

NEWSLETTER No. 7, October 2008



Dear SSEF ALUMNI Members

With this issue you hold already the 7th SSEF Alumni newsletter in your hands or better you "hold" it on your screens. We hope you enjoy the featured articles about pearls and gold mining. The pearl article is the first part of a series of three, highlighting the beauty of natural pearls. I am very glad that Mr. Laurent Cartier has not only contributed in this issue as one of the editors but has written a very substantial, yet also exciting article about his recent stay in Madagascar.

In summer, we had two very interesting gatherings with lectures. Laurent Cartier gave us an insight into the Indian diamond industry and about the cutting and trading of diamonds after visiting the country just some weeks before.

Vincent Pardieu gave a very exciting presentation of his extensive travels to gem deposits in East-Africa, concentrating on tsavolite garnet, spinel and corundum sources in Kenya and Tanzania. We would like to thank both for their effort.

Apart from the very informative talks, these gatherings always live by the open question/discussion section at the end of the talks and during the following dinner, where participants can share their views with the invited speakers and other Alumni members.

As we are further planning further lectures and events for 2009, we would like to receive any ideas from your side for a topic you are interested in. Please mail at info@ssef-alumni.org whatever topic you would like to get more first-hand information.

As time flies by, we are already getting close to Christmas season 2008. So I send all my best wishes for a peaceful Christmas to all the SSEF Alumni members and friends.

Leon Ascot

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Natural Pearls: The beauty of diversity

text & photos:

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Pearls have become beloved and affordable jewels since the emergence of large-scale pearl farming. Especially the huge production of cultured freshwater pearls from China has rendered necklaces containing such pearls, accessible. Efforts to considerably improve culturing practices have resulted in ever better and more homogeneous pearls available for the world market. Unfortunately, these developments have overshadowed much of the



Important natural pearl necklace. © H.A. Hänni, SSEF

exclusivity and singularity of natural pearls and relegated their particularities to a state of near obscurity. Natural pearls are just not always perfect. It is specifically this individuality that makes natural pearls unique jewels.

In this and two following articles, the focus will be on natural pearls: beginning with pearls that present a mother-of-pearl lustre, to later examining porcelain-like natural pearls from molluscs (part 2) and to finally discussing those originating from marine gastropods (part 3).

Salty or sweet:

Numerous rivers in central Europe were more or less well known for their pearls in past times. The pollution of rivers due to industrial waste, means that these pearl-forming Mollusks have become rare and are protected species- reserving the presence of freshwater natural pearls to antique jewellery, these days. The number of natural saltwater pearls is much greater, being found from the Persian Gulf to the Indian coast and all the way to the Pacific. The difference a criterion.

Freshwater pearls (both natural and cultured) have much greater concentrations of Manganese than saltwater pearls. Pearls are analysed using X-rays at the SSEF, both to visualise the internal structure of the pearl (radiography) and to record the X-Ray luminescence of the pearls (freshwater pearls display a bright reaction due to their more elevated Mn concentration, whereas saltwater pearls remain dark). But it often remains difficult to classify a pearl in accordance to its host mollusk species. There are often no distinct chemical, physical or visual (e.g. colour) characteristics, which might facilitate classification. We have been able to analyse an important number of pearls in our laboratory in the past year with which Thomas Hochstrasser (Dörflingen) also kindly lent the corresponding shells for our research on natural pearls.

Pinctada maxima:



Figure 1: A Silver-lipped Pearl Oyster (Pinctada maxima) with naturally attached Blister. The foreground displays a cutout blister and nine natural pearls of Pinctada maxima origin. © M.S. Krzemnicki, SSEF Swiss Gemmological Institute.

This especially large oyster species produces up to 20-30cm mighty shells, which often display beautiful mother-of-pearl. One differentiates between the Silver-lipped and Golden-lipped Pearl Oyster, depending on the colour of the mother-of-pearl towards the rim of the shell. *Pinctada Maxima* can be found in the East Indian Ocean all the way to the tropical west Pacific; especially in Burma, southern Thailand, Indonesia, Philippines and right up to the Australian coast. In practically all these areas, pearls are cultured in *Pinctada Maxima* host oysters and are marketed as the widely desired South Sea cultured pearls. It is often forgotten that natural pearls can also grow in these pearl oysters.

In this case, an irritation such as the snapping of a crab or the drilling of a borer is often the trigger for the formation of a natural pearl. Depending on whether the pearl lies completely in the organism, or adheres to the shell, or merely as a nacre-covered mount on the shell; pearl, a blister pearl or a blister. *Pinctada Maxima* natural pearls generally have a colour ranging from white to cream or gold/yellow. Unlike most South Sea cultured pearls, which have a round nucleus, these natural pearls are commonly individually formed, ranging from a slight tear-drop shape all the way through to barock.



Figure 2: The separated backside of a blister shows the reason for its formation: a small crab covered by mother-of-pearl. © M.S. Krzemnicki, SSEF Swiss Gemmological Institute.

Pinctada Margaritifera:

Figure 3: A *Pinctada margaritifera* shell from Indonesia with natural pearls from this pearl oyster species. © M.S. Krzemnicki, SSEF Swiss Gemmological Institute.

Many of the very appreciated grey/brown to black Tahiti cultured pearls originate from this pearl oyster. In addition to their dark body colour, these pearls often exhibit numerous colour tones ranging from green to rosé, which are a result of interference and scatter of incoming white light. These oyster shells can have widths of up to 30cm and can be found from the East coast of Africa to the central Pacific (Tahiti and further Pacific islands). The term *Pinctada Margaritifera* actually classifies a group of closely related pearl oysters. These exist in different variations- for example as Black-lipped Pearl Oysters (*Pinctada margaritifera cumingi*), which produce (both natural and cultured) dark coloured Tahiti pearls.

As is well seen in figure 3, the shell reveals an increasing grey colouration towards the rim, before the mother-of-pearl abruptly changes over to the brown/black coloured Calcite- and concholin zone. The interference colours of the mother-of-pearl are also noticeable in the photograph. Pearls stemming from *Pinctada margaritifera* need not necessarily be dark, but are often silver grey to grey/beige and also commonly appear barock in shape.

Pteria Penguin

The *Pteria penguin* species is often counted to the winged oysters due to its distinct wing-like oyster shells. These oyster shells can grow to 25cm in height and commonly display a gold to brownish grey colouration towards the rim. It can be found from the Red Sea to the tropical west Pacific. This pearl oyster is used for perliculture because of its beautiful nacre, which aside from its body colour often exhibits additional intensive interference colours. 'Mabé' cultured pearls (cultured half pearl, formed by inserting a half-sphere between the mantle and the shell) are widely sought-after types of pearls.



Figure 4:
Things can happen so fast. A curious guest (conch) becomes a blister in a *Pinctada margaritifera* shell. © M.S. Krzemnicki, SSEF Swiss Gemmological Institute.



Figure 5: *Pteria Penguin* oyster shell with a small blister pearl. Blister (left) and eleven pearls from this oyster species are displayed in the foreground. © M.S. Krzemnicki, SSEF Swiss Gemmological Institute.

Diversity vs. homogeneity

As is evident from the photographs, the presented natural pearls of these three pearl oyster species' are characterised by their individual diversity in shape and colour. Many of these pearls, when compared to cultured pearls, are by no measure perfect but instead have a unique colour, luster and shape.

For further reading on the subject, Elisabeth Strack's book 'Perlen' is recommended. It can be purchased at the SSEF Swiss Gemmological Institute, Basel (+41 61 262 06 40 or gemlab@ssef.ch).

Artisanal gold mining in Madagascar

text & photos: Laurent E. Cartier



The produce of a gold panning session © Laurent E. Cartier, 2008

The gem world sees a lot of gold and yet gold remains a distinctly mysterious companion of gemstones. Gold is extracted and mined on all continents, except Antarctica. It is a hugely varied and diverse industry, ranging from billion dollar firms to lone artisanal miners in remote rural areas, all generating an income by extracting gold from the earth. Since the very early beginnings of mining, over 160,000 tonnes of gold have been extracted from the earth in total (GFMS, 2007). The World Gold Council estimates that “around 70% of gold demand is jewellery, 11% is industrial (dental, electronics) and 13% is investment (institutional and individual, bars & coins)” (WGC 2008). The jewellery sector consumed a bit more than 2400 tonnes of gold in 2007 (GFMS, 2008). Gold used for jewellery comes from a number of different sources, but the majority (two-thirds) of it is sourced from ongoing mining of primary and secondary gold deposits. The remaining share is sourced from recycling (20%. Scrap, old jewellery etc.), and the sales of banks’ gold bullion (13%) (WGC, 2008).



Panning gold © Laurent E. Cartier, 2008

At least a quarter of primary gold (i.e. mined, not recycled or from banks) is produced by artisanal and small-scale mining (ASM). ASM, incidentally also the most common form of coloured gemstone extraction, “typically represents a spectrum of activities ranging in scale from small to large that is generally distinguished from ‘formal’ mining by a relatively low degree of mechanization, high degree of labour intensity, poor occupational and environmental health standards, little capital investments and lack of long-term planning. It is typically an informal and highly disorganized activity” (Hinton 2006). Gold, diamonds and coloured gemstones are all particularly suited to ASM because of their high value, low mining equipment investments and relatively easy processing of material.

The first (western) account of a gold discovery in Madagascar was by Jean Laborde in 1845. Legal codes effective under Queen Ranavalona II during a period of the 19th century punished any gold digger with 20 years imprisonment, dissuading people from mining gold. Policies eventually changed under Queen Ranavalona III, and an all time high of 3,697kg of gold was mined in 1909 (Premoli 1996). This made Madagascar the largest producer of gold in the old French empire at the time. At independence in 1960, Madagascar’s gold production had regressed to a scanty couple of kilograms of annual production. By 1990, informal production had dramatically increased and was (unofficially) back to 3-4 tonnes per year (Premoli 1996). The vast majority of Malagasy gold is now exploited informally. Official figures show a paltry 5kg of gold production in 2006, whereas the smuggled production is estimated to be between one and two tonnes for that

same year (USGS 2008). The advent of new large-scale gold mining projects is set to drastically increase Madagascar's official (and declared) gold production.

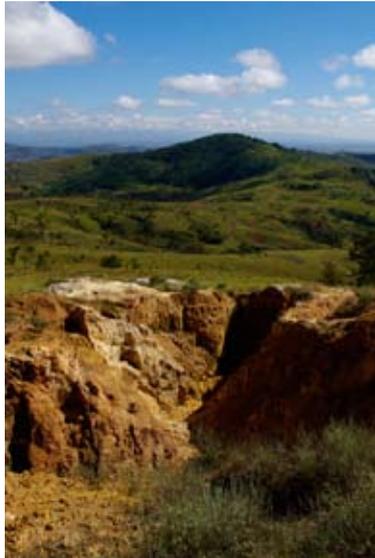
Gold (both artisanal and industrial) is still only refined to internationally highest grades, in a small number of specific refineries, worldwide. Zurich remains a global trading hub for gold, and Switzerland as a whole is still one of the most important gold refining countries on the globe. Alone the Produits Artistiques de Métaux Précieux S.A. refinery in Castel San Pietro (Ticino) processes over 450 tonnes of gold annually (PAMP, 2008).



Safeguarding the precious gold dust and flakes © Laurent E. Cartier, 2008

This whole expedition had been a mere coincidence, the result of unforeseeable circumstances. It had been a Friday morning and the decision to visit a new minor corundum deposit in the East had been a week old. I was to travel to this region with an acquaintance of long date. Trust is a tradable commodity, as are many things here, its best you know on whose side you are. Unfortunately, in many cases, 'knowing' your sides is also the best guide to getting it wrong. The best companion to getting through the trust quagmire was Lova. We had gotten to know each other working together in ruby and sapphire mines in southern Madagascar for a couple of weeks in 2006. He was and still is a part-time informal miner, working odd jobs when mines don't fare too well, and considers himself a (semi-) devout Jehovah's Witness. He had become part of a small company in Antananarivo that offered their services to various mining site proprietors around the island who needed strong, efficient and trustworthy artisanal miners. This venture had been a spin-off of the golden Ilakaka rush years and he had been sent all around the island with his gang of friends to dig for gemstones. The golden years are over, times have become harder for Madagascar's artisanal miners, and even their pioneering company has ceased to exist since. The 'drying' up of deposits government's confusing rough-gemstone export ban (first introduced in February 2008) hasn't made life easier for any of Madagascar's large artisanal mining population.

But plans, as so much else, are so prone to change in Madagascar. Due to an unfortunate lack of funds and the nature of the lands we were to visit, this trip would be like past ones: no jeep, a lot of walking and rice thrice daily. Having reached Antananarivo's large Fasan'ny Karana taxi brousse station too late, all bush taxis had gone, and so it required a change of plans. Instead of heading east, we headed south, in search of gold mines.



Landscapes surrounding the gold mines © Laurent E. Cartier, 2008

After some hours of a bumpy and overfilled bush taxi journey, and another 25km of walking past and through fields, we finally made it to the village in question. Reaching the village just before dusk, we sought and found the 'president du fokontany', hoping to inquire about the mines and find somewhere to sleep for the night. People had last mined here in 1982; no work has been done by orpailleurs (artisanal gold miners) since then, was his candid-sounding answer. Luckily, the young mayor (some-what paradoxically higher than the president in authority) arrived soon thereafter and took us aside for some rice and deceptively powerful local brew. Miners were still working and he would help out and find somebody to bring us to the sites, which were to be found another 30km further away. The undisguised Jehovah Witness connection between the mayor and my guide was most efficacious in aiding us. I never thought I might be incited to convert in the Malagasy bush, but here I was in a small rural Malagasy village reading Watchtower, talking about Jehovah and the 144,000 people that would one day enter heaven.



Bakoly, 15 years gold mining experience © Laurent E. Cartier, 2008



Freshly brewed coffee: what keeps miners going strong © Laurent E. Cartier, 2008

Early next morning after much waiting around and testing the great virtue that patience is said to be, a local guide was found. The first mining site was on top of a steep hill, some 30 kilometres to the Southeast. On top of this hill stands a prominent Holy Mary statue; the legend goes it was a hole (*lavaka*) full of gold, so the local priest built the statue atop to keep the gold to himself. Legends, oh legends.



Digging and collecting auriferous material from a secondary deposit
© Laurent E. Cartier, 2008

Some villagers, all local Merina, were on the other side of the hill digging and panning. Only about 15 people were working at this site, mostly women and children. It was a Saturday; none of the children had school, and were accompanying and helping their mothers in the local gold mine. In 2007 a considerable rush of migrant miners had come to this area to mine gold, who had all since left for Maevatanana (main gold producing area in Madagascar, some 300km north of the capital), realising that recovery and concentration grades weren't what ardent rumours had promised.

Seeing that the rice had just been harvested, mining constitutes a good alternative for some bitterly needed income. Rice, the staple diet, is kept locally for food and gold becomes the cash crop. Working in agriculture brings 5000FMG (0.40 Euro) a day, whereas mining gold brings double that. Orpillage has a long tradition of seasonal gold mining in the area, and the miners' village is only 3km away from the mining site. A couple of grams (typically 2-3 g) of gold are extracted in a week, depending on the number of people and hours working the deposit. Premoli (1996) roughly estimated that average artisanal production in Madagascar was about 20grams/miner/year; present seasonal artisanal exploitation in the southern Hautes Terres is likely to reach similar productivity figures. Miners' income here stems from profit sharing of 'free gold' sold to middlemen. The problem here, it seems, is less the price these miners are receiving for their gold; it is the amount of gold they can collect using their mining methods, per day. The amount of processed material and recovered gold remains exiguous, and the miners themselves are aware of this.

Over 80% of mined gold in Madagascar comes from secondary deposits (highly-weathered ores, alluvial/eluvial). Exploiting primary gold requires the adoption of other mining techniques- artisanal and small-scale mining worldwide is thus largely reserved to exploiting secondary gold deposits, which often exhibit grades that are insufficient for profitable mechanical exploitation. The deposits found in this region of the southern Malagasy highlands are mainly lateritic gold deposits. These are eluvial, produced by meteoric alteration of the primary deposit. Gravity concentration within this altered material can follow, potentially leading to an exploitable secondary gold deposit along alteration zones. Madagascar's gold originates mostly from lode gold deposits, commonly present in quartz veins associated with micashists and gneisses of the island's basement complex.



Gravity concentration of gold under a scorching sun © Laurent E. Cartier, 2008

The rudimentary concentration of auriferous material is methodically carried out manually using gravimetric techniques. The loosely consolidated ore from the supergene part of the deposit, is carried 100 metres down the hill, and placed into a number of small basins into which water is already deposited. The soil material is first 'cleaned' by being mixed in these basins. With two deep water holes present in the immediate vicinity of the basins, water is fortunately not a scarce resource. Inadequate control of this process can result in enormous losses. Gold has a specific gravity of 19.5 easily exceeding that of associated gangue and residual or altered minerals accompanying it. Finally, when the amount of material has been reduced, and gold has been further concentrated, the remaining material is subject to final gravitational separation by panning. This material corresponds largely to a 'black sand', with heavy minerals such as magnetite, hematite, ilmenite, and galena also present in these residual sands. Gravitation separation is at its most efficient when the particles of the processed ore are of similar size. Panning is done using specially adapted primitive metal pans. It is the most commonly used technique because of its low cost. No cyanide or mercury is used for amalgamation purposes in this area, in stark contrast to so many other gold mines worldwide.



Five miners fit into a strangely homogeneously coloured lateritic landscape © Laurent E. Cartier, 2008



Carrying the material to water basins for further separation © Laurent E. Cartier, 2008

Gold prices paid to miners by middlemen have risen in past years, but certainly not in concordance with the recent formidable rise of the international price of gold. There is very little trust in middlemen or newspapers (some of which publish gold prices), spurring those who travel to the capital to be asked to check updated prices on the Internet. A truly globalised world! Though price politics may seem more transparent than in the rough gemstone trade, it is by no means as evident or transparent as some may like them to be. Whichever price miners may seek for their gold; a buyer still needs to be found. Buyers, middlemen, exporters all also seek to earn income and profit from this supply chain. Further, the gold that is extracted is not melted or refined at a local level; it is sold as 'free gold' to middlemen (*mpanera*). A gram of gold is not necessarily equivalent to a gram of gold. The presence of micro-impurities (e.g. remaining heavy minerals coagulating to fine gold particles) increases the weight of the gold. Further, the quality of mined gold varies from deposit to deposit, making refining an important step in the gold supply chain.



A taste of a panning session's production © Laurent E. Cartier, 2008

The type of gold mining currently been undertaken in this southern area of Madagascar's Hautes Terres is likely to be as sustainable as things get in informal Malagasy artisanal mining. There is still a great need for assistance, mostly of a technical nature to assist artisanal miners with improving exploitation methods and processing (and potentially marketing) their gold to a post-melted stage. We visited a number of other laterite gold deposits in the region in the following days, coming ever nearer to the impressive Falaise de l'Angavo to the east. Mining techniques

were very much similar; as there were no financiers and no other source of additional investment into mining methods. This situation is set to be very different in major gold producing regions of Madagascar, where patronage and debt-bondage plays a much more prominent role, artisanal mining community dynamics are much more complex and the environmental and human costs of gold mining are considerably higher.

Formalisation efforts attempting to demarginalise artisanal gold miners have been underway for some time, but are only slowly making progress (BBC 2007). The value of gold certainly represents a great potential towards improving the livelihoods of the many artisanal gold mining communities, the fulfillment of this, however, remains a challenging undertaking. The hope is that rising gold prices, increasing consumer awareness, and much more importantly government and donor awareness can finally supply artisanal miners with the financial, legal and technological assistance they deserve.

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Rova, with a gold encrusted tooth and over a decade of mining © Laurent E. Cartier, 2008

News from the library:

Search the Web....

Some useful websites just found on internet:

<http://www.gemecology.org>

Balanced and interesting University of Vermont website with research results on the benefits and costs of artisanal gemstone mining in different countries.

http://www.cosis.net/members/meetings/programme/session_programme.php?mid=50&view=session

This summer, the 9th Kimberlite Conference was held in Frankfurt, Germany. On this site, you find the abstracts (click accepted contributions link in the different sessions!) of this highly informative scientific event.

<http://blog.modernmechanix.com>

A funny blog about technological in the 50ies and 60ies inventions which did not really change the way of our world...

SSEF Alumni Membership:

How to become a Member of SSEF Alumni ?

The SSEF Alumni Organisation is open for former participants of courses at SSEF Swiss Gemmological Institute, FGA students, and further interested persons in the gemmological community.

The SSEF Alumni is intended as a platform for the exchange of information and for continuous gemmological formation. Membership fee is 50 Swiss Francs per year. Please see our website for more information (www.ssef-alumni.org) or contact our President, Leon Ascot at info@ssef-alumni.org, when you would like to participate at exclusive SSEF Alumni events and to receive the highly informative electronic newsletter four times a year.

Impressum:

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You are invited to contribute to the newsletter with short articles of interest for other SSEF Alumni members. All contributions should be sent to Dr. Michael S. Krzemnicki gemlab@ssef.ch and will be published after editing if appropriate for this newsletter.