey dotted line) is disappearing. The observed difference in colour is mainly due to the more prominent transmission window in the blue part of the spectrum (red arrow), thus shifting the colour of the stone distinctly to pink. Figure: M.S. Krzemnicki, SSEF

△ **Figure 5:** An attractive fancy sapphire from Madagascar showing an unstable (but reversible) colour shift, somehow reminiscent to the chameleon effect in diamonds. Background photo: www.nationalgeographic.com.au

colour from pinkish orange (colour centre active) to pink (colour centre inactive). Spectroscopically spoken, the colour shift results from a distinct reduction (fading out) of a yellow colour centre, as can be seen in absorption spectra before and after fading tests (Figure 4).

Fading test and disclosure of unstable colour on SSEF reports

Based on current scientific knowledge, the colour stability of gemstones can be quite easily tested – even by a well-trained gemstone dealer. Before testing, the colour of the gemstone has to be very well defined (e.g. with Munsell colour charts or other Colour Scan systems). The stone is placed on a metallic reflecting plate and then exposed during approximately 3 hours to a very strong fibre optic light source (halogen). After this, the colour is again meticulously determined. Any noticeable change/shift may also be confirmed by UV-Vis spectra taken before and after the fading test. To check restoration of colour with UV radiation, the stone is subsequently placed table down directly on a strong UV light source (in a dark box) and exposed for about 10 minutes to UV radiation. Again, the colour needs to be meticulously determined to check if any change has occurred.

In cases where this tenebrescent shift of colour is only minimal (as we observed in a few padparadschas from Sri Lanka), it can be neglected and does not need specific attention. Some of this new material from Madagascar, however, has shown a very marked shift of colour from (slightly pinkish) orange to pure pink (Figure 2), which in our opinion requires specific disclosure. Buying a stone as padparadscha and seeing it a few weeks later as a just pink sapphire might be quite disillusioning for a consumer.

As a consequence, the SSEF is now regularly carrying out fading tests on padparadscha and padparadscha-like sapphires, again always with the consent of the client. We then disclose the stability of colour on our reports in the comments section. A further consequence of these new stones shifting from orange to pure pink, is that we do not call these stones padparadscha, but fancy sapphire, adding in such cases an explanation letter to our report. In our understanding, the term padparadscha is only applicable for sapphires of subtle orange pink to pinkish orange colour which do not show a noticeable colour shift.

Fancy sapphire with 'chameleon effect'

In summary, these orange to pink fancy sapphires of unstable colour - so far observed only from this new source in Madagascar – can still be very attractive in colour and size (Figure 5). The colour shift they show is certainly a challenge for the trade dealing with padparadscha sapphires. However, the good news is that this process is reversible, in many ways similar to the phenomenon found in so-called chameleon diamonds. As such, we suggest that the trade not just be worried, but also has the option of embracing this new material and appreciating this 'chameleon effect' as something special. ✶ **Dr. M.S. Krzemnicki**

FIELD TRIP TO PARAIBA, BRAZIL

For any gemstone connoisseur and gemmologist, the term 'Paraiba' is magical inspiration and epitomises pure beauty, referring to the incredibly vivid coloured copper-and manganese bearing elbaite tourmalines, which have mesmerized the trade and public alike since their discovery end of the 1980s in the state of Paraiba in Brazil. Up to today, this area has produced some of the finest tourmalines the world has ever seen with a range of vivid blue (to green) colours, known in the trade also as 'electric blue' or 'neon blue'.

△ **Figure 1:** A Paraiba tourmaline of nearly 10 ct and exceptional quality, tested recently at SSEF. Photo: V. Lanzafame, SSEF

Paraiba tourmaline - first discovered in 1989 by Heitor Dimas Barbosa near the village of São José da Batalha in Paraíba State, northeastern Brazil - immediately created a buzz in the market, because of its vibrant, almost unearthly colours and rarity. Until today, it is one of the most sought-after gemstones the world over and highly prized in finest qualities.

In October 2017, a team of gemmologists from the SSEF had the privilege to visit some Paraiba tourmaline mines in Brazil to get impressions about mining procedures, sorting, cutting and trading activity in the states of Paraiba and Rio Grande do Norte. This was also a great opportunity to study the geological context of the Paraiba tourmaline mining areas in more detail and collect samples first-hand. As we could see for ourselves, these areas produce many other stunning gems with a diversity reaching far beyond just 'Paraiba tourmaline'.

Dr. Hao Wang, Sebastian Hänsel and Alexander Klumb from SSEF were kindly accompanied during this field trip by Mr. Carlo Somma. We were very happy to have him as our guide, as he is very knowledgeable of this area.

During the week-long field trip, we were able to visit some famous Paraiba tourmaline mines in gem-bearing pegmatites within the Late Proterozoic metamorphic rocks of the Equador formation, such as the Mulungu-mine (also known as the Capoeira, Boqueirãozinho, or CDM mine) close to the city of Parelhas, which is the only mine currently producing Paraiba tourmaline in some quantities.

During the field visits, it was especially interesting to see the different techniques applied for extraction, ranging from simple artisanal mining in small-scale mines to mechanized large-scale mining.

In conclusion, we can say that this field trip to Brazil left us highly impressed. The aura of the area clearly reaches far beyond just the gemstones themselves. The rich gemstone heritage is present in many aspects of everyday life. A big part of the population of Parelhas has some link to gemstone mining or trading. We are very grateful to the mine owners and traders who opened their doors and let us visit their mining operations and show us their stones. We are especially grateful to Mr. Carlo Somma, Mr. Sebastian Ferreira, and Mr. Nelson Oliveira for their support and organisation of this field trip. ✶ **A. Klumb, SSEF**

△ **Figure 2:** An overview of the Mulungu mine (Rio Grande del Norte), the only active mine producing Paraiba tourmalines in some quantities at present. Photo: A. Klumb, SSEF

△ **Figure 3:** The geology in the Paraiba tourmaline mining area in Brazil is complex, and research still remains to be done to fully understand the gem formation in that area. Here, Dr. Hao Wang inspects comb-textured dravite (black tourmalines) arranged along the contact of the gem bearing pegmatite with the adjoining quartzite country rock at the Mulungu mine (Rio Grande del Norte). Photo: A. Klumb, SSEF

△ **Figure 4:** An overview of the Batalha mine near the village São José da Batalha (Paraíba) where the first Paraiba tourmalines were discovered in 1989. This mine has produced in the past some of the most beautiful and impressive Paraiba tourmalines ever found. Photo: A. Klumb, SSEF

△ **Figure 5:** Lucky find: Paraiba tourmalines are found along the shafts in the Mulungu mine (Rio Grande do Norte) even 100 meters below surface. Photo: H.A.O. Wang, SSEF

△ **Figure 7:** As single crystals are very rare, mainly Paraiba tourmaline intergrown with matrix (Quartz and other minerals) is polished as cabochons for sale. Photo: S. Hänsel, SSEF

△ **Figure 6:** Highly fractured, Brazilian Paraiba tourmaline crystals are almost always under a carat, as can be seen in this photo. Tourmalines in a huge array of different colours can be found. Photo: A. Klumb, SSEF

△ **Figure 8:** On the road to the Batalha mine, the entrance to the village of Sao Jose de Batalha with the town sign. From left to right: Sebastian Hänsel, Alexander Klumb, and Dr. Hao Wang.

ETHIOPIA: NEW SOURCE FOR SAPPHIRES AND EMERALDS

△ **Figure 1:** Small series of emeralds from Ethiopia analysed recently at SSEF ranging in size from 1.3 to 10 ct and showing an attractive saturated green colour. Photo: V. Lanzafame, SSEF

Ethiopia is known in the gem trade since many years mainly as an important source of opal. A first deposit was discovered in 1994 near Mezezo, about 150 miles northeast of Addis Ababa in the northern part of the Shewa Province, mostly producing opal of brown body colour and often characterised by crazing and cracking due to dehydration (SSEF Facette 2011, No.18, page 7). Later, starting from 2008, a new and even more relevant opal deposit was discovered in stratified volcanic rocks near the town of Wegel Tena in the Wollo Province in the northern part of the country. This material definitively put Ethiopia on the gem trade map, as it is until today supplying the trade with large quantities of precious opal of partly excellent quality.

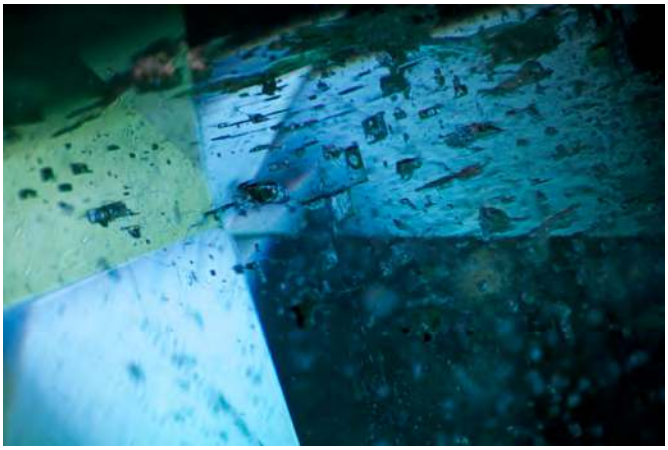
Ethiopia is geologically located at the northern section of the so-called Mozambique mobile belt - a major Proterozoic structural metamorphic unit along East Africa and a treasure trove aligning many exceptional gem deposits along this large scale geological structure. It is therefore not surprising that new gem deposits have been discovered in this area, and we are convinced further will come in the near future.

Emeralds from the South

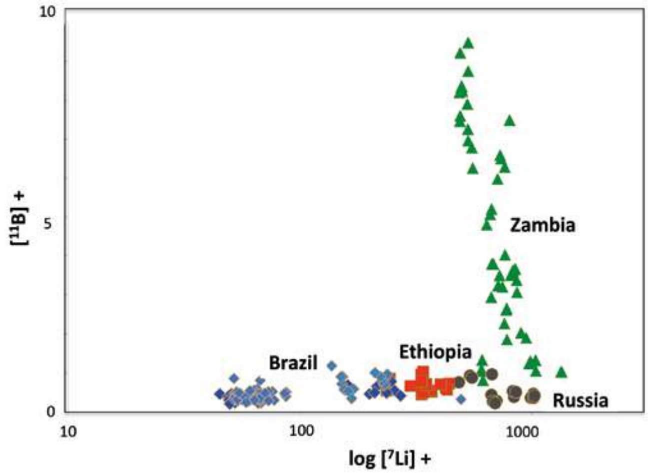
In 2016 the first emeralds appeared in the gem trade which reportedly came from new deposits discovered near the town of Shakiso in southern Ethiopia. Soon after, some of these stones partly of high quality were submitted to the SSEF (Figure 1) and we were able to collect microscopic and analytical data and to integrate a number of these new emeralds from reliable sources and a field trip as reference material into our SSEF gemstone collection.

These new emeralds from Ethiopia are in many aspects very similar to emeralds from other mica-schist related deposits, e.g. in Zambia (Kafubu) and Brazil, but clearly distinguishable from Colombian or Afghan emeralds. They often show rectangular two- to multiphase fluid inclusions (Figure 2), fine hollow channels parallel to the optical axis and dark brown mica (biotite) and some prismatic amphibole. The analysed absorption spectra are consistent with iron-rich emeralds from mica-schists in Zambia and Brazil, with a distinct absorption band in the near-infrared range due to iron. Origin determination of these new emeralds at SSEF is mainly based on a detailed trace element analysis (Figure 3).

As with emeralds from other sources, material with fissures is commonly filled and both oil and artificial resin have been identified in emeralds from this new source at SSEF.



△ **Figure 2:** rectangular to comma-shaped fluid inclusions in an emerald from Ethiopia. The different colours in this photo are an effect of the pleochroism of emeralds. Photo: M.S. Krzemnicki, SSEF



△ **Figure 3:** GemTOF bivariate plot using boron and lithium trace elements to separate emeralds from different schist-related deposits. Figure: M.S. Krzemnicki, SSEF

Sapphires from the North

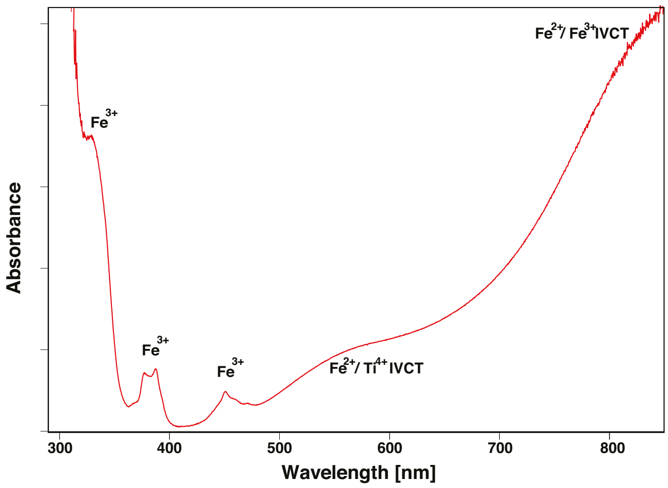
Apart from this new find in the south, at nearly the same time a new sapphire deposit emerged from the remote Ethiopian Highlands near the city of Aksum in the Tigray region of Ethiopia, close to the border to Eritrea. These sapphires are found in dusty gravel layers of a secondary deposit related to alkali basaltic rocks produced at the northern end of Africa's Great Rift Valley.

Reportedly, this new sapphire deposit produces sapphires sometimes of impressive size and quality. However – as very typical for basaltic sapphires, they are often rather dark (or even too dark) blue, and as a consequence need to be heated (in Sri Lanka or Thailand) to modify and improve their colour and clarity.

△ **Figure 4:** Sapphires from Ethiopia in rough and cut form. Photo: SSEF

The SSEF has received a selection of these sapphires for our reference collection and has analysed them in detail. They show great resemblance in inclusions, spectroscopic features and trace element concentrations with sapphires from other basaltic sources, e.g. from Rwanda (also bound to the African-Rift system), Nigeria, Thailand, Cambodia, to name a few. The separation of this new material from sapphires of classic metamorphic origin (e.g. Kashmir, Sri Lanka, Burma) is straightforward using microscopy, absorption spectroscopy, and trace elements. ✶ **Dr. M.S. Krzemnicki, SSEF**

△ **Figure 5:** Landscape of Ethiopian highlands. Photo: S. Hänsel, SSEF



△ **Figure 6:** UV-Vis spectrum of basaltic sapphire from Ethiopia. Figure: SSEF

NEW EMERALDS FROM AFGHANISTAN

△ **Figure 1:** Emeralds (approx. 1.5 to 6 cts) of exceptional purity from a new find in Afghanistan, analysed in September 2017 at the SSEF. Photo: J. Xaysonghkam, SSEF

Emeralds from Afghanistan are well known in the trade for their beauty and size, and are considered a historic source of fine emeralds. Despite the political turmoil of recent decades, these mines have recently produced again a number of gems of outstanding quality and size, as we could observe at SSEF during the past few months. The successful sale of a stunning emerald of 10 ct from the Panjshir mines at the Christie's Hong Kong sale in December 2015 marked just the beginning of this revival.

From a gemmolgical point of view, we can state that there are two different types of emeralds from Afghanistan, a) the classic material from Afghanistan, which has been described in literature quite extensively (Bowersox et al., 1991, Gems&Gemology; and Schwarz and Pardieu 2009, InColor magazine) and b) new material of exceptional similarity to Colombian emeralds which entered the trade presumably early in 2017. These new emeralds from Afghanistan, reportedly found in a single gem pocket in the Panjshir mines posed quite some problems for the gemmological community and labs. Being of outstanding quality and purity, they resemble in many aspects – including colour – the finest quality of Colombian emeralds.

A spectacular series of these new Afghan emeralds analysed at SSEF in September 2017 finally enabled us to resolve the mystery about these new stones and to define clear criteria to distinguish them from their Colombian cousins.

Microscopic observations revealed that the new material from Afghanistan contains irregular and spiky fluid inclusions (three and multiphase) very similar to Colombian emeralds. They are largely dominated by very fine and long parallel hollow tubes along the c-axis of the original emerald crystal (Figure 2), again very deceiving as similar features are well known in Colombian emeralds. A notable difference was however the absence of distinct (hexagonal) graining in all our specimens from Afghanistan, a feature rather common in emeralds from Colombia. Only in one specimen from Afghanistan we could observe a very weak and rather chevron-like growth pattern, together with few very fine and kinked hollow tubes (Figure 3)

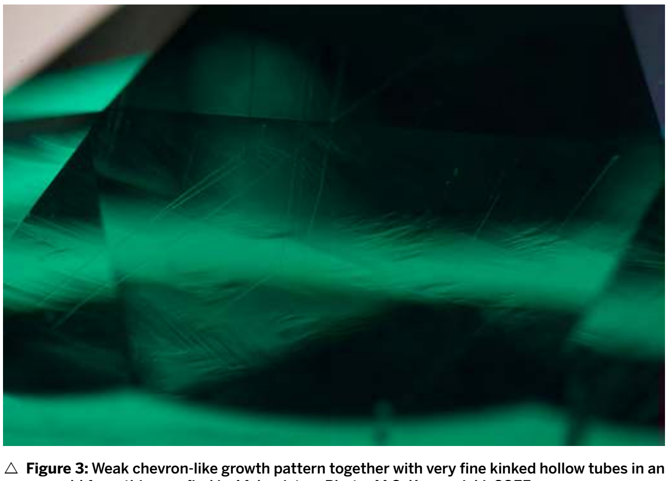
△ **Figure 2:** Emerald from Afghanistan with fine parallel hollow tubes along the c-axis, but hardly any other inclusion. Photo: M.S. Krzemnicki, SSEF

Classical gemmological testing further revealed that these new Afghanistan emeralds show a specific gravity of approximately 2.72 - well in line with Colombian material – but had refractive indices (ranging approximately from 1.582 to 1.592) slightly higher than most Colombian emeralds.

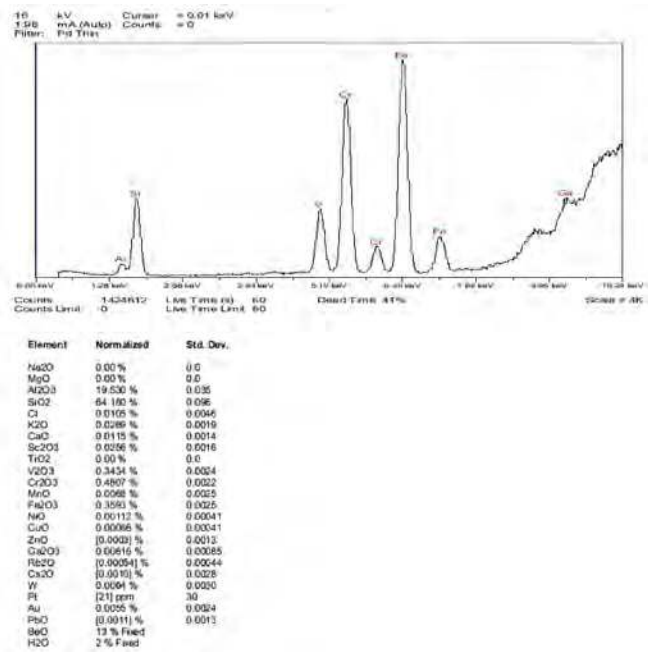
Coloured very similar to Colombian emeralds by a combination of chromium, vanadium and iron, the most important difference was found to be the distinctly higher concentration of iron (about 0.3 – 0.4 wt% Fe_2O_3) in all of these emeralds when measured with ED-XRF and compared to Colombian emeralds (usually distinctly < 0.1 wt% Fe_2O_3). The scandium concentration showed broad variations from 0.02 wt% to 0.14 wt%, so was not considered to be specific for this new material from Afghanistan.

The absorption spectrum of these emeralds shows main absorption bands in the visible range due to chromium and overlapping vanadium, and a small iron band at about 850 nm characteristic for Afghanistan emeralds (Figure 5), but usually not seen in Colombian emeralds.

In summary, the detailed study of these high-quality emeralds from this new find in Afghanistan finally enabled us to be the first laboratory to define clear criteria for a safe and reliable origin determination of this new material and a clear distinction from Colombian emeralds. However, it is not known at this point, whether there is an on-going production of similar emeralds in Afghanistan or if it was rather a lucky find of a single pocket filled with exceptional emeralds. ✶ **Dr. M.S. Krzemnicki, SSEF**

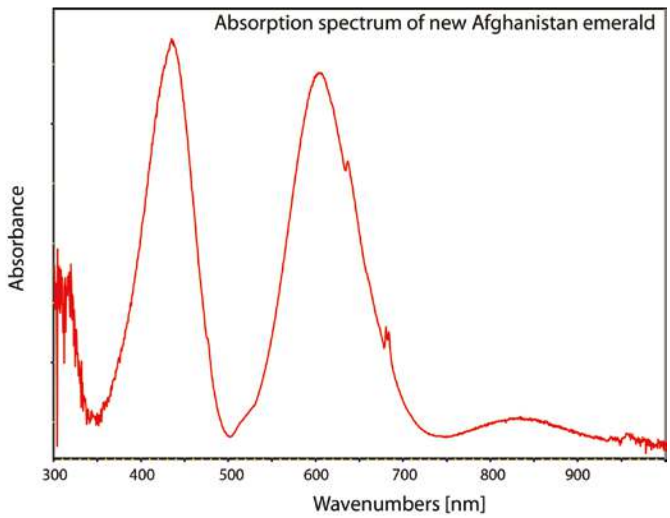


△ **Figure 3:** Weak chevron-like growth pattern together with very fine kinked hollow tubes in an emerald from this new find in Afghanistan. Photo: M.S. Krzemnicki, SSEF



Element	Normalized	Std. Dev.
Na2O	0.00 %	0.0
MgO	0.00 %	0.0
Al2O3	19.530 %	0.035
SiO2	64.180 %	0.096
Cl	0.0105 %	0.0046
K2O	0.0289 %	0.0019
CaO	0.0115 %	0.0014
Sc2O3	0.0256 %	0.0016
TiO2	0.00 %	0.0
V2O3	0.3434 %	0.0024
Cr2O3	0.4807 %	0.0022
MnO	0.0068 %	0.0025
Fe2O3	0.3590 %	0.0025
NiO	0.00112 %	0.00041
CuO	0.00066 %	0.00041
ZnO	[0.0003] %	0.0013
Ga2O3	0.00616 %	0.00085
Rb2O	[0.00054] %	0.00044
Cs2O	[0.0010] %	0.0028
W	0.0064 %	0.0030
Pt	[21] ppm	30
Au	0.0055 %	0.0024
PbO	[0.0011] %	0.0013
BeO	13 % Fixed	
H2O	2 % Fixed	

△ **Figure 4:** The ED-XRF spectrum of an emerald from this new find in Afghanistan, qualitatively resembling very much Colombian emeralds, but showing a distinctly higher iron concentration (0.359 wt% Fe_2O_3) calculated from above measured spectrum. Figure: J. Braun, SSEF



△ **Figure 5:** UV-Vis-NIR absorption of an emerald from this new find in Afghanistan collected with the SSEF portable spectrometer. Note the characteristic small iron-related band at about 850 nm in the near infrared for these emeralds. Figure: M.S. Krzemnicki, SSEF

TRADE ALERT: ARTIFICIAL RESIN IN RUBIES

Rubies often contain fissures, mostly due to geological conditions in which they formed, but also due to their brittleness, supported by the incorporation of chromium traces (responsible for the beautiful red colour of ruby) into their crystal structure. Especially rubies which formed in marbles, such as the famed deposits in the Mogok Stone Tract, but also similar rubies from Vietnam, Tajikistan, Afghanistan, and even East Africa (e.g. Kenya, Tanzania) are prone to containing rather large fissures, thus reducing the clarity and apparent beauty of such stones.

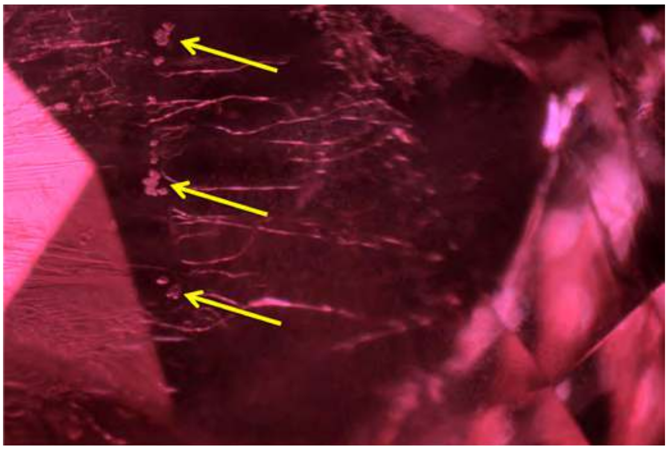
It is not astonishing that such a ruby – as for any gemstone containing fissures – is traditionally filled with colourless oil, to modify and enhance its clarity. A timely reminder of this often neglected fact was described in detail in the last issue of the SSEF Facette in 2017 (No. 23, page 16).

Very recently however, we came across a series of fine Burmese rubies (Mogok-type), which were treated with artificial resin (polymer-type) to modify the clarity of these fissured stones (Figure 1). Having seen in the past decades at SSEF only a very small number of rubies which showed small glued chips, this new find at the laboratory is rather alarming. These newly treated stones show fine and deep fissures, which are filled with a polymer of assumingly very liquid consistency (similar to the ExCel™ treatment of emeralds), which was then hardened to stabilise the filler. The visual effect of this clarity modification is quite noticeable, as the resin-filled fissures are rather difficult to see. Under the microscope, this observation is confirmed as these resin-filled fissures show distinctly reduced reflection effects compared to unfilled (or oil-filled) fissures. Furthermore, these fissures reveal few small, but structured air bubbles (see Figure 2) and occasionally tiny worm-like dendrites located mostly entirely within the fissures (see Figure 3). These structured dendrites are clearly different from the delicate rounded dendritic patterns (floral aspect) known from oil-filled fissures. An unambiguous detection of this filler type is provided by infrared spectroscopy (FTIR, see Figure 4), indicating the same pattern of absorption peaks known and described in scientific gemmological literature for artificial resin (polymers) in emeralds (Kiefert et al. 1999).

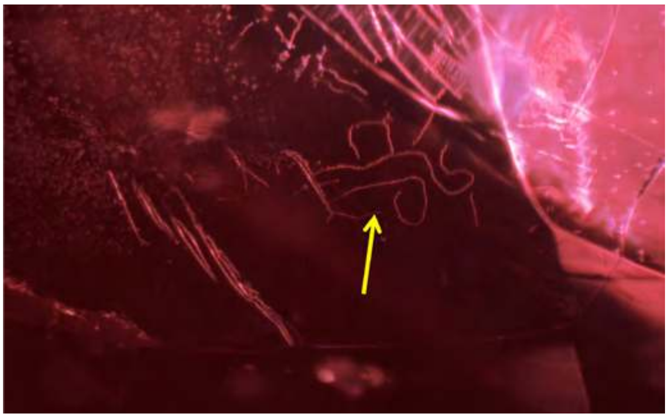
To reassure the trade, we would like to add that from a lab's perspective, the detection of artificial resin in rubies is possible using well established analytical procedures. As we follow a strict full disclosure policy at SSEF, such artificial resin fillers in rubies are identified and quantified in the comments section of our SSEF reports (see Figure 5) whenever present in a ruby (or any other gemstone!).

On a more general level we think that this issue has to be properly addressed by the trade and as early as possible. So far, the ruby trade – at least in the high-end segment- has been spared the turmoil and problems which have shaken the emerald market for years because of undisclosed filler substances. With this new and alarming find, we urge the ruby trade and producers to take strong action against this new practice of using artificial resin in rubies (of high quality) and against anybody involved in this treatment issue with the aim of protecting the image of rubies as valuable gemstones and to maintain the confidence of consumers in the ruby trade. ✶ **Dr. M.S. Krzemnicki, SSEF**

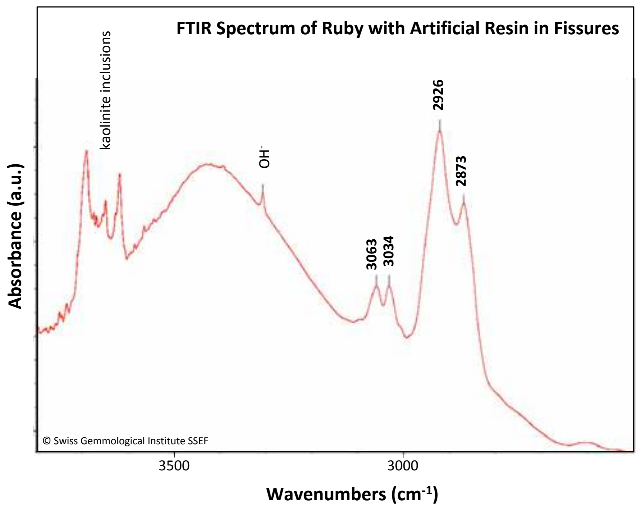
△ **Figure 1:** Series of rubies (2.5 - 4.5 ct) all containing fissures filled with artificial resin. Photo: V. Lanzafame, SSEF



△ **Figure 2:** Small structured air bubbled (yellow arrows) in a ruby fissure filled with artificial resin. Photo: M.S. Krzemnicki, SSEF



△ **Figure 3:** Fine structured worm-like dendrites (yellow arrow) in a ruby fissure filled with artificial resin. Photo: M.S. Krzemnicki, SSEF



△ **Figure 4:** FTIR spectrum of a ruby with peaks (labelled) indicating the presence of artificial resin in fissures. The sharp peaks at about 3600 cm^{-1} are related to fine kaolinite-type (clay mineral) inclusions naturally occurring in many rubies. Spectrum: SSEF

SSEF

SCHWEIZERISCHES GEMMOLOGISCHES INSTITUT
SWISS GEMMOLOGICAL INSTITUTE
INSTITUT SUISSE DE GEMMOLOGIE

Gemstone Report No. SPECIMEN

Weight:	4.986 ct
Shape & cut:	oval, brilliant / step cut
Measurements:	10.08 x 9.29 x 4.97 mm
Colour:	red of medium strong saturation
Identification:	RUBY (variety of natural corundum)
Comments:	The analysed properties confirm the authenticity of this transparent ruby. No indications of heating. Moderate amount of artificial resin in fissures at the time of testing. Origin: Burma (Myanmar)

SWISS GEMMOLOGICAL INSTITUTE – SSEF

Basel, 24 January 2018 tg

J.-P. Chalain, DUG

Dr. M. S. Krzemnicki, FGA

△ **Figure 5:** Specimen of an SSEF report indicating the presence and quantity of artificial resin in fissures.

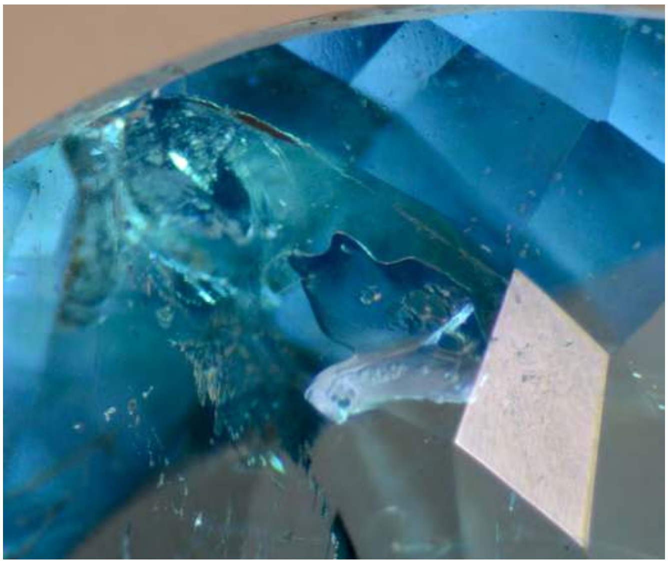
FISSURE-FILLING IN PARAIBA TOURMALINE

Paraiba tourmaline is a highly attractive coloured stone, renowned for its range of vivid blue to green colours. Often, however, this rare copper and manganese bearing variety of elbaite tourmaline contains small fissures which may then reduce its clarity. This is especially true for material which is heated, as the heating creates new fissures and expands existing ones considerably. As with any gemstone with fissures, it is thus of no surprise that some of this fissured material is filled with a colourless foreign substance (mostly artificial resin) to modify and enhance its transparency and thus apparent beauty. Needless to say that such fissure filling has to be disclosed throughout the trade and to the final consumer (CIBJO trade rules) and is thus detailed in the comment section of SSEF reports.

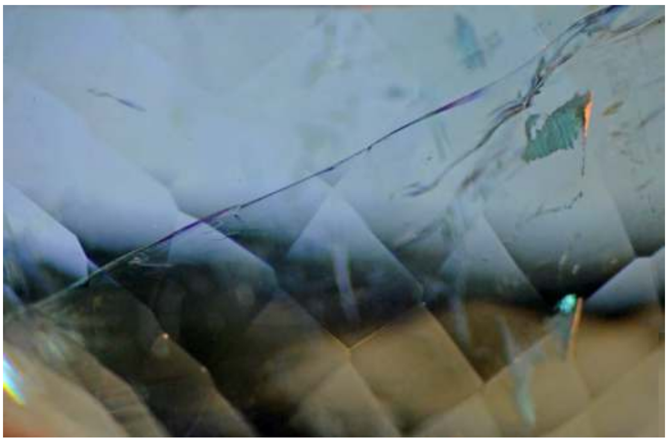
△ **Figure 1:** Paraiba tourmaline, heated and with artificial resin in fissures. Photo: V. Lanzafame, SSEF

We recently analysed a beautiful stone of approximately 3 ct size (Figure 1) and vivid blue colour, which turned out to be a perfect case study to expose this fissure filling in Paraiba tourmaline. Meticulous microscopic observation and spectroscopic analyses revealed that this tourmaline was heat treated to modify its colour, a fact which is very common for most Paraiba tourmalines, although not always detectable by scientific methods. In addition, this tourmaline showed large fissures which were at first hardly visible. Under microscopic magnification, those fissures showed tell-tale features of artificial resin as filler, such as flat, sticky and structured air bubbles (Figure 2) and purplish blue 'flashes' (Figure 3), very similar to 'flash effects' found in emeralds filled with artificial resin (Kiefert et al., Journal of Gemmology 1999; Kammerling Gems & Gemology 1995).

To reassure the trade, this treatment is not new and we further can say that we have not seen an increase of such material in our lab recently. When assessing/buying Paraiba tourmalines, such treatments need to be considered and tested for. Since many years, the SSEF applies very strict and consistent criteria for fissure filling quantification and identification in any gemstone, including Paraiba tourmalines, based on the LMHC harmonization and detailed in the last Facette No. 23, published in 2017. ✶



△ **Figure 2:** Fissure filling consisted of artificial resin containing large flat and structured air bubbles. Photo: M.S. Krzemnicki, SSEF



△ **Figure 3:** Fissure (diagonal) filled with artificial resin showing characteristic purplish blue flash effect. Photo: M. S. Krzemnicki, SSEF

HEATED SAPPHIRE DETECTED USING FE-HYDROXIDE TRANSFORMATION

Rubies and sapphires quite often contain small fissures. These fissures may be filled naturally by iron hydroxide, mineralogically known as limonite FeO(OH) x nH_2O, a mixture of hydrated iron oxides, such as goethite, lepidocrocite, and jarosite. This iron-rich substance shows a characteristic yellowish brown to orange colour and powdery consistence.

This is especially true for gems found in alluvial gravels below lateritic (iron-rich) reddish soil, which is most characteristic for tropical to sub-tropical climates, such as in Madagascar (e.g. Ilakaka, Ambatondrazaka), Mozambique (Montepuez), and Sri Lanka, to name a few.

As reported in literature before, heat treatment (already at about 350 °C) dehydrates limonitic iron hydroxide in fissures of gemstones into red iron oxide hematite Fe_2O_3 (Koivula, Gems & Gemology 2013; Sripoonjan et al., Journal of Gemmology 2016; Ruan et al., Spectrochimica Acta 2002). Recently, we received a sapphire for testing (Figure 1) which showed relatively few inclusions (mainly tiny rutile needles), which looked rather unaltered, apart from a surface-reaching fissure filled with brownish red granular substance (Figure 3). Already a hint for heat treatment, Raman microspectrometric analysis of the substance within the fissure further confirmed the heating process. It revealed this brownish red substance to be hematite, thus the product of dehydration (by the heating) of previously present iron-hydroxide. Detection of heat treatment in gemstones at SSEF is always based on a combination of meticulous microscopic observation and analytical data, as shown by this exemplary case. ✶

△ **Figure 1:** Sapphire that was examined for heat treatment. Photo: SSEF

△ **Figure 3:** Brownish red granular substance found within fissure provided evidence for heat treatment in this sapphire. Photo: M.S. Krzemnicki, SSEF

△ **Figure 2:** This heated sapphire still exhibits a dense pattern of fine rutile needles. As a reminder: the presence of rutile needles does not exclude a heat treatment. Photo: M.S. Krzemnicki, SSEF

GEMTOF ANALYSES OF SAPPHIRES FROM MADAGASCAR AND KASHMIR

Since September 2016, a sapphire mining rush brought a gem deposit close to Ambatondrazaka, Madagascar into the focus of the gem industry. The sapphire rough unearthed in the region sometimes show excellent quality and large sizes (Perkins 2016, Krzemnicki 2017, Pardieu 2017). In the beginning of 2017, gem testing laboratories started to receive cut stones from this new area for gem analysis and issuing reports. As stated in a trade-alert by SSEF in early 2017, some of this new sapphire material may resemble internal features of Kashmir blue sapphires, therefore careful microscopic investigations and further analysis are needed to tackle this challenge. Besides microscopic analysis, other analytical methods, e.g. GemTOF analysis, can bring further evidence and help gemmologists determine the geographic origin of such sapphires.

△ **Figure 1:** Figure 1: Three sapphires from Madagascar of excellent quality (left side) compared with five Kashmir sapphires (right side). Photo: V. Lanzafame, SSEF

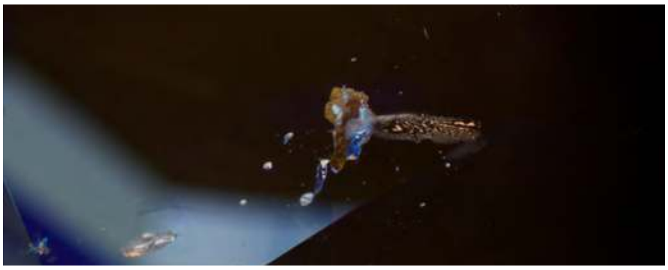
In this context, we initiated a number of research projects including detailed GemTOF analysis of samples from Madagascar and Kashmir. Samples labeled as Madagascar consist of materials from the newly discovered deposit in Ambatondrazaka as well as other deposits from Madagascar. More than 250 samples have been analyzed on GemTOF in the past year for this study. On average, each sample has been measured with 4 replicates, and quantitative chemical results were imported into the database. In order to achieve comparable results, we maintained stable GemTOF performance and reported reproducible limits of detection (LOD, an indicator of the instrument's figure of merit) of most isotopes. With this prerequisite, it allows us to compare chemical results of sapphires over a long period of time.

For the purpose of visualizing chemical results, we selected five elements, magnesium (Mg), vanadium (V), iron (Fe), gallium (Ga) and tin (Sn) and performed principle component analysis (PCA). Subsequently, the first three principle components (PCs), which explained in total >90% of variation, were selected for data visualization. In Figure 1 (a), the scatter plot using first three PCs shows that sapphires from Kashmir tend to chemically closely group together, and others from Madagascar tend to spread much wider. The closely grouped Kashmir sapphires can also be seen from plots of PC1 vs PC2 and PC1 vs PC3. A gray circle is a visual guide to locate 'Kashmir-like' material from Ambatondrazaka, Madagascar. When a new sapphire shall be tested, such plots provide gemmologists with valuable complementary information for origin determination.

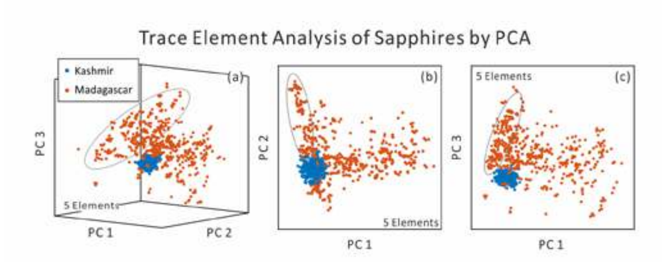
Trace elements are present in the matrix of sapphire. They are important for color and give unique chemical fingerprints for origin. In all Madagascar and Kashmir sapphires, Mg, V, Fe, Ga and Sn are above LOD. Median concentrations of V (11 ppm), Fe (1100 ppm), Ga (70 ppm) and Sn (0.5 ppm) in Madagascar sapphires are about double those of values in Kashmir samples. Trace elements titanium (Ti) and chromium (Cr) were detected in more than 95% of the samples. Interestingly, median concentrations of Ti and Cr, coloring agents, do not differ between the two origins, which could indicate sampling procedure may not be biased in color. About 60% of the samples have shown detectable amounts of germanium (Ge) and tantalum (Ta). Furthermore, Madagascar sapphires have a distinct higher amount of Ta, median 0.04 ppm, but similar Ge median concentration of 0.15 ppm.

Benefiting from simultaneous detection of almost all elements in the periodic table, GemTOF records elements that also rarely appear in sapphires. For example, beryllium (Be), niobium (Nb), lanthanum (La), cerium (Ce) and thorium (Th) etc. are more likely to be detected in Madagascar sapphires. Especially, many samples from Madagascar have shown a signal higher than LOD for thorium; however most of them are close to LOD, hence not significant. Others, with significantly higher Th than LOD, would be promising for direct age dating on sapphires (see article about age dating in this Facette).

Although statistics has shown general differences between sapphires from these two origins, it may still pose challenges if individual cases are under discussion, mainly due to wide margins for the elemental concentrations or overlaps, and boundary cases can be seen from Figure 3. Fortunately, origin determination relies not only on chemical analysis but also on a range of other methods including detailed examination of inclusions that can be characteristic for certain origins. For analysts, it is our responsibility to present gemmologists more straightforward visualization of the chemical data (not only from GemTOF but also other analytical instruments). To reach this goal, advanced statistical approaches are in development for sapphires as well as other gemstone varieties, e.g. emerald, and results will be summarized in future articles.
✶ **Dr. H.A.O. Wang, SSEF**



△ **Figure 2:** Surface-reaching rutile inclusion on which age-dating analysis was successfully carried out. Photo: M.S. Krzemnicki, SSEF



△ **Figure 3:** Principle component analysis (PCA) assisted data visualization of trace element concentrations in sapphires from Madagascar and Kashmir. Three-dimension plot of principle component (PC) 1 vs PC 2 vs PC 3; (b) PC 1 vs PC 2; (c) PC 1 vs PC 3. Gray circles are visual guides for 'Kashmir-like' sapphires mainly from Ambatondrazaka, Madagascar.

AGE DATING OF CORUNDUM USING INCLUSIONS

The geochronological age of corundum is related to tectonic and geological processes millions of years ago. This age information can be an indicator of origin, especially when comparing this to age databases of known geological areas. One of the most popular techniques to estimate the age of geological samples is mass spectrometry based measurement of radioactive decay systems in inclusions, for example uranium to lead (U-Pb) and thorium to lead (Th-Pb) in zircons.

In corundum, zircon is a common inclusion containing such a 'geological clock'. Almost no lead (Pb) content at formation and a relatively closed system during the decay makes zircon often an accurate and popular candidate for age dating. At SSEF, GemTOF, a laser ablation inductively coupled plasma time of flight mass spectrometry platform (LA-ICP-TOF-MS), is routinely performing age dating on zircons. However, a difficulty is to find zircon inclusions reaching a gemstone's surface, since GemTOF is only a surface analytical technique. It is so rare that, in the past year, only around five zircons have been found reaching to the surface of client sapphires tested at SSEF. To expand the possibility of age dating on inclusions, we are currently testing other similar 'geological clocks', such as apatite, titanite and rutile. A challenge, compared to zircon age dating, is to find well-characterized standard reference materials (SRM) respectively. The SRMs are more homogeneous in U-Th-Pb concentrations as well as being constant in age. Recently, a selection of gem-quality apatites, titanites and rutiles have been characterized, and already a first sapphire with a rutile inclusion on the surface has been age dated, which provided additional information to gemmologists for origin determination.

Even more rarely than finding inclusions on surfaces, unexpected U and Th signals were detected during routine trace element analyses in sapphires and rubies. Up to now, less than a handful of samples with up to tens of parts per million (ppm) U or Th concentrations were age-dated. Since a matrix-matched standard is lacking, estimations were only conducted based on sensitivity normalization of the NIST 610/612 standards. GemTOF simultaneously collects all isotopic information, therefore becoming eligible of performing trace element analysis and age dating at the same time. However, trace element analysis using LA-ICP-Quadrupole-MS often measures ^{208}Pb isotope only, the most naturally abundant isotope of lead, and could not perform age dating without adding other Pb isotopes and re-ablating the sample.

Although providing direct evidence, age dating on corundum should be carefully investigated and compared to that on inclusions in future developments. A preliminary study has indicated that U and Th may not be homogeneously distributed in corundum. Further studies focusing on the chemical and microscopic environment of these heavy and large atoms in the matrix would be interesting to understand mechanism of corundum formation and find targeted areas containing high U or Th for direct age dating analysis. ✶ **Dr. H.A.O. Wang, SSEF.**

SIMS STUDY ON DIAMONDS IN COLLABORATION WITH UNIVERSITY OF LAUSANNE

In recent years, advances in CVD (Chemical Vapour Deposition) and HPHT (High Pressure High Temperature) technology –the two methods used to synthesise diamonds- have made the availability of synthetic diamonds much more widespread. The introduction of undisclosed diamonds into the market has at present become a critical issue for the diamond and jewellery industry at large. Although techniques such as FTIR, UV-vis-NIR, Raman, photoluminescence (PL) and cathodoluminescence (CL) can be used to distinguish natural from synthetic diamonds, further research is required to develop methods to understand diamond formation mechanisms. This involves testing and developing new methods to characterise different types of diamonds.

In collaboration with the University of Lausanne – where Dr. Laurent E. Cartier is a lecturer in gemmology- we were able to conduct a SIMS study on diamonds to investigate carbon isotopes in a range of natural and synthetic diamonds. Secondary Ion Mass Spectrometry (SIMS) is an extremely sensitive instrument used to analyse surfaces at high resolution. It has not been used widely in gemmology as it is a complex and costly method to use.

This preliminary study focused on using SIMS to measure relative carbon isotope ratios for natural and synthetic diamonds (i.e. those grown by both chemical vapour deposition [CVD] and high pressure, high temperature [HPHT] techniques). An article has been submitted to the Journal of Gemmology and should soon be published detailing the interesting findings of this study. ✶ **Dr. L.E. Cartier, SSEF**

△ **Figure 1:** Seven colourless and fancy-colour diamonds (up to 3.03 ct) of various natural or synthetic origins are shown here. The top-right and bottom-left round brilliants are HPHT- and CVD-grown, respectively, and the other diamonds are natural. The confident separation of both natural and synthetic diamonds is critical to maintaining consumer confidence in the trade. Composite photo by Luc Phan, SSEF.

△ **Figure 2:** SwissSIMS Cameca IMS 1280-HR at the University of Lausanne. Photo: UNIL

HOW DIAMONDS SALTED INSIDE BATCHES OF SYNTHETIC DIAMONDS CREATES CONFUSION

The diamond trade today is seriously concerned about synthetic diamonds mixed in with parcels of natural diamonds; however, we also propose here that the opposite situation of natural diamonds mixed in with batches of synthetic diamonds is also something to be concerned about and will in the near future be a (wanted?) source of confusion in the diamond trade.

Already in 2016, readers of the SSEF Facette were alerted of the presence of natural diamonds found in batches of synthetic diamonds (see SSEF Facette n° 22 «Undisclosed natural diamonds in a parcel of synthetic diamonds»). This phenomenon has not ceased and has also been confirmed to SSEF by other international gemmological institutions.

The first confusion that the presence of natural diamonds mixed into a purchased parcel of synthetic diamonds creates is that the reader of these lines may immediately question the ability of SSEF **to make the difference between a synthetic diamond and a natural diamond.**

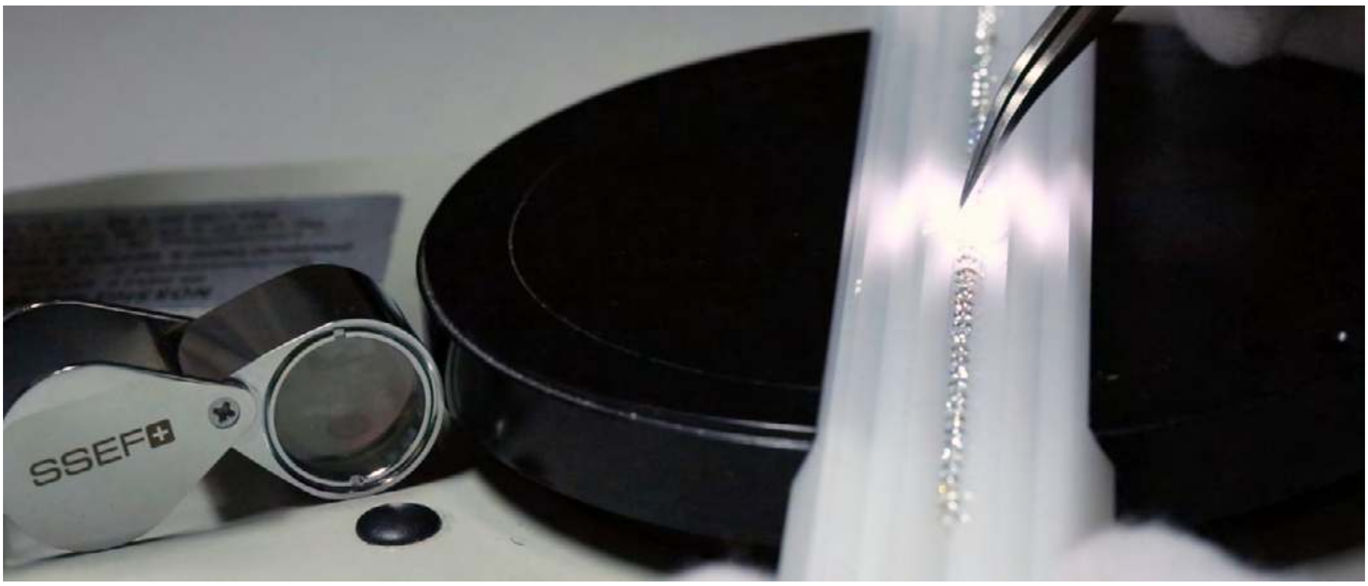
This is a serious concern when dealing with confidence and we know that part of these sceptical readers may still nowadays not understand what the difference is between a synthetic diamond and a diamond simulant. Such scepticism may also be encouraged by the thought, «Salting a batch of synthetic diamonds with natural diamonds is just stupid - and therefore unlikely to really happen - simply because natural diamonds are more expensive than synthetic ones».

Unfortunately, natural diamonds are often mixed in batches of synthetic diamonds and one explanation was already given in the SSEF Facette No. 22, in 2016.

The second confusion that the presence of natural diamonds mixed into a purchased parcel of synthetic diamonds creates for a gemmologist is that by lack of proper equipment or experience or both, a gemmologist might buy a salted parcel of synthetic diamonds and keep it as a reference for containing only synthetic diamonds. This gemmologist would then **create a wrong database** and therefore will later emit wrong results on reports.

The third confusion that the presence of natural diamonds mixed into a purchased parcel of synthetic diamonds creates is for a jewellery manufacturer or a diamond manufacturer that does not identify the presence of natural diamonds inside the salted parcel prior to presenting such a so-called synthetic diamond parcel to an external or an internal gemmologist for a blind test. The results concluded by the gemmologist, whether right or wrong would anyhow be different from that expected by the manufacturer, resulting in a possible **unjustified loss of confidence** of the manufacturer towards the gemmologist.

The fourth confusion that the presence of natural diamonds mixed into a purchased parcel of synthetic diamonds creates is finally for a gemmologist or manufacturer who would decide to test a diamond screening machine for its ability to differentiate natural and synthetic diamonds. We know that well over a dozen machines are now available in the trade, some of which are already known to be unreliable in differentiating natural from synthetic diamonds. Hence, the need of testing these machines… but what if the parcel is not made of the stones it should contain? **The test will be false** and it will probably give rise to an endless discussion between the potential client and the manufacturer of the screening machine. ✶



△ **Figure 1:** Small diamond testing at SSEF. Photo: SSEF

GRANDIDIERITE AND OTHER RARE GEMSTONES AT SSEF

In addition to the extensive article about rare collector stones in the last SSEF Facette (2017, No. 23, pages 8 – 10), we would like to present in this issue three minerals which were tested in the past few months at SSEF and which at least partially made headlines in the news for collectors and aficionados of such gemmological rarities.

Grandidierite from Madagascar

The most exciting certainly is a new find of grandidierite from southern Madagascar (Vertriest et al. 2015, Gems & Gemology; Bruyère et al. 2016, Gems & Gemology) close to the town of Tranomaro, near the original type-locality at the cliffs of Andrahomana (Madagascar). Grandiderite, a complex Mg-Fe aluminous borosilicate of subtle bluish green to greenish blue colour was first described by Alfred Lacroix in 1902 and named after Alfred Grandidier (1836–1912), a French explorer and naturalist who extensively studied the natural history of Madagascar.

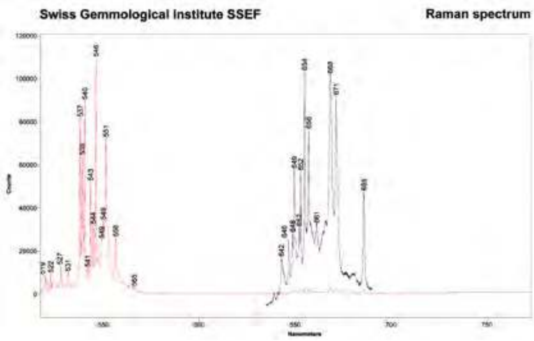
◁ **Figure 1:** Small collection of the rare collector's stone grandidierite from Madagascar. The subtly greenish blue stone in the centre weighs 12 ct and shows an excellent purity. Photo: J. Xaysongkham, SSEF

Having so-far only seen tiny and rather included samples, we were stunned to recently see three faceted grandidierite samples of exceptional purity and size during the last few months, with the largest of these stones showing an impressive size and weight of 12 ct.

Fluorite from the Swiss Alps

Not so new as a collector stone, but for us at SSEF a first-timer was a pair of faceted pink fluorite from the Swiss Alps (Figure 2). These pink fluorites are rare and sought after minerals of late-Alpine hydrothermal formation. They can be found in clefts together with rock crystals, feldspar and other minerals. The studied samples showed a nice salmon-like pink colour, very characteristic for this material from Switzerland, and contained numerous tiny fluid and solid inclusions. The pink colour of these fluorites is linked to the presence of yttrium (REE), as could be confirmed by EDXRF analyses of our samples. As a consequence of the presence of yttrium and possibly traces of further REEs in these fluorites, the Raman spectroscopic identification of the small colourless prismatic inclusions at this point still remains a mystery. Multiple series of intense photoluminescence peaks from these REEs are overlapping any possible structural peaks in the Raman spectra, measured with our green argon laser (514 nm).

◁ **Figure 2:** Pair of salmon-pink fluorites from an Alpine cleft in the Swiss Alps. Photo: V. Lanzafame, SSEF



△ **Figure 3:** Photoluminescence spectrum (using green argon laser 514 nm excitation) of pink fluorite shows two series of very marked REE emission peaks (the purple series represents the small red series at the same position, just after vertical stretching for better visualisation. Figure: M.S. Krzemnicki, SSEF

Chromium-rich red musgravite from Mogok

And finally we purchased for our research collection a small intensely red musgravite crystal, originating from the Mogok Stone Tract. This area has already in the past proven to be a treasure trove not only for ruby, sapphires, and spinels, but also for a wide range of very rare and exotic minerals and gemstones, such as jeremejevite, poudrettite, painite and johachidolite, to name a few.

Raman analysis revealed matching peak positions with reference spectra (RRUFF database) of musgravite, renamed by the International Mineralogical Association IMA as magnesiotaaffeite-6N3S due to crystal structural considerations (Armbruster 2002).

◁ **Figure 4:** Small but vivid red musgravite crystal from Mogok, Myanmar. Photo: M.S. Krzemnicki, SSEF

The intense red colour is due chromium which - to our knowledge – is far higher (approximately 2 wt% Cr_2O_3) than in any musgravite from Myanmar, Sri Lanka, East Africa or Madagascar so far reported in scientific literature. Further studies are ongoing to characterise this highly uncommon red musgravite from Mogok. ✶ **Dr. M.S. Krzemnicki, SSEF**

SANNAN-SKARN: A NEW MATERIAL RESEMBLING MAW SIT SIT

In 2015, a significant volume of complex fine grained green rock material from Western Pakistan was sold to gemstone dealers under the name Maw Sit Sit. The new material originates from a remote area in Balochistan, about 60 km from the Muslim Bagh chromite mine. The productive area lies in a thrust zone (Kazmi & Snee 1989) known as the Karakorum Suture Zone. There, sediments from the Tethys ocean were welded onto the Eurasian Plate during collision with the Indian continent some 65 million years ago. During this tectonism, triassic carbonate sediments and oceanic crust were imbricated, strongly brecciated, mylonitized, and altered by heat and fluids (metasomatism). The fine grained green rock material formed by this metasomatic alteration of parent rock and is referred to as a skarn. Sannan is a specific modifier that describes the skarn from the new occurrence.

Minerals found in the strongly varying Sannan-Skarn fine grained green rock are hydrogrossular, diopside, aegirine, pectolite, chlorite, calcite, winchite, sodalite and other in subordinate amounts. The green colour is due to chromium (Cr) and iron (Fe). The results of the crystal-optical analysis were confirmed by micro-Raman spectroscopy. A full description is given in Hänni, H.A. & Franz, L. (2016) Sannan – Skarn, ein neuer Schmuckstein aus Pakistan. Z.Dt.Gemmol.Ges. 65/1-2, 41-46. Densities vary with composition and are recorded from 2.7 – 3.3 g/cm^3. Differentiation from Maw Sit Sit using classical gemmological instruments is difficult; therefore, identification of the components using micro Raman spectroscopy is recommended. EDXRF analyses will have high concentrations of calcium, whereas calcium is minor in Maw Sit Sit.

Since 2015, Sannan-Skarn has been cut in cabochons, bangles, and spheres. Sannan-Skarn will find its position in the market among other green stones, such as jadeite jade, Maw Sit Sit, and nephrite jade. Sannan-Skarn can be identified correctly and shall be sold under its correct name, proposed here as Sannan-Skarn. It is not to be confused with Maw Sit Sit from which it is clearly different. Sannan-Skarn can either be differentiated from Maw Sit Sit by EDXRF by the presence of elevated calcium (Ca) concentration, or by micro-Raman spectroscopy by the identification of aegirine, winchite, hydrogrossular and the other minerals listed above. Similar results are expected by using micro FTIR , e.g. Lumos from Bruker. ✶**Prof. H. A. Hänni , Prof. Leander Franz, Dr. Zhou Wei**

△ **Figure 1:** Maw Sit Sit (left) in comparison with Sannan-Skarn (right).

△ **Figure 2:** A vein of Sannan-Skarn in it parent rock. Length 12 cm.

JADEITE & FRIENDS AT SSEF

In the past few months, gemmologists at SSEF had again the pleasure of analysing a number of outstanding jadeite-jade items for the international trade and auction houses. This included a highly exceptional jadeite bangle (see Figure 2) and a series of twelve impressive cabochons of highly matching vivid green colour (Imperial green) and high translucency (Figure 1). After setting in a necklace and a pair of ear-pendants, this set of cabochons was sold in October 2017 for US$ 9 million at Poly auction Hong Kong.

◁ **Figure 1:** Set of twelve highly matching Imperial green jadeite-jade cabochons, ranging in size from 15 to 19 cts each, sold by Poly auction in Hong Kong in October 2017.

Apart from such high-quality items, we also analysed a few impregnated and dyed jadeite jades, including a broken and subsequently glued bangle (Figure 2), which was quite a bad surprise for our client.

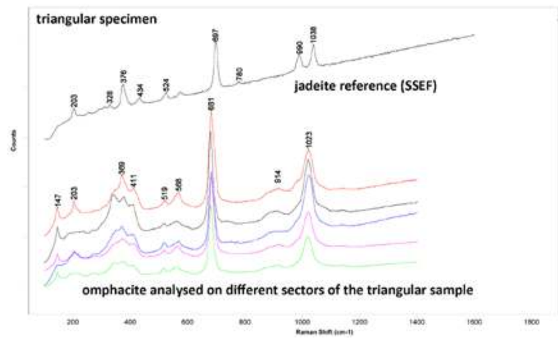
△ **Figure 2:** Comparison of the described high-quality jadeite bangle (on the left) and the impregnated and dyed (broken) jadeite bangle which was repaired (glued) prior to submission to SSEF.

As is well known to gemmologists (and the trade), jadeite jade used in jewellery is not a single crystal (such as ruby or spinel etc.) but is in fact a rock, consisting mainly of tiny and densely interlocked jadeite crystals. In many cases, these rocks are not homogeneous in their mineralogical composition, but may contain further members of the pyroxene group (especially of the jadeite-omphacite-kosmochlor solid solution) and even further minerals (e.g. feldspar, amphiboles etc.), thus posing some problems for analysis and for the application of correct nomenclature.

A perfect example for this complexity was found recently among a series of small carved client stones, which visually strongly resembled green jadeite jade (Figure 3).

△ **Figure 3:** Two of a series of jadeite-looking stones sent for testing to SSEF. The round polished slab (left) is dominantly consisting of jadeite, whereas chemical and Raman microspectroscopic analyses revealed that the triangular specimen is dominated by omphacite, thus identified as omphacite-jade on our report.

Chemical but mostly multiple Raman microspectroscopic analyses revealed that these specimens contained variable amounts of jadeite and omphacite. The round slab still being dominated by jadeite jade, whereas the triangular one was in fact dominated by omphacite, a Ca-Mg-rich pyroxene and intermediate member of the jadeite-diopside solid solution (Figure 4b). As a consequence, the correct name for this triangular item was ompacite-jade and not jadeite jade as the other samples of this series. Although, this separation may seem quite sophisticated and a lofty scientific decision, it has to be added that omphacite is distinctly more abundant than jadeite and as such can be found in rather large quantities in nature. In line with CIBJO definitions, we think that this is important information for the trade, although both jadeite and omphacite may look very similar and can be used with the affix 'jade' in the trade. After the nomenclature (and standardisation) developed and issued in 2016 by the Gemmological Association of Hong Kong (GAHK) along with the Hong Kong Testing and Certification Council (HKCTC), the traditional term 'Fei Cui' may be used for both jadeite and omphacite dominated ornamental rocks (see GAHK Journal 2017. Vol. 38, pages 22-28, www.gahk.org/journal/2017/a07.pdf).



△ **Figure 4:** multiple Raman analyses measured on the triangular specimen, all indicating the predominant presence of omphacite (thus specimen identified as omphacite-jade). Figures: M.S. Krzemnicki, SSEF

Jadeite and jadeite-like rocks, aka 'friends', are complex but fascinating and intriguing stones for gemmologists as described above (see also Facette 2012, No. 19, pages 8 – 11). They not only offer beauty and value, but also are of specific scientific interest, as they offer geologists insight in geological processes and formation conditions (high pressure metamorphism!) and historians and archaeologists a window to past cultures and historic trading routes. ✶ **Dr. M.S. Krzemnicki, SSEF**

SURPRISING NEW PRODUCT FROM CHINA: MINI MING CULTURED PEARLS

Some twenty years ago a certain type of Japanese cultured pearls reached the market- these were special in two ways. Firstly, they were grown in the gonad of freshwater mussels and secondly they carry a shell bead. These so called Kasumiga pearls were internally characteristic as they had a drill hole in the bead when they were nucleated, and later a second drill hole through the finished product. The production had ceased because of worsening water qualities.

Since about 2010, Chinese pearl farmers have been growing similar pearls. These Chinese gonad-grown cultured pearls from freshwater mussels are called Edison pearls or Ming pearls, probably in allusion to the Chinese Ming dynasty of emperors, and to reflect the size and beauty of these cultured pearls. The shell that is used for those pearls is also a hybrid between *Hyriopsis schlegeli* and *Hyriopsis Cumingii*. With diameters from impressive 15 to over 20 mm they got world-wide interest and admiration and are a serious alternative to South Sea cultured pearls when bleached to white colours.

In September 2017 the author could admire a number of small Ming cultured pearls of 7 mm at the Hong Kong Trade Show. The pearls possessed pastel colours as seen in Hyriopsis shells and are perfectly round as they possess a 5 mm bead. Cross sections and X-ray pictures revealed that they had the same drilled bead nuclei as large Ming pearls. According to Johnny Chan, former president of the Hong Kong Pearl Association and owner of SEA PEARL (Hong Kong) these Mini Ming pearls are produced in the mantle of the same shells that are breeding large Ming pearls in the gonad. The gonad nucleation is performed in one year old mussels. At the age of 2.5 years they the get 6 pieces of 5mm beads into the mantle of both shell wings. At the age of 4 years the pearls are harvested. The result is then usually one big Ming pearl and 12 Mini Ming per shell.

The first large production will be ready in 2019. It is expected that most of the originally pastel colour 7 mm pearls will be drilled and bleached white. They will then make an impressive competition to Japanese saltwater beaded cultured pearls as an alternative to Akoya cultured pearls of similar diameters. ✶ **Prof. Dr. H.A.Hänni**

△ **Figure 1:** Cultured Mini Ming cultured pearls from China. The bead and drill hole in the bead is visible in the two cut samples that show cross-sections.

△ **Figure 2:** Two small Mini Ming cultured pearls compared with Ming cultured pearls (two loose and one strand) on a shell in which these beaded freshwater cultured pearls are grown. Photo: L. Phan, SSEF

IMPACT OF OF NEW WATER REGULATIONS ON FRESHWATER CULTURED PEARL PRODUCTION IN CHINA

Chinese freshwater cultured pearls have experienced a meteoric rise in the jewellery industry since they hit the international market in the early 1980s. However, China has a longstanding tradition of pearls, with natural freshwater pearl fishing dating back several millenia and the Chinese having been some of the first to experiment with half-pearl production in freshwater mussels by the 13th century. The vast quantities of pearls that could be produced in Chinese ponds and lakes, was down to the simple fact that the mussels *Hyriopsis schlegelii* and *Hyriopsis cumingii schlegelii* hybrids (today's most commonly used pearl mussels) could house up to 50 beadless freshwater cultured pearl at a time. The vast quantities produced by China since the 1980s opened up completely new markets and market segments to the pearl industry, offering cultured pearls at very varied price points. Although reliable statistics are hard to find, at its peak it is believed that Chinese producers produced up to 1500-2000 tons per year. At present, it is estimated that production lies around 600 tons per year. The trend has been to focus less on quantity but to innovate farming techniques in order to produce more valuable and high-quality freshwater cultured pearls. New regulations and changes in the industry are having an impact on farming practices and pearl prices, as government addresses more sustainable water use and seeks to reduce water pollution in the country.

△ **Figure 1:** **Freshwater cultured pearl farm near Changde (Hunan province, China). The mussels are placed in nets that are suspended by being attached to plastic bottles. The water quality of such water bodies is being investigated and regulated by authorities. Photo: L.E. Cartier, SSEF**

In the past decade there have been increasing reports in Chinese media and academia about envionmental problems linked to pearl farming. In one case in 2007, pearl mussel farming was temporarily banned in Hubei province because of concerns with the levels of manure and fertilizer used in pearl production. In April 2015, the Chinese government released The Water Pollution Prevention and Control Action Plan ('10-Point Water Plan'), in order to limit and remediate water pollution in the country, across all sectors and regions. The implementation of this nationwide plan is having a serious impact on the pearl industry, as many pearl producers are now faced with having to answer for bad water qualities in their ponds. The plan, for example, foresees that by 2020 the quality of over 70 percent of the water in seven key river basins (some close to pearl farming areas), will reach level III or above, and the amount of foul water in urban built-up areas will be controlled, thus not exceeding 10 percent.

△ **Figure 2:** **Freshwater cultured pearl grading in a sorting factory in Hunan province, China. Photo: L.E. Cartier, SSEF**

These new regulations are forcing the industry to upgrade their techniques and continue to innovate in order to produce pearls in a more ecologically sustainable manner. This is difficult for pearl farmers at present, but may ultimately lead to much higher qualities of pearls. Prices for higher quality freshwater cultured pearls are set to rise further as farmers adapt their practices to new water regulations in China. ✶ **Dr. L.E. Cartier, SSEF**

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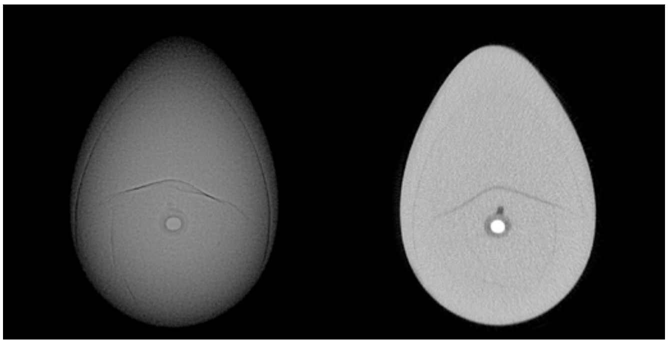
PEARL WITH A STRANGE METAL CORE

We recently received a very beautiful drop-shaped pearl of about 3.5 ct for testing, which showed a very intriguing bright white core in radiography and tomography (Figure 1). As we had encountered very few further such pearls – all assumed to be cultured pearls from *Pinctada maxima* – we were highly interested to better understand this feature. Interestingly, this white spot in X-ray radiography resulted in no acicular artefacts in tomographies, thus we could exclude a pure metallic composition (e.g. steel).

Kindly permitted by our client, we carefully cut this pearl in half, so as to expose the central core for further analyses. Microscopic observation, Raman microspectroscopic and X-ray fluorescence analyses revealed that the core in fact consists of a cubic grain of massive Fe-oxide, surrounded by a thin spherical rim of brownish fine granular Fe-hydroxide (metallic reflection in microphotograph, see Figure 2). This 'metallic' core is then surrounded by a small brownish zone of radially arranged calcite columns intermixed with organic matter, covered up to the surface by a very dense and uniform aragonite layer.

Although the reason - accidentially or by intent (during seeding) of this specific core is unknown to this day, we have not yet seen any such feature in any pearl of confirmed natural origin. ✶



△ **Figure 1:** Radiography and tomography section of the described pearl, showing a very uncommon white core. Images: SSEF

△ **Figure 2:** Microphotos of the core section in normal light and reflected light, revealing the black cube Fe-oxide grain in the centre, surrounded by a thin layer of dark brown Fe-hydroxide and radially arranged calcite columns with brownish organic matter. Photos: M.S. Krzemnicki, SSEF

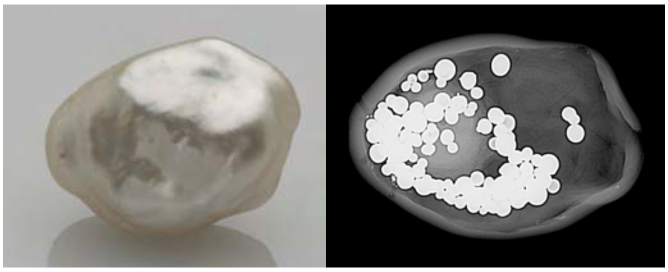
PEARLS WITH METAL BEADS

Hollow pearls are generally rather delicate items with an even more inspiring and delicate (French) name 'Soufflure', as if they were formed by a smooth blow of air, or more magically by the sweet whisper of an angel. Their real formation is however much less poetic, as they are mostly formed in a pearl sac expanded by gas due to fouling organic matter. Their shape is commonly baroque, but they can become outstandingly large in size.

It is a very traditional practice to fill such hollow pearls with a foreign substance, usually some sort of a glue or cement, in order to stabilise the fragile nacreous surface of the hollow pearl that may then be used in jewellery.

Recently, we analysed a beautiful hollow pearl which did not show a commonly encountered filler substance, as it was filled with a great number of small metallic beads (Figure 1). This stunning observation was most evidently seen in the radiography where the metallic beads are bright white, as they completely absorb the X-rays. Most probably, these metallic beads were inserted to increase the weight of the pearl so that it would approximately match the weight of a pearl of the same size and shape consisting completely of calcium carbonate.

Importantly, hollow pearls are clearly identified as such on SSEF reports. Filler substances, including such metallic beads, are mentioned in the comments section of our reports as we consider it a processing step that needs to be disclosed. ✶



◁ **Figure 1:** Hollow pearl with metal beads inside, best seen on the radiography of this pearl. Photo: V. Lanzafame, SSEF

PEARL ARTICLES PUBLISHED

As worldwide leaders in pearl testing and authentication SSEF is constantly investing much effort and funds in pearl research, with a special focus on new analytical approaches to analyse and identify pearls. In the last few months, this research has led to a series of four articles in the Journal of Gemmology (JoG) – the quarterly publication of the Gemmological Association of Great Britan (www.gem-a.com). These articles describe in detail our findings and new analytical developments.

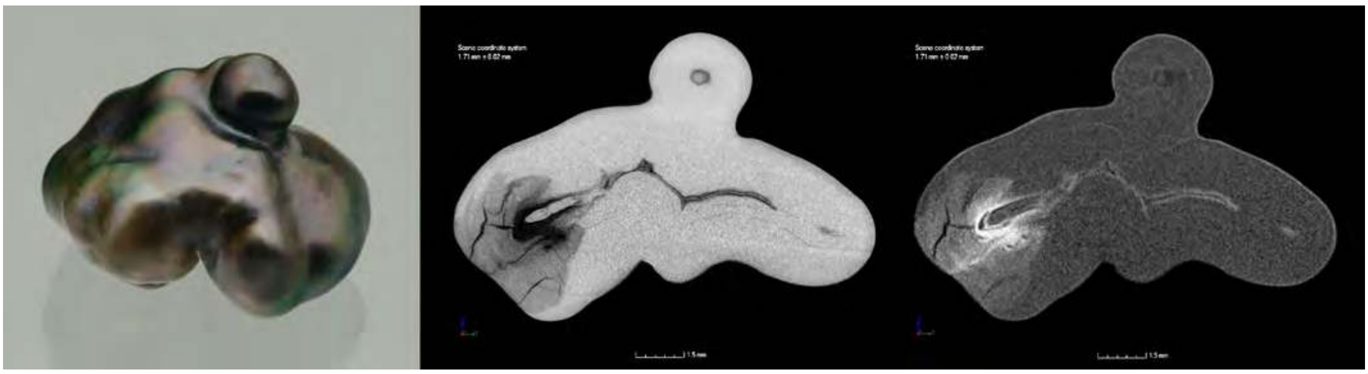
The series started in June with an **article about (large) fake pearls** (Krzemnicki et al. 2017, http://dx.doi.org/10.15506/JoG.2017.35.5.424), actually cut from thick shells (e.g. *Tridacna* species). These fake pearls repeatedly make sensational headlines in the media, but lack any critical review of their identity. These fake pearls cut from shells are characterised by specific banding structures (of the shell). As such, they are very different to 'real' pearls (predominantly blister pearls) and blisters/concretions of large size (Figure 1) which are often the result of proliferating (pathological) precipitation of calcium carbonate within a shell (see also article about the so-called 'Sleeping Lion pearl' in the SSEF Facette 2017 (No. 23), pages 13-14.

In a second article, published in September in the JoG, we describe in detail **X-ray phase contrast and dark field imaging** as an additional method for pearl identification (Krzemnicki et al., 2017 http://dx.doi.org/10.15506/JoG.2017.35.7.628). Presented in a short article already in the SSEF Facette 2016 (No. 22, pages 24-25), this article shows the application of this new analytical approach on a whole range of natural and cultured pearls (beaded and non-beaded).

The third article is describing **radiocarbon age dating** of pearls, with a special focus on the historic pearls discovered in the Cirebon ship wreck in the Java Sea off the coast of Java, Indonesia (Krzemnicki et al. 2017; http://dx.doi.org/10.15506/JoG.2017.35.8.728). This method, already applied since a few years at SSEF, and since 2017 also as a service to our clients, offers new and highly interesting insights into the historic provenance of pearls and will become more important in the near future for pearl testing.

The last article of this pearl series has just been submitted and will be published in the upcoming issue of the Journal of Gemmology (Spring 2018). This article describes in detail the possibilities and limitations of using **neutron imaging** methods to visualise and analyse internal structures of pearls (Hanser et al. 2018, in press). Similar to X-rays, neutrons can penetrate matter, thus producing radiographs. However, these neutron radiographs are kind of inversed, as neutrons are highly attenuated by hydrogen and thus any organic matter in pearls, but much less by the anorganic calcium carbonate of the pearl. As such, neutron radiography (and tomography) offers a complementary view of pearl structures and may even assist pearl identification in certain cases. However, it has to be mentioned that neutron radiography of pearls requires a strong neutron source, only available at few synchrotron and beamline facilities, and is therefore a rather costly method not suitable to normal routine pearl testing. ✶ **Author: Dr. M. S. Krzemnicki, SSEF**

△ **Figure 1:** Tridacna shell with concretion (not a pearl!) which grew at the hinge of the shell and close-up illuminated from below showing the tentacle-like surface of this tridacna concretion. Photos: Julien Xaysongkham and Michael S. Krzemnicki, SSEF



△ **Figure 2:** Non-beaded cultured pearl from Pinctada margaritifera (so-called 'Keshi cultured pearl') with a comparison of a section visualised by X-ray tomography (left) and neutron tomography (right). Photos: C. Hanser

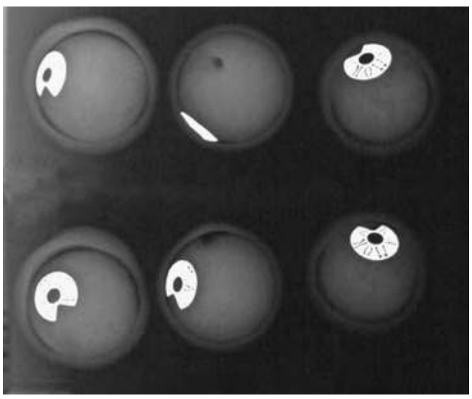
TRACEABILITY OF GEMSTONES & PEARLS: CHALLENGES AND OPPORTUNITIES

The tracking and traceability of gemstones is an increasingly important issue. Consumers are ever more interested in knowing where and how the materials they consume are extracted and manufactured. Media and NGOs are increasingly scrutinizing the gemstone industry about the origin and sustainability footprint of different gemstones. Governments want to improve the management and revenue collected from gemstone resources and global governing bodies have highlighted issues such as smuggling and money laundering in recent years. Documenting the provenance and source of gemstones is one way of addressing these concerns; and tracking and traceability are two available mechanisms to achieve this. Although a multi-folded approach – for example a strengthening of specific ethical and sustainability standards within mining, processing and sale of gemstones worldwide - is required to address these issues, the development of techniques to track and trace gemstones may be vital to the accountability and credibility of such schemes.

The recent appearance of undisclosed synthetic diamonds on the market further highlights this, how are, could and should different types of gemstones be separated on their journeys through the supply chain? Correct disclosure of sold gemstones, for examples treatments in emeralds, is already required in the form of the CIBJO Blue Books. Being able to provide information about the source of a gemstone is set to become more and more critical for jewellery houses, gemstone miners and gemstone traders if experiences from other sectors are anything to go by. Tracking and traceability can be considered both a growing requirement for some and for others a competitive advantage. The industry today already has clear pricing gradients for natural vs. imitation (turquoise vs. imitation turquoise), natural vs. synthetic (natural spinel vs. synthetic spinel), untreated vs. treated goods (untreated ruby vs. heat treated ruby), and gemstones of different origins (Colombian emerald vs. Zambia emerald). A further level is being added by claims from mining companies, traders and jewellery houses that certain gemstones are 'ethical', 'sustainable', 'fair trade', 'conflict-free' or 'traceable' gemstones. In order to provide these claims with further credibility, independent verification may be required. This is an important matter of discussion in the industry at present. However, as for example experience with treatment disclosure shows, transparency and traceability are a much wider subject in the business of diamonds, gemstones and pearls.

Gemmological science may provide assistance in such cases and SSEF is conducting research in collaboration with partners on possible strategies, opportunities and limitations of tracking (downstream 'from mine to market') or tracing gemstones (upstream 'from market to mine') using gemmological and other approaches. This follows and builds on past work carried out on pearl traceability efforts that were published in 2013 (Hänni & Cartier, 2013). Advances in new technology to map unique gemstone inclusion features and characterise their chemical and spectroscopic properties can aid in these traceability measures. Other approaches involve phyisically tracing or marking a gemstone or pearl either at the mine or at a subsequent stage in the supply chain (e.g. Figure 2). Blockchain technology has made great advances in recent years, and can offer promising complimentary solutions to address certain supply chain concerns. Past experience has shown that there is no one size fits all silver bullet solution. Ultimately, gemmological science can contribute with complimentary approaches and techniques in offering additional information about a gemstone and its provenance. Promoting transparency through full disclosure (e.g. of treatments) has been important for SSEF for many years. Our research in the field of traceability will continue to build on that, not only exploring mine-to-market solutions but as our recent research output shows, on documenting the provenance of historical objects and offering new services such as age dating of pearls. ✶ **Dr. L.E. Cartier**

◁ **Figure 1. Miner with rough corundum in Zazafotsy, Madagascar. How could such material be tracked from mine to consumer? Photo: Laurent E. Cartier**



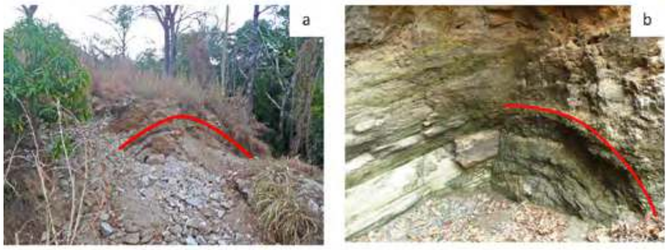
◁ **Figure 2: Experiments carried out with the Kamoka pearl farm in French Polynesia that were published in 2013. This work focused on physically marking and tracing nuclei in beaded cultured pearls so that they could be 'traced' through the supply chain. Radiography: H.A. Haenni.**

MARBLE-HOSTED RUBY DEPOSITS OF THE MOROGORO REGION, TANZANIA

Dr. Walter A. Balmer, research associate of SSEF, recently published a scientific paper on marble-hosted ruby deposits in Tanzania. The study was published in the Journal of African Earth Sciences. The research focused on the geology of ruby deposits of the Uluguru and Mahenge Mts, Morogoro Region. These deposits are related to marbles which represent the cover sequence of the Eastern Granulites in Tanzania. Based on structural geological observations the ruby deposits are bound to mica-rich boudins in fold hinges where fluids interacted with the marble-host rock in zones of higher permeability. Petrographic observations revealed that the Uluguru Mts deposits occur within calcite dominated marbles whereas deposits in the Mahenge Mts are found in dolomite-dominated marbles. The mineral assemblage describing the marble-hosted ruby deposit in the Uluguru Mts is characterised by corundum-dolomite-phlogopite ± spinel, calcite, pargasite, scapolite, plagioclase, margarite, chlorite, tourmaline whereas the assemblage corundum-calcite-plagioclase-phlogopite ± dolomite, pargasite, sapphirine, titanite, tourmaline is present in samples from the Mahenge Mts.

Although slightly different in mineral assemblage it was possible to draw a similar ruby formation history for both localities. A first formation of ruby appears to have taken place during the prograde path (M1) either by the breakdown of diaspore which was present in the original sedimentary precursor rock or by the breakdown of margarite to corundum and plagioclase. The conditions for M1 metamorphism was estimated at ~750 °C at 10 kbar, which represents granulite facies conditions. A change in fluid composition towards a CO_2 dominated fluid triggered a second ruby generation to form. Subsequently, the examined units underwent a late greenschist facies overprint. In the framework of the East African Orogen the study assumes that the prograde ruby formation occurred at the commonly observed metamorphic event around 620 Ma. At the peak or during beginning of retrogression the fluid composition changed triggering a second ruby generation. The late stage greenschist facies overprint could have occurred at the waning stage of this metamorphic episode which is in the range of ~580 Ma.

Such geological research is important to understand the formation mechanisms of gemstones and consequently improve origin determination of gemstones. ✶



◁ **Figure 1:** Photos a-c (by W. Balmer) geological fieldwork investigating the relationship between fold structures and mineralisation zones at the Mwalazi Mine.

△ **Figure 2:** A selection of rough and cut rubies reportedly from the Uluguru Mts. Photo: Thai-Lanka Trading

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PHD PROJECT ABOUT THE MOGOK STONE TRACT, MYANMAR

Since 2015, Ms. Myint Myat Phyo, student from Myanmar, is working on her PhD research project under the supervision of PD Dr. Michael S. Krzemnicki and Prof. Dr. Leander Franz at the University of Basel. This project is kindly supported with a grant by the canton of Basel (Switzerland) especially designed for young scientists from developing countries.

Her research studies focus on the geology and petrology of the Mogok Stone Tract and its gemstone heritage, using samples collected during an extensive field campaign in early 2016 in Mogok. The Mogok Stone Tract is mainly composed of high-grade metamorphic rocks such as marbles, calc-silicate rocks, gneisses, peridotites and igneous rocks such as granites, syenites and gabbros etc. Furthermore, the Mogok Stone Tract is eminent for fine quality gemstones like rubies, sapphires, spinels and other gemstones.

△ **Figure 1:** Ms. Myint Mya Phyo in a gemstone mine in the Mogok area. Photo: M.S. Krzemnicki, SSEF

Ms. Myint Myat Phyo has presented part of her research results by the end of last year at the MAESA Conference in Yangoon (www.maesa.org/info.html) and at the Swiss Geoscience Meeting in Davos, Switzerland (see Abstract, pages 88-89, https://geoscience-meeting.ch/sgm2017/downloads/), further publications are in preparation in the next few months. ✶

MASTER THESIS ON BRAZILIAN EMERALDS

We would like to congratulate Ms. Irene Monares Robles for the completion of her Master thesis about emeralds from the Belmont mine (Itabira), Minas Gerais, Brazil. This study was carried out under the supervision of PD Dr. Michael S. Krzemnicki (SSEF and University of Basel) and Prof. Dr. Leander Franz, Institute of Mineralogy and Petrology at the University of Basel in Switzerland. Ms. Monares Robles investigated a number of Belmont emeralds using Raman microspectrometry and GemTOF (see www.gemtof.ch) and compared them with a range of samples from other emerald deposits in Brazil. This thesis was kindly supported by the Ribeiro family. We would like to thank Mr Marcelo Riberio and his family - owners of the Belmont mine in Brazil-, for the generous support and for the possibility of visiting the mining operation and to take valuable geological and gemmological samples for this study. ✶

△ **Figure 1:** Belmont mine (Brazil) with emerald. Area photo: Irene Monares Robles

SSEF AT AUCTION THE SELECTION 2017

This selection of gemstone, pearl and jewellery items sold at auction in 2017 is a selection of both iconic and gemmologically interesting pieces, all sold with SSEF reports. Unless stated otherwise, photos are attributed to SSEF.

Exceptional necklace,Red Romance' with 84 Burma rubies (total 139.14 ct), sold for 8.67 mio US$ at Tiancheng International Hong Kong, December 2017

VCA ring with Burmese ruby cabochon (13.35 ct), sold for 857'600 US$ at Sotheby's Hong Kong, October 2017

15.03 ct ruby from Burma set in a ring, sold for 13.70 mio US$ at Christie's Geneva May 2017

Pigeon blood red ruby (13.26 ct) from Burma set in a ring by Bhagat, sold for 10.45 mio US$ at Sotheby's Hong Kong, October 2017. Photo: Sotheby's

Pigeon blood red Burma ruby (4.01 ct), sold for 1.08 mio US$ at Christie's Hong Kong, November 2017

Pigeon blood red Burmese ruby (6.02 ct) set in a ring, sold for 2.23 mio US$ at Phillips Hong Kong, May 2017

Burmese ruby of 18.86 ct set in a ring, sold for 5,03 mio US$ at Sotheby's Geneva, November 2017

East-African ruby (12.20 ct) set in a ring, sold for 626'000 US$ at Phillips Hong Kong, November 2017

Mozambique ruby pair (14.54 and 13.12 ct) set in ear pendants, sold for 6.13 mio US$ at Tiancheng International Hong Kong, December 2017

Ring with three Burma rubies (centre 5.02 ct), sold for 1.28 mio US$ at Sotheby's Hong Kong, April 2017

Burmese ruby (8.49 ct), set in a ring by JAR, sold for 1.70 mio US$ at Sotheby's Hong Kong, November 2017

Exceptional ear rings with Kashmir sapphires (16.23 & 2.69 ct) and diamonds, sold for mio 3.07 US$, Christie's Hong Kong, May 2017

Brooch (late 19th century) with a Ceylon sapphire (12.96 ct), sold for 42'000 US$ at Sotheby's London, June 2017

Tiara and hair ornament (1840s and later) with Ceylon sapphires, sold for 255'000 US$ Sotheby's Geneva November 2017

Kashmir sapphire(royal blue) of 11.64 ct set in a ring, sold for 1.88 mio US$ at Sotheby's Geneva, May 2017

Burmese sapphire (23.49 ct) set in a ring, sold for 980'000 US$ at Poly auction Hong Kong, October 2017

Exceptional bracelet with seven Kashmir sapphires (royal blue), sold for 4.65 mio US$ at Christie's Hong Kong, May 2017. Photo: Sotheby's

Kashmir sapphire(9.61 ct) set in a ring, sold for 1.20 mio US$ at Bonhams London, September 2017

Royal blue Kashmir sapphire (11.22 ct) set in a ring, sold for 2.25 mio US$ at Christie's Hong Kong, November 2017

Art Nouveau ring by René Lalique with Ceylon sapphire, sold for 240'000 US$ at Christie's Geneva, November 2017

Burmese Sapphire (47.63 ct), set in a ring, sold for 2.58 mio US$ at Christie's Geneva, May 2017

Kashmir sapphire(15.42 ct) set in a ring, sold for 1.13 mio US$ at Sotheby's Hong Kong, October 2017

Colour-changing sapphire (11.19 ct) from Sri Lanka, sold for 46'000 US$ at Tiancheng International Hong Kong, December 2017

Padparadscha (28.04 ct) from Ceylon set in a ring, sold for 2.46 mio US$ at Christie's Hong Kong, November 2017

Padparadscha (8.01 ct) from Ceylon set in a ring, sold for 780'000 US$ at Sotheby's Hong Kong, October 2017. Photo: Sotheby's

Exceptional bangle with' with Burmese spinel octahedrons, sold for 60'000 US$ at Christie's Hong Kong, November 2017

Mozambique pink sapphire (9.05 ct) set in a ring, sold for 145'000 US$ at Sotheby's Hong Kong, April 2017. Photo: Sotheby's

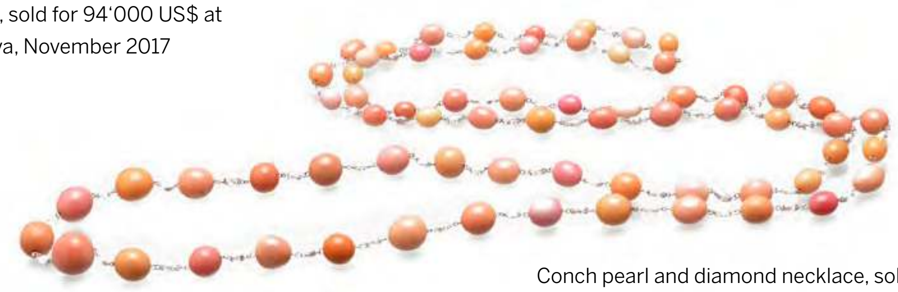
Pink sapphire (38.69 ct) from Ceylon set in a ring, sold for 652'000 US$ at Christie's Hong Kong, May 2017

Madagascar pink sapphire (8.05 ct) set in a ring, sold for 88'000 US$ at Phillips Hong Kong, May 2017

Art Nouveau ring by René Lalique with purple sapphire from Ceylon, sold for 94'000 US$ at Christie's Geneva, November 2017

Pink sapphire (18.83 ct) from Ceylon set in a ring, sold for 810'000 US$ at Christie's Hong Kong, November 2017

Art Nouveau ring by René Lalique with pink sapphire from Ceylon, sold for 87'000 US$ at Christie's Geneva, November 2017



Conch pearl and diamond necklace, sold for 255'000 US$ at Christie's Hong Kong, November 2017

Necklace by Paspaley with 237 natural pearls. Sold for 2.06 mio US$ at Christie's Hong Kong, May 2017. Photo: Christie's

Fancy intense yellowish brown diamond (17.71 ct), set in a ring, sold for 150'000 US$ at Christie's Geneva, Nov.2017. Photo: Christie's

Fancy light yellow diamond of 9.08 ct, sold for 103'500 US$ at Tajan Paris, June 2017

Natural pearl and diamond ear pendants by Etcetera for Paspaley. Sold for 820'000 US$ at Christie's Hong Kong, May 2017

Type IIa diamond of 15.73 ct (L/loupe clean), offered for 250'000-310'000 US$ (unsold) at Tajan Paris, June 2017

Drop-shaped natural pearl (approx. 29 ct) set in a pendant, sold for 1.45 mio US$ at Bonhams New York, December 2017

Necklace with 63 natural pearls, sold for 1.11 mio US$ at Sotheby's Hong Kong, April 2017. Photo: Sotheby's

Pair of natural pearl ear clips by Alexandre Reza, sold for 1.52 mio US$ at Sotheby's Geneva, May 2017

Necklace with 79 natural pearls, sold for 1.13 mio US$ at Christie's Geneva, May 2017

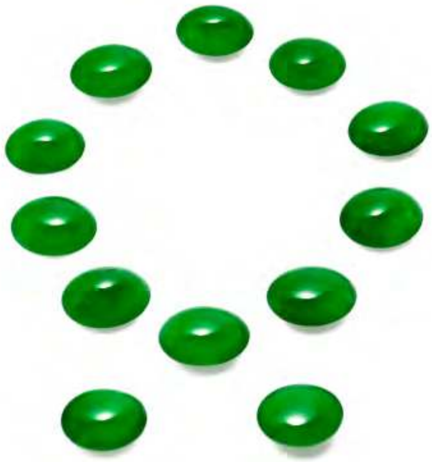
Natural pearl (approx. 45 ct), sold for 950'000 US$ at Christie's Geneva, May 2017

Pair of natural pearls (approx. 20 & 18 ct) set in pendants, sold for 972'500 US$ at Christie's New York, Dec. 2017

Pair of Colombian emeralds (21.79 and 20.15 ct) set in ear pendants by Graff, sold for 2.87 mio US$ at Poly Auction Hong Kong, April 2017. Photo: Poly Auction

Colombian emerald of 22.22 ct (no oil) set in a ring by David Morris, sold for 4.14 mio US$ at Tiancheng International Hong Kong, June 2017

Jadeite bangle of 295.30 ct, sold for 7.62 mio US$ at Poly auction Hong Kong, April 2017



Exceptional collection of twelve Imperial green jadeite cabochons set in a necklace and a pair of earrings, sold for 9.05 mio US$ at Poly auction Hong Kong, October 2017

Emerald and diamond necklace (Colombia, no oil) by Edmond Chin for the House of Boghossian, sold for 5.94 mio US$ at Christie's Hong Kong, May 2017. Photo: Christie's

Pair of antique emerald bangles (Colombia), sold for 2.00 mio US$ at Christie's Hong Kong, November 2017

Tsavorite garnet (12.03 ct) set in a ring, sold for 107'000 US$ at Tiancheng International Hong Kong, June 2017

Colombian emerald necklace (minor to moderate oil), sold for 1.15 mio US$ at Sotheby's Geneva, November 2017. Photo: Sotheby's

Alexandrite (3.38 ct) from Brazil set in a ring, sold for 77'000 US$ at Christie's Hong Kong, November 2017

Colombian emerald of 19.90 ct (no oil) set in a ring, sold for 1.24 mio US$ at Phillips Hong Kong, November 2017

A beautiful emerald and diamond pendant, sold at Christie's Geneva November 2017 auction for 883'000 US$. It was accompanied by SSEF report no. 93899. The 4 emeralds were from Colombia, the 6.29 carat emerald showing no indications of clarity modification, the 4.73 carat and the drop-shaped emeralds showing indications of minor amount of oil, and the 10.87 carat emerald showing indications of moderate amount of oil.

SSEF COURSES
in 2018

2017 was again a busy year for the SSEF Education Department. Our courses have a strong international reputation and we see more and more gemmologists, jewellers and gemstone and pearl professionals from very different countries attending our courses. It's interesting to have participants from so many different gemmological and international backgrounds. In 2018, we will again be offering a wide range of courses. The SSEF Basic Gemmology Course (12 - 27 November 2018) and the SSEF Basic Diamond Course (01 - 05 October 2018) offer good introductions, and participants can graduate with a certificate after taking theoretical and practical examinations. For more in-depth courses we offer Advanced Training Courses on coloured gemstones, pearls and small diamonds. Finally, the Scientific Gemmology Course (SGC) is an ideal course for those interested in learning about the advanced instruments used in laboratory gemmology today, and should be available again in 2019.

ADVANCED PEARL COURSE

This two-day pearl course takes place twice a year (10-11 December 2018). It is ideally suited for participants (max. 6) who want to know more about how pearls are formed, about possible treatments, and how natural and cultured pearls can be identified and separated. SSEF's important collection of shells and pearls offers a good opportunity for practicing and expanding your skills and knowledge of pearls. The course also offers an introduction into the use of UV-visible spectrometry, EDXRF, X-ray radiography and luminescence for pearl testing in a scientific laboratory.

ADVANCED COLOURED GEMSTONE COURSE

The advanced coloured gemstone training course is an intense gemmological programme that offers a detailed hands-on approach to identifying treatment and origin of ruby, sapphire and emerald. Please note that this course is always in high-demand and already fully booked for 2018. In this course we demonstrate the possibilities and limitations of treatment detection and origin determination of corundum and emerald. Participants will have the opportunity of analysing and testing numerous samples from our collection.

SMALL DIAMOND COURSE

The SSEF small diamond course (30 October - 01 November 2018), which focuses on diamonds of a diameter between 0.7 and 3.8 mm, mainly used in the watch industry, enables participants to themselves perform the quality control of such small diamonds. These courses are aimed at people working in the jewellery and watch industry, and can be tailored to your company's specific needs. Previous gemmological experience is welcome but not a requirement.

SCIENTIFIC GEMMOLOGY COURSE

In 2018, the one-week Scientific Gemmological course will not be taking place. We are currently revamping this course that has been very successful in recent years by focusing on the scientific aspects of gemmology. This includes learning about techniques and applications of instruments like X-Ray fluorescence spectrometry, UV-Visible-NIR spectroscopy, GemTOF, Raman and FTIR spectrometry in the field of gemmology, as performed at the Swiss Gemmological Institute SSEF.

SSEF COMPANY COURSES

The SSEF Swiss Gemmological Institute can personalise a course based on your or your company's specific requirements. This course format is especially suited for companies that need specific gemmological training for their employees. In 2017, a number of companies have benefited from such courses that were tailored to specific topics including small diamond quality control, diamond treatments or learning to identify coloured gemstones from different origins. If you or your company are interested, please contact us to discuss how a gemmological course can be tailored to your needs. ✶

△ ATC Coloured Gemstone Course Participants in October 2017. Photo: SSEF

CONGRATULATIONS:

The Swiss Gemmological Institute SSEF wants to express its congratulations to the following persons for graduating from the following courses in 2017:

Basic Gemmology Course

- Bhramini Reddy
- Abhijita Kulshrestha
- Christoph Eisenkölbl
- Romain Perusset
- Corinne Fischer
- Melina Schatz

Basic Diamond Course

- Christoph Eisenkölbl
- Serena Menzi
- Chantelle Hoffmann
- Carla Alegria
- Sara Quhaiwi
- Simon Lienhard
- Jeffery Bergman
- Vahid Ahadnejad
- Stefania Suter
- Nathan Ribeiro
- Aurélie Haverlan

Advanced Pearl Course

- Jeffery Bergman
- Serena Menzi
- Stefania Suter
- Esther Leung
- Yves Bleiberg
- Anne Gruaz Flowerday
- Olivier Pauquet

Advanced Coloured Stones Course

- Dragica Dubravac
- Charlotte Leclerc
- Kirsten Everts
- Sara Thomeier
- Michael Gardner
- Michael Gargour
- Mohamed Fahmy Mohamed Hilmy
- Sailesh Lakhi
- Bruno Wyler
- Tamara Moussaieff
- Lindsey Miller
- Abraham Poulad
- Max Berent
- Fritz Kohler
- Vinaykumar Singh
- Oren Nhaissi
- Ramon Schmid
- Mohamed Farhan Fyzee
- Manish Sakhariya
- Arno David Olaf Oehlbaum
- Frederic Walter
- Rahul Jain
- Christoph Eisenkölbl
- Melissa Amenc
- Pawanya Trakulmechokchai

Advanced Small Diamond Course

- Charline Crouau
- José Alves
- Lionel Gendre
- Fabrice Nicolas

Scientific Gemmology Course

- Christoph Eisenkölbl
- Regina Franchetti
- Karim Gargour
- Hendro Susanto
- Nasseri Modjtaba
- Mohamed Farhan Fyzee

PEARL COURSES AT SSEF

Since many years, the SSEF offers an Advanced Pear Course (ATC Pearls) at our premises in Switzerland for interested students and professionals in the pearl trade. These courses are always held with a restricted number of participants (maximum 6), so as to ensure that participants can best benefit from the course.

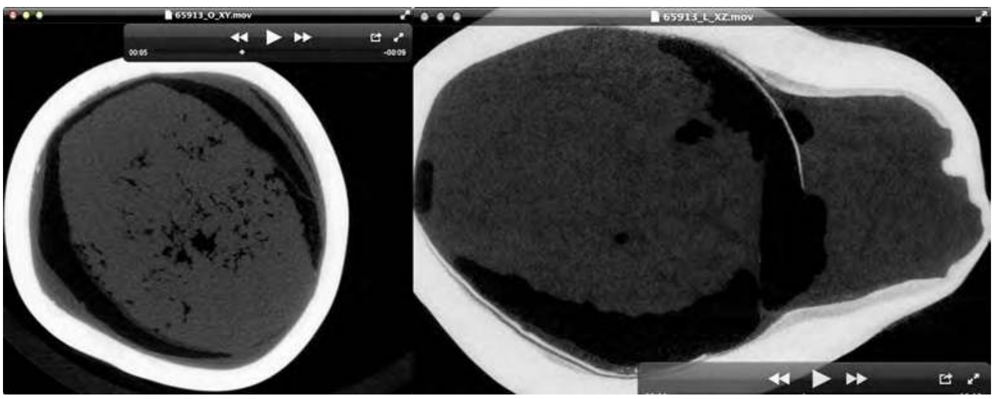
For 2018, we have decided to redesign the ATC pearl course into a two-day course, with a strong focus on pearl testing and identification, including hands-on practical sessions and analytical demonstration using X-ray methods such as radiography and tomography, X-ray luminescence and X-ray fluorescence, but also Raman spectroscopy for pearl colour authentication. Interested readers are requested to contact SSEF or see our website for further information and early registration is recommended.

Apart from our SSEF courses, we would like to inform readers of an online course developed two years ago by Pearls As One (www.pearlsasone.org), an educational initiative of the Cultured Pearl Association of America in collaboration with Jeremy Shepherd (Pearl Paradise, USA), and the pearl experts of pearl-guide.com. This course is ideal to understand cultured pearls and the cultured pearl industry at large, packed with information from world-renowned pearl experts. It could be a great starting point before attending the Advanced Pearl Course at SSEF. ✶ **Dr. M.S. Krzemnicki, SSEF**

△ The participants of the last Advanced Pearl Course at SSEF in November 2017. From left to right: Dr. Michael S. Krzemnicki (SSEF), Anne Gruaz Flowerday, Olivier Pauquet and Yves Bleiberg. Photo: Vito Lanzafame, SSEF

△ **Figure 1:** Selection of pearls from different species, discussed during ATC Pearl Course. Photo: SSEF

△ **Figure 2:** Untreated golden South Sea pearls from the Philippines. Photo: L.E. Cartier, SSEF



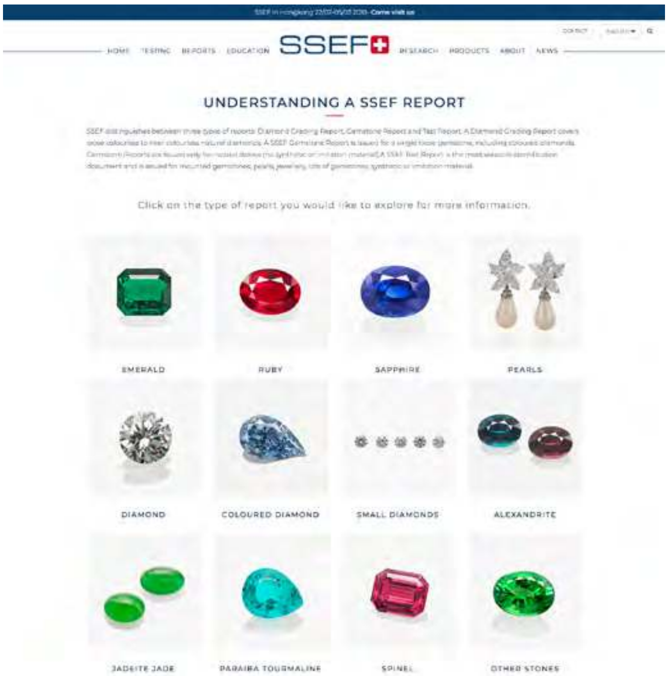
△ **Figure 3:** Learn more about the internal structures of pearls and how to distinguish natural and cultured pearls. Images: SSEF

NEW WEBSITE

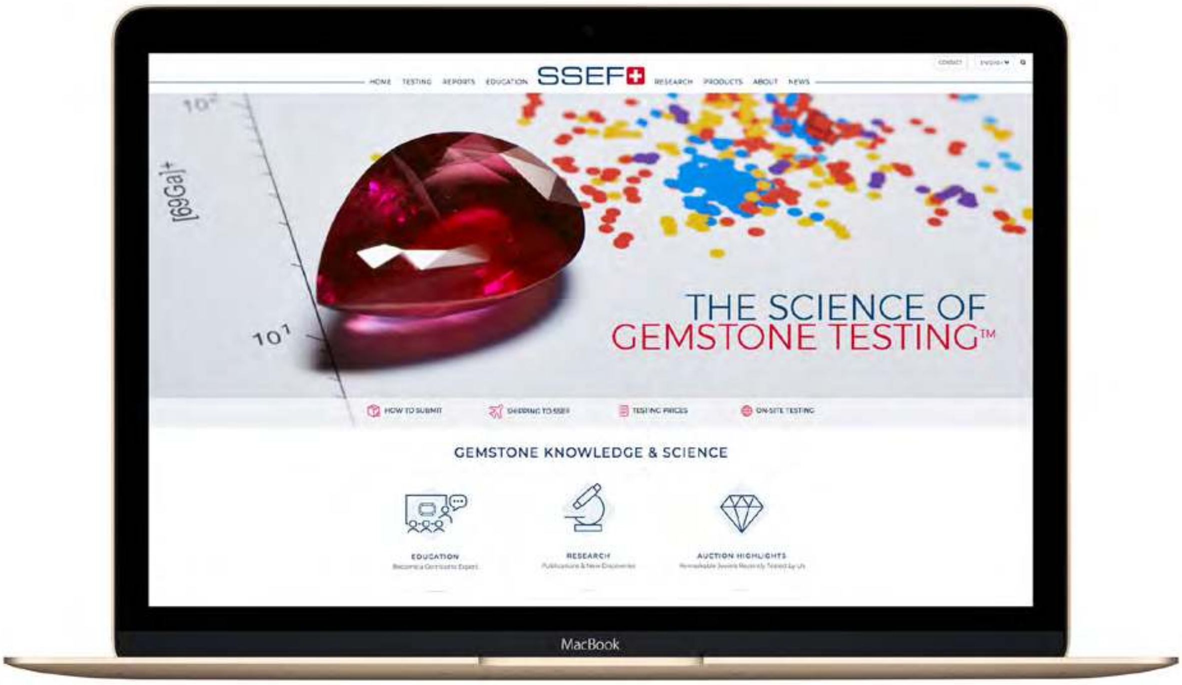
Mid-March 2018 we will be launching our new website www.ssef.ch. We are revamping our website to reflect a more modern design and provide more content to our clients and those interested in gemmology. It will feature not only latest news (courses, on-sites, gemmological research), but also detailed background information on SSEF reports and standards and an extensive library of publications.

Prices, testing services, shipping information can easily be found on the SSEF platform. We would also like to remind clients that SSEF reports can be verified on a separate website www.myssef.ch, on which reports issued after July 2016 can also be downloaded as PDF files.

Finally, to stay informed by email do subscribe to our newsletter, which will inform you of updates, news or gemmological research. If you are not already subscribed to our newsletters, you can sign up on www.ssef.ch. ✶ **Dr. L.E. Cartier, SSEF**



△ New section on SSEF website where detailed information on the language and standards used on SSEF reports can be found

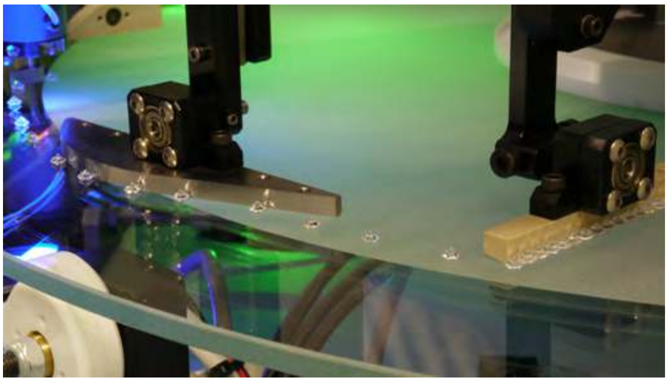


△ New SSEF website with revamped design and friendlier user navigation

ASDI NEWS

SSEF recently improved its ASDI machine by coupling its Raman spectrometer, its short save UV light spectrometer, and its mechanical double-switch system to the height variation of the rotating glass-plate. When rotating, within the specifications of the glass-plate manufacture, at its rim its height varies at a maximum of 0.1 mm. The 60 cm-diameter-glass-plate of the ASDI machine is an exchangeable part and shall be replaced after about one million stones have been tested.

Coupling the two spectrometers and the mechanical switch enable these three components to strictly follow the height variation of the glass-plate at the position where small diamonds are analysed. This new improvement now enables the ASDI machine to analyse smaller stones than ever. While the previous limitation of the ASDI was a minimum diameter of 1.0 mm, it is now 0.7 mm for stones of good clarity. Eventually, we expect this enhancement to preserve the glass-plate life to more than one million stones. Validation tests were performed at SSEF with a large number of diamonds with diameters ranging from 1.30 mm to 0.55 mm. ✶



△ **Figure 1: ASDI instrument in use at SSEF. Photo: SSEF**

SEALED BAGS

Apart from the over one million small diamonds that SSEF checks every year for their authenticity (mainly with the ASDI machine, but also with our automatized micro infrared spectrometer) hundreds of thousands small diamonds are also controlled for their quality (e.g. size, colour, clarity, finish, and fluorescence). Usually these stones are submitted in large batches by the watch and jewellery industries. The quantity of submitted diamonds within one batch may vary from several dozen to thousands of stones. In this last eventuality, the quality control is performed on a sampling basis.

Since SSEF detected undisclosed synthetic diamonds mixed in batches of natural diamonds, some of our clients expressed their need for receiving the controlled batches inside sealed bags. Thus, from January 2018 on, SSEF delivers the controlled batches of small diamonds in a thick plastic bag (100 µm) sealed with a SSEF white seal showing the SSEF logo, a bar code and a unique serial number (see Figure 1). Once the seal is opened, a very visible 'VOID/OPEN' message will appear on the face of the bag. ✶ **J.-P. Chalain, SSEF**

△ **Figure 1: A typical sealed bag containing small diamonds after control**

ASMEBI ORGANIZES A CONFERENCE ON SYNTHETIC DIAMONDS, GENEVA 2017

On the 6th of April, 2017, ASMEBI (Association Romande des Métiers de la Bijouterie) invited Dr. M.S. Krzemnicki and J-P. Chalain to give two presentations on synthetic diamonds at the conference session held in Geneva, entitled «Diamants de synthèse: l'horlogerie et la joaillerie en danger ?».

An international panel of ten diamond specialists presented their talks to more than 200 persons. This informative session on synthetic diamonds exclusively addressed to the jewellery and watch-industry members was well organized by Mr C. Berruex and the President of ASMEBI, Mr. A. Perrin.

Most of the presentations can be downloaded at: www.asmebi.ch/fr/lassociation/actualites ✶

△ **Figure 1:** Panellists gathering at the ASMEBI conference

ICA CONGRESS AND JAIPUR GEMSTONE CUTTING FACILITIES VISITS

The 2017 International Coloured Gemstone Association (ICA) congress took place in Jaipur, India from 21st -24th October 2017. The congress brought together experts on a wide range of different issues such as mining, trading of gemstones, gem labs, ethical issues, design and blogging. This was a good occassion for ICA members to discuss ongoing developments in the industry, and work towards the further promotion of the colored gemstone industry.

Dr. Laurent E. Cartier of SSEF was invited to give a talk during the laboratory session on recent innovations in pearl testing. Although pearls were only a side issue of the congress – the other talk on pearls was by Douglas McLaurin of Cortez pearls from Mexico-, Jaipur was a good location to speak about pearls. India has a rich heritage of using natural pearls in jewellery and trading in such pearls. India's growing middle class is also becoming increasingly interested in cultured pearls.

Jaipur is one of the world's main central hubs for coloured gemstone trading and manufacturing. As such, it was an ideal location for the ICA congress. Dr. Cartier also had the opportunity on the last day to visit numerous gemstone cutting facilities. From high-end emerald and ruby cutting workshops to factories processing all types of gemstones or lower-grade goods it was a highly insightful to be able to visit so many different types of facilities. ✶

△ **Figure 1:** Traditional gemstone cutting in Jaipur, India. Photo: L.E. Cartier, SSEF

△ **Figure 2:** Amethyst rough selection, sorting and pre-processing. Photo: L.E. Cartier, SSEF

△ Figure 3: Precision cutting of emeralds in Jaipur. Photo: L.E. Cartier, SSEF

CIBJO CONGRESS 2017 HELD IN BANGKOK

CIBJO Congress 2017 held in Bangkok

The 2017 CIBJO congress took place in the famous city of Bangkok, Thailand. While the official congress was held from the 05 to 07 November, the pre-congress, where CIBJO steering committees meet, began on 02 November. The opening ceremony was highlighted by the presence of the Prime Minister and the Minister of Commerce of the Kingdom of Thailand. CIBJO blue books were updated according to the reviewed recommendations received since the last congress and they are downloadable from the CIBJO website (www.cibjo.org, tab 'blue book').

This year's congress was notable because of the agreement between CIBJO and IDC (the International Diamond Council that groups WFDB - the World Federation of Diamond Bourses - and IDMA - the International Diamond Manufacturers Association) to recognise the CIBJO Diamond Blue Book as the one and only one reference book for the entire diamond trade industry.

More information on the 2017 CIBJO congress at: http://www.cibjo.org/congress2017/

CIBJO and Russian Government Agreement, 2018

On January, 24, 2018, Gokhran of Russia organised the conference 'Polished Diamonds Classification: Ways of Development' in Moscow. Among other speakers was J-P. Chalain, Head of the Diamond Department of SSEF and vice-President of the CIBJO Diamond Commission, who presented the CIBJO Diamond Grading System - PAS 1048. About 200 people attended the meeting.

In conclusion to this very well organised meeting, Mr. Alexei Vladmirovich Moiseev Deputy Finance Minister of the Federation of Russia, Dr. Gaetano Cavalieri, President of CIBJO, and Stephane Fischler, President of AWDC signed a Memorandum of Understanding with Gokhran of Russia with the purpose of harmonizing the official system used in Russia for the classification of polished diamonds with CIBJO. For more information contact: communications_1@cibjo.org

Diamond & Jewellery Organizations release a common Diamond Terminology Guideline

On January 30th 2018, the following 9 diamond and jewellery organisations: AWDC, CIBJO, DPA, GJEPC, IDI, IDMA, USJC, WDC and WFDB released a press release. They agreed on a common guideline for promoting the ISO 18323 Standard ('Jewellery - Consumer confidencein the diamond industry') and the CIBJO Diamond Blue Book. This is an important step towards worldwide harmonisation and is very much supported by SSEF. ✶

△ The 2017 CIBJO congress took place in Bangkok, Thailand. Photo: CIBJO

PIGEON BLOOD AND ROYAL BLUE: SSEF EXPLAINS CRITERIA IN NUMEROUS LECTURES WORLDWIDE

The use of the trade terms 'pigeon blood red' and 'royal blue' in the trade and on lab reports has become an important issue in the trade, mainly as there does not exist so far a uniform and worldwide accepted set of criteria for these highly appreciated (and valued) historic colour terms.

As our clients know, the SSEF decided only a few years ago to use these trade terms on our reports. Since then, the SSEF has applied a very rigorous and strict set of criteria for any ruby or sapphire to qualify for these colour terms. The main principle for us is that these terms have historic roots and meaning and that they were used and still should be used only for gems of vivid red or blue colour and outstanding quality. A detailed description of our criteria was published in our annual magazine SSEF Facette in early 2016 (see SSEF Facette 22, pages 8-10). A presentation with even much more detailed description of our criteria was put together in 2016 – originally for the CIBJO Congress in Yerevan (Armenia) in 2016 – and available since then publicly on our SSEF website for reference purposes.

The SSEF sees an important part of its mission to educate and explain its procedures to the trade and as such we have given numerous lectures and courses in the past two years to explain the use of the terms pigeon blood red and royal blue by SSEF.

Among these were invited lectures in Hong Kong during the March Jewellery Show at a highly attended event kindly organised by the Gemmological Association of Hong Kong GAHK, and a lecture at the Gemmological Association of Austria in Vienna. Very recently again, the SSEF was invited to present their criteria at the most recent GILC meeting in Tucson in January 2018, with the aim of explaining and discussing these criteria between labs and the trade and to further harmonise the use of these colour terms at an international level. ✶

△ **Figure 1:** Dr. M.S. Krzemnicki at the GAHK Seminar, Hong Kong March 2017. Photo: N. Siu, GAHK

GEMMOLOGY LECTURES IN CHINA

In spring 2017, one of our senior gemologists, Dr. Wei Zhou, was invited for talks based on the topic 'International Gemstone Testing' in five different Chinese University and Academies in China. They are Shanxi Academy of Social Sciences, Xi'an Academy of Fine Arts, Northwest University, and Shanxi Normal University in Xi'an Shanxi, and Jiangsu University in ZhenJiang, Jiangsu. In total, over 1000 people joined this 3 hour presentation about rubies, sapphires and other interesting topics about gemstones. For the last two years, Dr. Zhou has been interacting with Chinese academic institutions and universities. With the development of China's jewelry market, enhancing exchanges and cooperation with Chinese scientific institutions will bring SSEF Swiss Gemmological Institute interesting and meaningful opportunities. ✶

SSEF AT THE IGC CONFERENCE IN NAMIBIA

The 35th International Gemmological Conference IGC was held last October in Windhoek, Namibia. Co-organised by Dr. Uli Henn (DSEF, Germany), Prof. Dr. Henry A Hänni (GemExpert and SSEF Research Associate, Switzerland), and Andreas G. Palfi (consulting exploration geologist, Namibia), this biannual gathering of eminent gemmologists from all over the world was a great success with an outstanding number of contributions on coloured stones, diamonds and pearls. The SSEF was present in Windhoek with two research associates, Prof. Dr. Henry A. Hänni and Dr Walter A. Balmer to present the latest research findings of SSEF. Our contributions included a presentation about GemTOF as a new and highly versatile method for trace element analysis and posters about traceability of gemstones, Sannan Skarn from Pakistan, cobalt-diffusion treated spinel, and jadeite from Kazakhstan (see also articles in this Facette).

The conference was perfectly organised including two excursions to diamond mining operations (Namdeb) and coloured stones (demantoid and tourmaline) deposits before and after the conference. More details about IGC can be found on the website www.igc-gemmology.org. Interested readers are invited to download the full abstract volume of the 35th IGC conference. ✶

△ **Figure 1:** Participants at the IGC conference in Namibia in October 2017. Photo: IGC

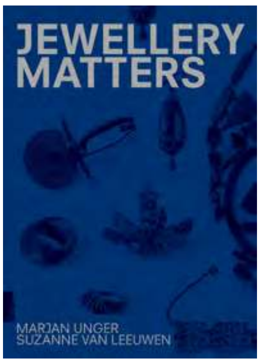
JEWELLERY MATTERS SYMPOSIUM IN AMSTERDAM

In October 2017, an international group of art historians, designers and scientists met at the Rijksmuseum in Amsterdam for a two-day symposium to discuss the context of gems and jewellery in society since historic times, current trends in jewellery design, and jewellery as cultural heritage. This symposium was organised to celebrate the publication of the book Jewellery Matters by Marjan Unger, jewellery collector and art historian from the Netherlands, who has worked extensively on this topic.

△ **Figure 1:** Dr. Michael S. Krzemnicki speaking at the Rijksmuseum in Amsterdam. Photo: Rijksmuseum

As an invited speaker, Dr. Michael S. Krzemnicki presented our latest research in age dating of pearls of historic provenance, a topic highly relevant when it comes to authenticating historic jewellery (e.g. Renaissance). Apart from the very informative talks and discussions, the organisers kindly provided the participants an opportunity to visit the restoration facilities for historic jewellery, paintings, books, and dresses of the world famous Rijksmuseum in Amsterdam.

The book Jewellery Matters can be ordered on Amazon or directly at the Rijksmuseum. Interested readers may also get a copy of the abstracts volume of the symposium from the organisers, please send an email to S.van.Leeuwen@rijksmuseum.nl ✶



◁ **Figure 2:** Jewellery Matters book

75TH ANNIVERSARY OF THE SWISS GEMMOLOGICAL SOCIETY

From the 29th of June to the 2nd of July 2017, the Swiss Gemmological Society (SGS) celebrated its 75th anniversary combined with the European Gemmological Symposium. To further honour this occasion, the congress and jubilee events took place in the Grand Hotel Zermatterhof in the world-famous alpine resort village Zermatt. 120 Society members and guests attended the congress and festivities.

Dr. Walter A. Balmer, member of the SGS's scientific committee, Dr. Michael S. Krzemnicki, director of the SSEF, Dr. Laurent E. Cartier, research scientist at SSEF and Michael Hügi, director of the Swiss Gemmological Society chaired the conference. SSEF has supported the Swiss Gemmological Society for years, and will continue to do so to strengthen education and research on gemstones in Switzerland.

The conference covered a broad variety of topics, and invited world-renowned guest speakers and gemmologist held fascinating lectures on coloured gemstones, diamonds and pearls. SSEF members gave three talks at this prestigious conference. Dr. Michael S. Krzemnicki gave a talk highlighting how the combination of mineral inclusion studies and sophisticated scientific instrumentation is advancing gemstone treatment and origin research. Dr. Laurent E. Cartier shared insights on the history of emeralds, the meanings and uses of these stones, and their different geographic origins. Dr. Laurent E. Cartier shared insights on the history of emeralds, the meanings and uses of these stones, their different geographic origins, and updates on treatments. Prof. Henry. A. Hänni (Research Associate SSEF) spoke about the discovery of Sannan-Skarn, a beautiful new ornamental stone resembling Maw-Sit-Sit. Finally, SSEF's new foundation board member Bernhard Berger (Director Cartier Tradition) presented the work on Cartier's historic collection.

Award for Dr. Michael S. Krzemnicki

The former Swiss prime minister, Adolf Ogi, and the president of the SGS, Hans Pfister, gave commemorative speeches at the anniversary gala dinner. At this event, Dr. Michael Krzemnicki of SSEF along with Dr. Thomas Hainschwang received the Excellence Award of the Swiss Gemmological Society for their work and international reputation. The conference was concluded on Sunday by a trip at the Gornergrat, where Prof. Dr. Kurt Bucher, University of Freiburg i. Br. gave an overview of the geology of the Zermatt region. ✶

△ **Figure 1: The conference participants; in the center of the first row is the former Swiss prime minister Adolph Ogi, who was an honorary guest of the conference. Photo by M. Hügi.**

△ **Figure 2: Presentation of the SGS Excellence Award to Dr. Thomas Hainschwang (left) and Dr. Michael Krzemnicki (second from left) by SGS President Hans Pfister (right) and SGS Director Michael Hügi (second from right). Photo by D. Bellandi**

GEMMOLOGY SESSION AT SWISS GEOSCIENCE MEETING IN BERN

The Swiss Geoscience Meeting will be taking place in Bern in 2018 from November 30th to December 1st 2018, and again be having dedicated session to gemmology convened by Dr. Laurent E. Cartier and Dr. Michael S. Krzemnicki. SGM is an ideal setting to exchange with geology and mineralogy researchers based in Switzerland. The conference focuses on all disciplines in Earth Sciences. Since a few years, SSEF has been organising a session for gemmology at this annual meeting. We feel it is important to support these initiatives as this way we can grow and foster scientific interest in gemstones by university research departments in Switzerland and abroad. For more information on how to submit an abstract to this conference, or attend as a guest please visit the SGM website: https://geoscience-meeting.ch/ ✶

sc | nat

Swiss Academy of Sciences
Akademie der Naturwissenschaften
Accademia di scienze naturali
Académie des sciences naturelles

GEMSTONE AND SUSTAINABLE DEVELOPMENT KNOWLEDGE HUB

A Gemstone and Sustainable Development Knowledge Hub has recently been initiated that aims to facilitate learning across the full supply chain of coloured gemstones from mines to markets, and improve the sector's contributions to sustainable development. The hub is a collaboration between the University of Delaware (USA), the University of Queensland (Australia), and the University of Lausanne (Switzerland), supported by the Tiffany & Co. Foundation. The Knowledge Hub is also working with museums, gem miners, gemmologists, dealers, jewelry manufacturers, grassroots organizations and development agencies in this endeavor. SSEF's Dr. Laurent E. Cartier is involved as a senior researcher and Dr. Michael S. Krzemnicki as an advisory board member.

Coloured gemstone supply chains are highly fragmented. The large variety of different gemstones found in the trade, each facing different mining & manufacturing issues and production cycles, adds to this complexity. The Knowledge Hub seeks to contribute to overcoming some of these gaps, by bringing together existing knowledge and targeting critical research issues in coloured gemstone mining, manufacturing and sales.

The Knowledge Hub welcomes the broadest range of collaborations and looks forward to featuring research and practice which serves to furthering the contributions of the sector to sustainable development. For more information: www.sustainablegemstones.org ✶

SCIENTIFIC CONFERENCE: EUROPEAN WINTER CONFERENCE ON PLASMA SPECTROCHEMISTRY

One of the biggest scientific conferences on ICP-MS in Europe is the European Winter Conference on Plasma Spectrochemistry. In February 2017, it was held in the beautiful ski resort in Sankt Anton, Arlberg, Austria. More than 450 analytical scientists and ICP-MS specialists from all over the world joined and contributed to presentations and discussions. A wide range of interesting topics were discussed, including instrument and methodology development, as well as geological, biological, metrological applications. Due to recent advances, Laser Ablation ICP-MS is one of the most popular techniques in the conference, among which LA-ICP-Time-Of-Flight-MS (LA-ICP-TOF-MS) is gaining more and more attention and frequently highlighted. Either researchers presented results analyzed using TOF-MS, or they paved down future plans using this unique method.

Since the implementation of GemTOF (LA-ICP-TOF-MS) in summer 2016, SSEF has focused on trace element analysis and how chemical information may bring additional information to gemmologists in helping origin determination. With support from instrument manufacturers, the SSEF foundation board and the whole team at the SSEF laboratory, GemTOF has produced exciting output within just a few months of operation. First results were summarized and presented in a talk, titled 'Trace Element Analysis of Gemstones using LA-ICP-TOF-MS', at the conference in Sankt Anton. The talk began by discussing challenges in accurate origin determination and its importance to foster transparency and sustainability issues throughout the gem trade. Then we introduced the GemTOF platform and its characterization was emphasized. Preliminary trace element analysis, age dating as well as inclusion analysis was presented and the potential of providing complementary evidence for origin determination of sapphires was also discussed. In the outlook, we outlined the future plan of data analysis using advanced statistical methods as well as application of GemTOF on other varieties of gemstones. In the talk, as well as afterwards, many discussions and feedbacks were received from the audience. Most of them were very constructive, which helps us in the further development of trace element analysis at SSEF. ✶ **Dr. H.A.O. Wang, SSEF**

△ **Figure 1:** GemTOF monitoring at SSEF. Photo: SSEF

CLOSE UP: JULIEN XAYSONGKHAM

Julien Xaysonghkam joined the Swiss Gemmological Institute SSEF 10 years ago in 2008, when the team was still rather a small family. Starting as an aide and trainee for the testing of small diamonds at SSEF, he soon became very interested in gemmology. By following an intense internal training he gradually became a diamond grader and gemmologist, working together with his colleagues in the diamond department at SSEF.

We soon realised that Julien has many other skills – and we are not speaking here about perfect preparation of Laotian spring rolls for our team lunches – but mainly his artistic notion when taking photos of gemstones for our reports. Julien has a very focused and exact working attitude, in fact perfect preconditions to be a responsible diamond expert who analyses large and small diamonds submitted to SSEF with a large range of sophisticated analytical methods, such as cryo-FTIR, micro-FTIR, and cryo-Photoluminescence spectroscopy, to name a few.

Julien, originally from Laos, but living since a very young age in France, has managed to perfectly blend Asian virtues with French lifestyle. Laid-back but focused in his work, the team is very much happy to have Julien on board, especially in stressful times when we work on-site in a small booth at a Jewellery Show.

Always eager to learn more, Julien recently has started a journey into tricky Swiss German dialects and words, and we are not astonished to see that he is actually also getting to be an expert in this. ✶

TEAM EVENT

On November 23rd, SSEF shut its doors and treated it's employees to a special and inspiring day out. Nicknamed the Cultural Capital of Switzerland, Basel is home to almost 40 museums. It was therefore decided to dedicate the morning to culture and as such our first stop of the day was at the Basel Antique Museum/ Antikenmuseum where the exhibition 'Scanning Seti: The Regeneration of a Pharaonic Tomb' was on. This exhibition took us on a fascinating journey to Egypt /transported us to Egypt and the Valley of the Kings, where in 1817, the rock-cut tomb of Pharaoh Seti I (Father of Great Rulers in Egypt, such as Ramses II) was discovered by Giovanni Battista Belzoni. Known to be one of the finest examples of Egyptian funerary art ever found in history, the 3,300-year-old royal tomb has been recreated -for the exhibition- in its original beauty and size. This was made possible thanks to watercolours documenting its wonderful decorations, made at the time of the discovery, combined with the most up-to-date 3D scanning and reproduction processes. Walking through the life-sized magnificent burial chambers and discovering the pharaonic monument, as Belzoni did, 200 years ago, was an impressive and enchanting experience for all of us.

After a relaxed and informal lunch, the team headed to 'Unser Bier' brewery with the pleasant mission to learn how to brew bier. Tapping beer was also part of the study and it was not long before each of us became masters in beer tapping! The hands-on 'brewing experience' took us all the way through to the evening; plenty of information was shared and many techniques taught to us. The story does not say if some of us will experiment home brewing beer, but we can say for a fact, that we were all very enthusiastic when, seven weeks later, the highly sought after and desired SSEF beer was delivered to the laboratory. ✶**V. de La Soujeole, SSEF**

△ **Figure 1:** SSEF's 2017 team event involved beer brewing at the Unser Bier brewery in Basel. Photo: W. Zhou, SSEF

NEWS FROM THE SSEF FOUNDATION BOARD

As you may know, the Swiss Gemmological Institute is part of the Swiss Foundation for the Research of Gemstones (SSEF: Schweizerische Stiftung für Edelstein-Forschung) and as such is a fully independent non-profit organisation (Swiss Foundation) under the aegis of the Federal Department of Home Affairs. Founded in 1974 by Swiss trade organisations, the SSEF is supervised by a board of seven members, who represent different parts of the supply chain such as the trade in gems, jewellery manufacturing and retail. The board meets regularly to discuss the general policy and direction of the laboratory.

In July 2017, the SSEF Board had a two-day retreat in a mountain lodge, kindly arranged by the acting president of the Foundation Board, Marc-Alain Christen in his private 'Chalet Paradiesli', close to heaven as we may say.

The mountain scenery surrounding Wengen in the Swiss Alps and the beautiful weather has again proven to be very inspiring for the board members. Main topics were the SSEF board structure and how to organise in the coming few years the succession of board members - many of them serving the board now for more than 20 years.

As part of this succession, we are very pleased to welcome Mr Bernhard Berger, Head of Cartier Tradition, as a new member of the SSEF Foundation Board. ✶

△ Jungfrau (the virgin mountain) seen from the mountain lodge 'Paradiesli'. Photo: M.S. Krzemnicki

△ The participants of the board meeting in Wengen (from left to right): Marc-Alain Christen (President of the Board), Bernhard Berger, Adrian Meister, Rolf Fankhauser, Martin Häuselmann, Charles Abouchar, Ronny Totah, Nicky Pinkas, Niklaus Bieri, and Michael S. Krzemnicki (director of the SSEF laboratory). Photo: SSEF

DONATIONS

As in previous years, we are grateful for numerous donations we received in 2017 from many pearl and gemstone dealers around the world. These donations not only support our research but also add to our collection of specimens to be used in our courses, with the aim to educate the participants and to give them the opportunity to learn gemstone and pearl testing on a wide variety of untreated and treated materials.

We would like to especially thank the following persons and companies:

FOR PEARL DONATIONS:

Jeremy Shepherd (Pearl Paradise, USA), Andy Müller (Hinata Trading, Japan), Michael Hajjar (Belpearl, Hong Kong), Laurent Cartier (Basel), Thomas Faerber (Geneva),

FOR GEMSTONE DONATIONS:

Henry A. Hänni (GemExpert, Basel), Yianni Melas (Cyprus), Groh & Ripp (Germany), Jeffery Bergman (Primagem, Bangkok), Charles Abouchar (Abouchar S.A., Geneva), Sepher Jewelry (Tehran), Nino Autore (Australian South Sea Pearl, Dubai), Jean-Baptiste Mayer (Basel), Htay Paing (Myanmar), Chiku Sukhadia (Sukhadia Stones Co. Ltd., Bangkok), Sebastian Hänsel (Basel), Miemie Thin Thut (Bangkok), Kyaw Swar Htun (AGGL Gem Lab, Yangoon) ✶

SSEF ON-SITE IN 2018

In 2018 we will be exhibiting and/or offering our on-site testing services as follows :

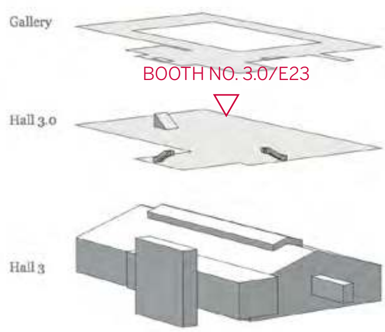
Hong Kong	22 February - 05 March
BaselWorld	22 - 27 March
GemGenève	10 - 13 May
Bangkok	21 - 25 May
Hong Kong	18 - 24 June
Bangkok	20 - 24 August
Hong Kong	07 - 18 September
Paris	on request
Other locations	on request

Further on-site services will be communicated through our website and in newsletters. Please subscribe to our newsletter on our website www.ssef.ch to be updated regularly about our on-site schedules, other services and news. ✶

BASELWORLD 2018

During BaselWorld 2018 (22 - 27 March), the SSEF will be once again offering its convenient gemstone and pearl testing services.

You can find us in the first floor of Hall 3 at **booth No. 3.0/ E23, at a different location** than in past years. The phone number at our booth (+41 61 699 51 29) remains the same, as does our high-quality express service, which may even include a nice cup of coffee and some Swiss chocolate. We are looking forward to meeting you at our booth and to testing your gemstones and pearls during the Basel Show. If you would like to have a number of items analysed, we suggest you call us in advance at the SSEF office (tel. +41 61 262 06 40) to fix an appointment. This is also strongly suggested if you would like to have your items tested shortly before the show. ✶



△ Photo © BaselWorld 2013.

GEMGENÈVE: SSEF AT NEW SHOW 10 - 13 MAY IN GENEVA

GemGenève, a new gem and jewellery show will be launched in May 2018 at the congress and exhibition centre Palexpo in Geneva. Initiated and organised by a small group of traders, this international show will unite some of the most prestigious and reputed international gem companies. The show has been ideally scheduled just ahead of the viewing days of the Geneva spring auctions of Christie's and Sotheby's. For more information about this new show, please check their website www.gemgeneve.com

The SSEF will be present with a booth at GemGenève, where we will offer our testing services for coloured gemstones. Clients who wish to submit us their gems at this new show are kindly requested to fix an appointment beforehand (admin@ssef.ch).

Apart from offering our testing services, Dr. Michael S. Krzemnicki, director of SSEF will also give a public lecture about our newest research findings. For the title and venue of the talk, please consult the GemGenève website or SSEF website www.ssef.ch in the coming weeks.✶

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△ SSEF team in January 2018. Photo: SSEF

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