This report forms part of a series of simple yet informative reports that describe field trips undertaken by GIA Field Gemologists in order to obtain specimens from mines producing a variety of gemstones throughout the world.

Concise Field Report

Volume 1:
Pailin, Cambodia
(Dec 2008 – Feb 2009)

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Figure 1: Rough natural ruby and blue sapphire from Pailin, Cambodia. *Photo: V.Pardieu/GIA Laboratory Bangkok, 2009*

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Objectives

Vincent Pardieu (VP) started as Supervisor for Field Gemology at GIA Laboratory Bangkok in Dec 2008. For his first Field Expeditions for GIA, it was decided that we would first focus on South East Asian ruby and sapphire deposits. These deposits were conveniently local and well placed is order to begin the process and to test the necessary protocols GIA will use for further field expeditions, see Annex 1.

It was decided to start with few visits to Pailin as after 14 visits to this location from 2004 to 2007, VP had many local contacts and knew the area well. Pailin is also a very interesting ruby and sapphire mining area that has produced basalt related gems for about 120 years. Apart from the origin challenges, Pailin rubies and sapphires can present difficulties for gemologists regarding the identification of possible heat treatment and thus it was imperative that good reference samples were collected and fully documented.

The samples collected will promote a better understanding of corundum from this locality and thus GIA will be able to provide improved treatment identification and origin determinations for its clients.

ABSTRACT

These expeditions (FE01 and FE04) were VP's 14th and 15th visits to Pailin mining area. He visited Pailin 13 times from May 2004 to Dec. 2006. Except for his first visit VP used to collaborate each time with great pleasure and success with Votha, a Cambodian National living in Pailin. Votha arranged the transportation and provides regular updates about gem mining around Pailin. We could visit during these two expeditions several mining operations:

Down town Pailin (12°51'32"N and 102°36'06"E), Phnum Yat area: Mr. S sapphire mine: 6 diggers using pit mining and hand tools but no production yet as the mine just started the day we arrived. (Operational only during FE01).

O Ta Prang (12°50'49"N and 102°36'44"E), Phum Yat area: Mr. K Sapphire mine: 5 diggers and workers with pit mining using hand tools and 2 ladies at the washing area. (Operational during FE01 and FE04)

Phnum Ko Ngoap volcano area (12°51'53"N and 102°34'10"E) One mechanized ruby mine (using one trommel and a jig). No workers present on mine site but the mine was reported to have been in production few days before. (Not in operation at the time of FE01 and FE04)

O Beng village (12°53'38"N and 102°35'15"E), Phnum O Tang area: Mr. D ruby mine: 6 miners using high pressure water and a jig mining rubies in a rice field. (Operational during FE01 and FE04)

Suon Umpal, Phnum Yat area, we witnessed 2 men mining in a stream for sapphires using hand tools.

It was also reported during FE01 that about 30 miners were working for a Russian company on the top of Phnum Trop volcano (12°45'15"N and 102°36'12"E) located in the jungle in the south of Pailin (A mining area VP visited in 2004). During FE04 we could see that there was no real mining there just some exploration work. Only 2 local miners were active as guards at the time of our visit.

At Pailin gem market we met during FE01 and FE04 about 10 miners/dealers. We could see several parcels of rubies and sapphires either rough or cut in quantity quite higher compared to what the author used to see during his last visits in 2005 and 2006. Most of the rough stones we saw were unheated while most of the faceted stones were heated. The largest faceted ruby of fine quality was about 2 carats while the largest fine faceted sapphire was about 7 carats. Regarding rough we saw a fine ruby about 3 carats and a milky trapiche sapphire crystal specimen about 20 carats.

An introduction to Pailin

The Pailin ruby and sapphire mining area was described by Lacombe in 1970 and again by Berrangé and Jobbins in 1976 (Lacombe, 1970, Berrangé and Jobbins, 1976). The Pailin region is the continuation of the Chanthaburi-Trat ruby and sapphire mining area. It was discovered in 1874 (Kievlenko, 2003) probably by Burmese merchants traveling to the Mekong. Several travelers reported Burmese people mining for gems near Pailin in 1880-1896 (Smyth, 1994, Pavie, 1999).

Until 1998 Pailin municipality was part of Battembang province which was under Siam (the former name of Thailand) control until 1907 when it became part of the French Indochina. Pailin was then part of Cambodia. During the civil war from 1979 to 1999, Pailin was a Khmer rouge stronghold. Pailin was created as an independent province at the end of the Civil war.

The rubies and sapphires from Pailin are related to volcanic events which took place between 0.4 and 4 million years ago. During that period different volcanic eruptions occurred, some of them brought to the surface rubies, sapphires, zircons and other gems which were probably formed deep underground. After weathering of the basalts which contained the gems, rubies and sapphires were concentrated in the gravels of former and current river streams which are the places where most of the mining occurs nowadays.

An interesting book section about “The Geology and Genesis of Gem Corundum Deposits” was written by Giuliani and is recommended reading (Giuliani, 2007).

Rubies and sapphires are commonly found in 4 different locations around volcanic cones or plateaus near Pailin. Most gems are recovered in secondary deposits in river beds or in the ground resulting of the weathering of the basalts.

The Phnum O Tang (Figure 3) is a 50 meter high eroded volcanic dome (about 1km diameter) which produces mainly rubies. The VP visited from 2004 to 2006 and noted several ruby mining operations near Bang Pra Lad village. Local people told VP that the Phnum O Tang had been intensively mined with machinery by Thai companies during the 80s and 90s. VP was able to witness several times ruby mining there in 2005 and 2006 using small jigs and water pressure and in rare cases an excavator.

Figure 2: Google Earth map of the Pailin - Samlot - Trat - Chanthaburi region

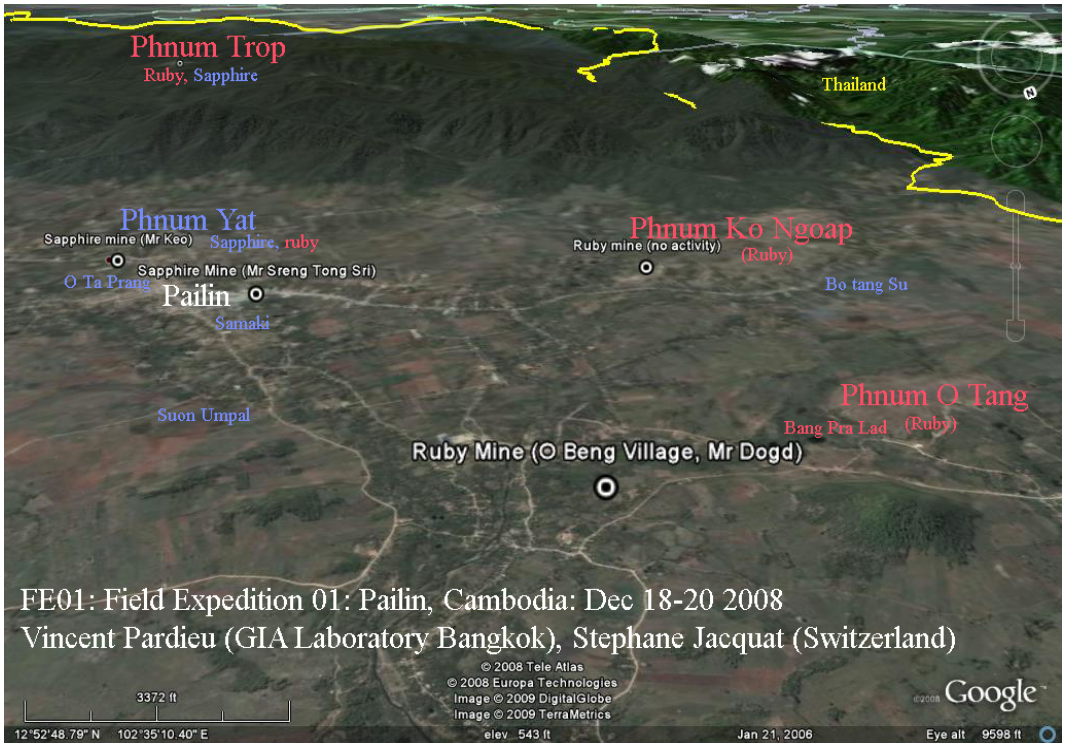

Figure 3: Detailed Google Earth map of the pailin region.

The Phnum Ko Ngoap (Figure 3) is a wide and low basaltic plateau (about 1km by 3 km) which is known to produce mainly rubies. VP witnessed regularly from 2004 to 2006 low scale ruby mining using hand tools on the plateau and in the river on the north of the plateau particularly at Bo Tang Su (rubies, blue sapphires, zircons, garnets and gold). Local people told VP that the Phnum Ko Ngoap had been intensively mined with machinery by Thai companies during the 80s and 90s.

The Phnum Yat (Figure 3) is a composed of a plateau and mountain and is dominated by a scenic Buddhist monastery. The plateau was reported to have been mined by Thai companies during the civil war, but local people reported to VP that the Phnum Yat Mountain was never mined as it was seen in Pailin as sacred place.

The Phnum Trop volcano (Figure 3), it is a jungle covered mountain located in the south of Pailin. Its access is possible from Pailin as some Thai companies which were working the area were reported to have built a dirt road linking Pailin to the top of the volcano in 1996 - before the area was accessed from the Thai border. Thai companies were reported by local people in Pailin to have worked the area until the beginning of 2004. At the end of 2006 an exploration permit was given to a Russian company.

FE01 Concise Expedition Report:

Introduction

- **Expedition Dates:** Dec. 18-20, 2008
- **Expedition Leader**: Vincent Pardieu
- **Expedition Guest:** Stephane Jacquat (Switzerland),

- **Expedition Main Objectives**:

  - Reactivate local contacts Pailin (Cambodia)
  - Survey the sapphire mining activity near Chanthaburi and around Pailin
  - Collect corundum samples from the different mines in accordance with the GIA protocols.
  - Test our way to work on the field and communicate the results.

Thursday, Dec 18th, 2008: Arriving in Pailin:

We entered Cambodia by land after driving from Bangkok to Chanthaburi and then to the Thai-Cambodian border at "Pong Nam Ron" (Thailand) – "Prum" (Cambodia). We crossed the border at 14.30 without any difficulty taking at the border our visa to Cambodia.

On the Cambodian side of the border we met Votha (Figure 4), VP's local contact in Pailin since 2004.

Prum's main economic activities are its numerous casinos where Chanthaburi and Bangkok people come to play.

Figure 4: The author's local contact in Pailin: Votha Un with several Pailin rubies and blue sapphires. *Photo: V.Pardieu 2008*

Votha took us to Pailin in his car and after 20km of dirt roads and a 45 minutes drive we arrived in downtown Pailin. We checked at the "Kim Young Heng Guest House" located just besides the "Samaki central market" which offers simple and usually clean rooms (with satellite TV and private cold shower) for $7 per night for a room with 2 beds.

We started our visits in Pailin by a rapid visit to the demining unit headquarters (Figure 5), and a visit at Phnum Yat Mountain. At the demining unit headquarters we visited the city small land mines' museum. It is a good visit to remind the people traveling with VP there that Pailin is not really a tourist destination like Pattaya, Kho Samui or Phuket but was a former Khmer Rouge stronghold during the war with Vietnam from January 1979 to December 1999.

Notes about Pailin current economy and several security aspects:

Currently Pailin just looks like a quiet farming village. The old destroyed Russian made tanks were taken to Phnom Pen during spring 2004. The only visible consequences of the civil war are the large "Demining Unit Headquarters" and its numerous white cars. Pailin's main activity is now agriculture (rice and red corn mainly) while gem mining and timber trade with Thailand looks to be far lower compared to what it was reported to be during the 20 years of the civil war. During VP's visit in Dec 2008 and during his previous visits from May 2004 to Dec 2007 he never saw any visible military presence or military activity. After 13 expeditions to Pailin VP can state that the area is surprisingly very peaceful and welcoming as we were also never asked any questions regarding our activities and were never subjected to any aggressive behavior from the local population. Indeed, we were all the time welcomed by the miners, gem cutters and gem burners we met.

Figure 5: Mines we don't want to find in the field: Land mines and artillery shells at the Demining Unit Headquarter in Pailin. *Photo: V. Pardieu, Dec. 2008*

We continued our visit to Phnum Yat volcano. Phnum Yat is dominating the city and it is Pailin's sacred hill and holy place and it is also the source of Pailin Sapphires. VP used to start each visit to Pailin by a visit at Phnum Yat temple located on the top of Phnum Yat. There several statues illustrate the legend of Pailin discovery: Until the end of the 19th century Pailin's location was a jungle area with just a bad road

through the jungle used by merchants traveling from Siam to Phnom Pen and Saigon. *It seems that some Burmese merchant traveling from Siam to the French Indochina saw an otter playing with red and blue stones in a stream. The Burmese recognized rubies and sapphires and soon they settled there and started to search for gems*.

Figure 6: Ye Yat" shrine is located in the Buddhist pagoda on the top of Phnum Yat Mountain in Pailin, Cambodia. *Photo: V. Pardieu, Dec. 2008*

The local legend said that people who were hunting in the forest met an old woman called "Ye Yat", which was in fact a local spirit. "Ye Yat" was not happy about people killing animals near her home and she told to the people that instead of killing animal they should go to the river where they will find something better to do. Arriving at the river they saw an otter playing with a ruby and a sapphire. Currently Pailin people commonly go to pray and make some offerings to the "Ye Yat" shrine on the top of the volcano (Figure 6). An interesting aspect is that gem mining was never allowed on Phnum Yat as it is seen as a sacred hill. Nevertheless after the rain people can walk on the Phnum Yat hill and collect on the ground (without digging) rubies and sapphires.

After this introduction to Pailin, we went to visit Mr. S's office located few hundred meters from our hotel. Mr. S (Figure 9) is a one of Pailin's major gem miners, mining for rubies in the past around Bang Pra Lad village near Phnum O Tang volcano. This time we were surprised to see that near his house on Pailin dirt road walkway he was starting a sapphire mining operation digging a vertical pit to reach the sapphire rich gravels (Figure 7). It was the very first time (after 13 visits to Pailin from May 2004 to Dec. 2007) that VP could witness gemstone mining inside the city. During our stay we could see that it took his miners two days to reach the gem rich gravels which were about 3 meters deep. When VP left Pailin they just started to collect some ground to wash.

Figure 7: VP witnessing Sapphire mining downtown Pailin. *Photo Stephane Jacquat, Dec. 2008*

Figure 8: Pailin faceted rubies reported to have been mined at Phnum O Tang volcano area. Rubies: 0.5 to 2 carats. *Photo: V. Pardieu, Dec. 2008*

At Mr. S's house VP could see seven faceted rubies from 0.5 to about 2 carats (Figure 8) of which two of them (first row left on the Figure 8), were reported to be unheated.

We saw also two large (for Pailin standards) sapphires of about 7 carats reported to be unheated; one of them was set on Mr. S's finger ring (Figure 9).

After returning to our guest house, it was late already and we went for a rapid diner and an early sleep in order to be operational the following day to scout the mines around Pailin.

Figure 9 Mr. S and his Pailin sapphire ring. *Photo: V. Pardieu, Dec. 2008*

Friday, Dec 19th, 2008: Visiting Pailin gem market and mining operations around the city:

At 06.45 we left with Votha to the **Pailin gem market**. From 2004 to 2007, the gem market was located in front of the Pailin police headquarters, but it has now moved to a more popular place in front of the entrance of the stairs to Phnum Yat temple. We started looking at stones at 7.00 and were surprised to see that there were quite a large number of stones around mainly from dealers that VP already knew. There were about 10 dealers and miners present at the market, drinking tea, taking a noodle soup and looking at gems. Within 2 hours we were presented with around 1 kilo of rough rubies and blue sapphires (most of them rather low quality) and about 40 to 50 faceted heated sapphires about 1 carat size (Figure 10). We could see one clean fine unheated rough blue sapphire about 5 carats size and an interesting milky trapiche type deep blue crystal about 20 carats. People reported that mining had been good in November even if it was quite low at the moment; due to the fact that it was the time most people and the work force were busy harvesting red corn. We bought at the market what was told to us to be yesterday's production of a nearby blue sapphire mine operated by Mr. K and we selected mixed rubies, sapphires, and a few other stones from the same mine but of lower quality (Figure 11) these are type D stones (Annex 1).

Figure 10: A parcel of heated blue sapphires reported to have been mined at O Ta Prang area, near Phnum Yat in Pailin and an unheated, trapiche type blue sapphire crystal of the milky type commonly found in Pailin. *Photo: V. Pardieu, Dec. 2008*

Figure 11: Pailin rubies and sapphires as seen at the morning gem market in Pailin. *Photo: V. Pardieu, Dec. 2008*

Note about Heat treatment in Pailin

It seems that heat treatment in Pailin has a long history: I was reported by some major French gem dealer that at the beginning of the 20th century, at the time of the first synthetics (of the so called Geneva and Verneuil process), some successful experiments were done in France/Switzerland and possibly also Germany about heat treatment of sapphire using some Pailin stones (The Pailin area was integrated in French Indochina after 1906 while Chanthaburi was under French control from 1893 to 1904). They reported that the people who did these experiments had business and friendship links with some local families in Pailin/Chanthaburi. As it was common at that time some young people from these families may have come to France to study and later returned to Pailin with knowledge about heat treatment. It is possibly the way few local families started to secretly heat Pailin blue sapphires under reducing conditions (Piat, 2005). This method will become more widely known in Chanthaburi area after the burning of the Chanthaburi gem market in 1968, which turned Chanthaburi people like Sammuang Kaewen to think that gem could be improved using fire. In 1969 Sammuang was successful in his experiments and developed the modified drum type furnace still used today in Pailin. As Sammuang was not able to keep his discovery secret heat treatment of blue sapphire under reducing condition became a common practice in Chanthaburi, opening an area of intense heat treatment experiments in Thailand (Kaewen, 2005).

Figure 12: A Pailin burner performing heat treatment under reducing conditions on some of VP's stones, *Photo: V. Pardieu, 2004*

We were told during our visit that 4 heat treatment facilities were still present in Pailin burning for two of them only blue sapphires (with Thai type modified drum furnace and Vietnamese coke) and heating both rubies and sapphires for the two other ones. On December 20th we visited one facility (for blue sapphire) but in the past VP visited and used two of the other burners which were very friendly. Only one burner (heating rubies and sapphires) refused to let VP see his furnace and burn his stones. This "unfriendly burner" is commonly used by Pailin main dealers and seems to be the most experienced one in town. Regarding heat treatment in Cambodia, it seems nevertheless that the most efficient ruby burners are located in Battembang, a city located in the East of Pailin on the way to Angkor and Phnom Pen. From May 2004 to Dec. 2006 with the exception of the "unfriendly burner" blue sapphire heat treatment of Pailin blue sapphire was performed in Pailin while ruby heat treatment had to be done in Battembang.

At about 9.00am after visiting the market we followed Mr. K to visit his sapphire mine located about 200 meters from the market just near the road in the area known as O Ta Prang. In fact the miners were mining between several houses. We spoke with the miners, witnessed the digging between the houses in three different pits and the washing activity which was taking place just nearby. While three men were digging using simple hand tools (iron stick and shovel, Figure 13), two women were washing the content of the bags in a nearby pond (Figure 14). As it is common in many mining area, the women were collecting gems like zircons in a small glass while fine blue sapphires or rubies were probably kept in their mouth. After about 2 hours witnessing their activities we left the miners telling them that we were planning to return to visit them around 17.00 in order to see the production of that mining day.

Figure 13: Sapphire mining using hand tools at Mr. K mine, O Ta Prang area, Pailin. *Photo: V. Pardieu, Dec. 2008*

Note about blue sapphire mining near Pailin:

Of Pailin three gem rich volcanoes only one: The Phnum Yat, located just near the city centre, is known to produce blue sapphires and few rubies, the other volcanoes, the Phnum Ko Ngoap and the Phnum O Tang are known to produce rubies. Around Phnum Yat several mining areas are known: The O Ta Prang area seems to be the most famous and the most productive as each time VP visited Pailin from 2004 to 2006 he witnessed some mining there. The O Ta Prang area is famous for its light blue milky sapphires reacting very well usually to heat treatment. The others blue sapphire mining areas were located further from the volcano at Suon Umpal, behind the Samaki market and a little bit on the southern and the western side of the volcano. Of these areas only Suon Umpal and the areas behind Samaki market had some irregular production from 2004 to 2006. Suon Umpal sapphires are locally known to be somewhat darker compared to the stones from O Ta Prang area. Both Suon Umpal and O Ta Prang areas are related to former river beds. No mining was reported last week end at Suon Umpal, or in any other mining areas except O Ta Prang and the new operation of Mr. S inside Pailin city.

Figure 14: Khmer ladies washing gem rich ground in a pond at O Ta Prang with as background the Phnum Yat Mountain. *Photo: V. Pardieu, Dec. 2008*

At about 11.00 am, we continued then our visit driving to Phnum Ko Ngoap, an area famous for its rubies located about 4 kilometers away which was very busy during the 1980's and 90's when Thai mining companies were operating around Pailin. Our plan was to visit a mining operation Votha noticed few days before. As we arrived to the mine we could see that a trommel and a jig were present but no miners were around. Votha guessed that these people stopped mining for a while in order to harvest red corn. In the land mine rich forest around Phnum Ko Ngoap (the land mines were reported to have been placed in order to protect the mining operations from possible attack from the jungle as the time of the civil war) it was commonly

reported that small scale mining using hand tools similar to the previous sapphire mine (Figure 15) took place. Votha told us that this time he had no knowledge about anybody mining in the area today, as we commonly saw in the past. Again he told us that it was not surprising as people were busy farming…

Figure 15: Ruby mining on Phnum Ko Ngoap plateau as witnessed by the author in 2005. *Photo: V. Pardieu, 2005*

We then left the area at about 11.15am to visit another ruby rich area located nearby near Phnum O Tang volcano. From 2004 to 2007 VP commonly visited small mechanized ruby mines in the area near Bang Pra Lad village. This time a mining operation was reported in an area near O Beng village where he had never witnessed any mining activity previously. The mine was operated by a miner VP met many times mining blue sapphires at O Ta Prang area near Phnum Yat. He was mining the rice field of a local farmer who had knowledge that there was some natural ground in the area even if that area was reported to have been mined by a Thai company during the civil war. We could see that he was working with a team of five miners; using high pressure water and a jig (Figure 16). In 2005 near O Ta Prang he was using a trommel and an excavator. The miner explained to VP that he was in partnership with a local farmer and his wife: The money collected after selling the gems would be shared this way: 20% for the farmer (owning the land), 10% for the miners, 70% for Mr. D which was the investor coming with his machines and paying for the fuel used by the machines, the food for the miners and the mining tax to the local authorities. After about one hour visiting and discussing his mine we went to the farmer house in order to see the production they got the day before. We were presented a small sealed plastic bag with few small rubies. We bought it after a 30 minutes long discussion. We then agreed to return to the mine about 16.00 in order to witness the harvest and possibly buy the day's production. These are type C stones (Annex 1).

Figure 16: Ruby mining using high pressure water and a jig in O Beng area, Pailin. The jungle covered volcano at the background is Phnum Pod, a volcano which basalts are not known to contain any gems. *Photo: V. Pardieu, Dec. 2008*

Around 14.00 we went back to downtown Pailin to have a short lunch at Samaki market and witness there goldsmiths working and visit some gem dealers (Figure 17). We could see many natural and synthetic gems presented set in jewelry or sold as loose stones.

Figure 17 Faceted red to golden zircons from Pailin. *Photo: V. Pardieu, Dec. 2008*

At 15.00 we left to visit again Mr. S's house and see how the mining outside his house inside Pailin city was going. We could see that two miners were working in the round mining the pit now about 3 meters deep. The diggers were reaching the gem rich layer and the gem rich ground was taken to the surface to be stored inside bags. Mr. S told us that he was planning to wash this ground the following day.

At 16.00 we returned to the ruby mine near O Beng to witness the harvest. First the miners using high pressure water were cleaning the mining pit of all its mud. The rubies which are very heavy seem to accumulate in the last mud in the mining pit. The miner told us then that cleaning the mining area was then of prime importance. When the mining pit was clean, they stopped pumping and checked inside the jig for gems (Figure 18). That day one rough ruby of fine color and good shape weighing 2.75 ct was found. The stone had nevertheless a deep fissure. Besides this ruby,

several smaller rubies, garnets and zircons were found. We could buy on site the production of that day with the exception of the 2.75ct ruby as Mr. D was not willing to sell it right away. These are type B stones (Annex 1).

Figure 18: Stephane Jacquat witnessing the ruby harvest at Mr. D ruby mine near Pailin. *Photo: V. Pardieu, Dec. 2008*

At 18:00 we returned to Pailin to visit Mr. S. mine and Mr. K. house and mining operation. We could see the blue sapphire production of the day from Mr. K wife and could purchase their production (D type samples)

Figure 19: Recovering potentially gem rich gravels at Mr. S. mine in downtown Pailin. *Photo: V. Pardieu, 2008*

We then returned to our guest house and had diner.

Saturday, Dec 20th, 2008

At 06.00 we visited again the gem market for breakfast and to see a new furnace for sapphire located at the back of the market restaurant. We then left to the Thai Cambodian border.

FE04 Concise Expedition Report:

Introduction

- **Expedition Dates:** Feb. 27- Mar 01, 2009
- **Expedition Leader**: Vincent Pardieu
- **Expedition Guests:** Richard W. Hughes (USA) Wimon Manoratkul (Thailand), Walter Balmer (Switzerland), Loretta Cardosso (USA), Randy Price (Canada), Flavie Isatelle (France), Olivier Segura (France), Philippe Ressigeac (France)

- **Expedition Main Objectives**

    - Visit the Phnum Trop ruby and sapphire mining area in the jungle south of Pailin.
    - Visit again the different mining area around Pailin visited during FE01 and possibly new ones in order to collect additional samples following the GIA protocols.

After the FE01 expedition to Pailin, VP stayed in contact with Votha in Pailin in order to have a new expedition with main focus to visit the mining activity on Phnum trop volcano. Votha tried to get in contact with the Russian mining there and the Pailin authorities. In the past during summer of 2004 we visited the Phnum trop volcano during a 2 days expedition. Most of the traveling was walking as the road to reach the mines was difficult and we could not find any vehicle able to get there. For security reason we decided then to build a 8 people expedition composed of friends of VP and of several gemology students willing to discover the Cambodian jungle.

This time again we expected first to walk a lot and thus I gathered a large group of people motivated for a hard walk and possibly a tough night in the Cambodian jungle. (Note: At night the Cambodian jungle is incredibly noisy with insects, birds and monkeys and nights are also very cold on mountains thus last time nobody was able to sleep…) but Votha informed the author that the Pailin authorities would provide us a vehicle and an official escort to visit the area and we should be able to visit the mine with our car in one day and to return in Pailin before night fall.

Friday, Feb. 27th, 2008:

We traveled from Bangkok to Chanthaburi with different schedules and gathered as usual in Chanthaburi before passing the Thai Cambodian border together. Around 5.00pm we passed the border and met our Pailin guide Votha who provided us an update about the situation: Everything was fine and we had good chances to visit Phnom Trop the following day. Votha also provided us an update about the ruby and

sapphire mining around Pailin: Mr S was not anymore mining in Downtown Pailin. On the other hand Mr K. and Mr D. were still mining respectively sapphires and rubies and he saw recently some people mining in the river near Suon Umpal, a sapphire mining area which was quite active while the VP was visiting regularly the area in 2005 and 2006.

We decided to visit these areas possibly after our visit to the Phnum Trop in order to be present for the harvest or on Sunday before to returning to Bangkok.

Saturday, Feb. 28th, 2008:

We left our hotel at around 8.00am with our Pick-up truck and the official from the Pailin Governor office. After 20min we passed the last farm and we entered in the Cambodian jungle. Soon the dirt road started to climb hard and after about 10 additional minutes we started to get some difficulties with our car. We had then regular stops where people were walking in order to help our car on the most difficult parts of the road. The driving was fine except for a minor technical issue that took around 10 minutes for our driver to fix. We could see on the way that one of the first things the Russian miners did here was to repair the road leading to the mining camp on the top of Phnum Trop.

We passed the first pass at 9.15am and stopped for few minutes at a place locally known as “Chinese cry”. Votha told us that the name origin comes from the fact that this place was an area where people (mostly Chinese) who were carrying the food and supply for the miners on their back were resting for a while and sometimes crying as they were very tired… We then walked and drove downwards for about 2 km before the road to start again going up. At around 09.50 we passed the second pass and few minutes after we could have a clear view on the bold top of the Phnum Trop as the miners chopped the jungle on the top of the volcano. After a few minutes driving down we started to go up again on Phnum Trop slope to reach after few minutes a small camp and a barrier blocking the road (Figure 20).

Besides the barrier a large signal decorated with Russian and Cambodian flags was telling in Russian and Cambodian that the area was private and entrance not allowed without permission. A guard present near the barrier moved to us and stopped us. We recognized immediately the guard as one of the Burmese miners Votha and I met in 2004 when we first visited the area. After exchanging few words with the Pailin official escorting us the guard came to us and was obviously remembering also our unusual visit few years ago and rapidly the discussion became very friendly particularly when the group started to show some interest in the guards only visible weapon: a powerful slingshot carved from a strong V shaped piece of wood. The weapon became rapidly more popular in the group as would have been a nice ruby, attracting all the attention of our photographers as its handle was skillfully carved as a penis, something quite common in South East Asia. Anyway the encounter was very friendly, the guard told us that the Russian miners were not present at the moment and that no mining was currently taking place on the volcano. He was alone

here with another miner guarding the mine. That was disappointing news as few weeks before the word in Pailin was that many people were working here but these are things to be expected and a good reason not to take for granted everything we can hear in gem markets. We decided nevertheless to continue and visit the mining area. The guard opened the barrier and we were allowed to continue our way to the top of the volcano.

Figure 20: At the entrance of the Russian run mine in the Cambodian jungle south of Pailin. *Photo: V. Pardieu 2009*

We reached the top of Phnum Trop and its mining camp at 10.20am. We had no difficulty to find the miner guarding the area as he was standing near a small hut where he was cooking some soup. We went to introduce ourselves and started to speak with each other.

Around that time one of the members of the group noticed some blood on Richard Hughes leg which was obviously wounded, Richard was surprised as he was not remembering any injury either in the car or during the short walks he had on the way. Examining his leg he found that he had been a good meal for a large leech which had already left him with his bleeding leg. He cleaned it rapidly and hopefully for Richard the wound was not serious. In 2004 most of the team members were wounded by leeches but that was after some 5 hours walking.

The Phnum Trop volcano area was reported by Pailin people to have been mined for more than 70 years. In 1996 a road was built by some Thai companies from Pailin and for about 7 years three Thai miners: Sia Puang, Sia Noc and Sia Put ("sia" means "boss" in Thai) worked using machinery the top of the volcano. Around 2003 most Thai companies stopped working around Pailin and on Phnum Trop. In 2004 when VP first visited the Phnum Trop mining area, we could see on the way to the mines the remains of the former Thai mining camp down the volcano; the jungle was starting to regain it. In 2009 nothing was remaining: It was all jungle.

Figure 21: Randy Price assisting R.W. Hughes with his Leech wound: It is nice to have friends to support you in tough times...
Photo: V. Pardieu, 2009

The miner told us that the working in the area since the arrival of the Russians was mainly exploration work. To his experience both rubies and blue sapphires are found on Phnum Trop even if blue sapphires tend to be more common. To the best of his knowledge the bigger nice rough ruby he saw here was about 10 carats while the biggest sapphire was about 20 carats rough. The best stones were usually found in the weathered ground on the top of the volcano or in the streams on the mountain side. In 2004 VP met the guard and his group as they were mining a stream about 1 or 2 km on the south of the volcano top. We could see then a few low quality sapphires and rubies.

Note this was to be expected as miners living in the jungle usually don't show their best stones (if they have some) to the first visiting party coming to their mines. The miner told us that his group was working for more than 20 years in the area. They are nevertheless not really locals but of the Mon ethnic group and their group was originally from the jungle covered mountains between Tavoy and Moulmein in Burma. Local people refer usually to them as "Kula": "Kula" is the local name in Pailin-Chanthaburi region for the miners of Burmese origin which were common in the area since its discovery at the end of the 19th century. As most "jungle people" they were working without mining license and have also usually not even a proper ID and a nationality, despite the fact that Mons are one of the older ethnic groups living in the area. They were present even before the Burmese and the Thais settled respectively in the Irrawaddy and the Chao Praya basins.

Figure 22: Kula miners mining in the jungle south of the Phom Trop during summer 2004. *Photo: V. Pardieu/AIGS, 2004*

Asking about other gem mining activity in the jungle around Phnum trop the Kula miner told us that some people were working at a place called “Durian” about 3 hours walking distance in the North West of the Phnum Trop close to the Thai border. But we could not confirm this.

After about 20min discussing we asked the Kula miner if we could visit the area with him. We then visited the area for about one hour studying the former mining area and studying the rocks present in the area: quartz veins and olivine rich basalts outcrops were visible here and there. It was interesting to see some unusual rounded like structures similar to the porphyroblasts seen in Kenya and Tanzania tsavorite mines. Here the structures were probably related to the nearby fissures.

We could see only few changes compared to what we saw in 2004 while visiting the area, some ground was obviously moved here or there but the most visible evidence of the exploration work performed by the Russian company was a mining pit around 10 meter deep which was obviously dug for prospecting.

Figure 23: A global view of the Russian mining camp on the top of the volcano and the former mining area which was worked in the past by Thai companies. *Photo: R. Price 2009*

At 14.00 after a rapid lunch, and sadly without to have been able to collect or even to see any ruby or sapphire sample, we left the area to return to Pailin.

We arrived in Pailin at around 4pm. Without losing any time we went to visit Mr. K. sapphire mine located near the Phnum Yat but the miners had already stopped working, we decided then to leave rapidly in order to drive to o bang area to see Mr. D. mining operation we visited also last December. It was then perfect timing as we arrived there at 16.30 early enough to witness the last 20 minutes of mining using high pressure water. When the miners had finished their work geologists like Walter Balmer and Flavie Isatelle could study the bedrock and the different levels of the ground over it. Obviously the ground here was a natural alluvial area which was not mixed, thus it was obvious that this area was not mined before. Speaking about it with the miner Mr D. he confirmed that it was the type of ground that he was searching for in order to begin mining. The fact is that around Pailin there has been mining for around 120 years and mining an area which was already mined is something he was not willing to do. For that the best way to his experience was to dig and to study the structure, the color and the composition of the different layers of ground present.

Figure 24: Mr D (foreground) mining for rubies at O Beng. *Photo: V. Pardieu, 2009*

Besides studying the mining site we could witness the ruby harvest at the jig. Everything was done by hand and the stones found were then put in a coffee mug filled with water. At the end of the day about 10 small flat rubies and many small dark red garnets were covering the bottom of the mug. We could then purchase the result of that mining day as reference samples for the GIA origin related reference collection as "B type samples" (Annex 1). Returning to the miners hut we could also collect 4 small sealed plastic bags containing the result of the 4 previous days mining the area.

Figure 25: Mr. D (left) recovering rubies from the jig at O Beng. *Photo: V. Pardieu, 2009*

After examination the content of the 4 bags were similar with the result of the mining we witnessed. Nevertheless as we didn't witness the mining process for those samples, they will be integrated in the collection as "C type samples" (Annex 1).

On the way back from the mines we met another miner with some stones in a small glass bottle he said to have mined in the morning from a nearby stream... the fact was confirmed by some other local people around. The composition of his bottle was very similar to what we saw from Mr. D. Mine even if coming from a different source: few rubies, many garnet and few zircon and quartz crystals. The parcel was interesting and then purchased as "D type samples" for the GIA reference collection.

Figure 26: Cambodian miner presenting the 5 days production of their ruby mines near Pailin. *Photo: V. Pardieu, 2009*

Sunday, Feb. 28th, 2008

We left our hotel early in the morning to visit the local gem market just down the Phnum Yat. Arriving at the gem market around 7:15am we found the area empty, we then decided to visit the Phnum Yat temple covering the locally famous sapphire rich volcanic cone. It was the occasion for a group photo near the otter statue which is a reminder about the origins of the Pailin name and of the discovery of its stones (see FE01 report)

Figure 27: FE04 group photo at Phnum Yat Temple. *Photo: V. Pardieu, 2009*

After the visit we returned to the market where we could see few dealers. The stones were available in much lower amount compared to what we saw during the FE01 expedition. Besides the typical synthetics, lead glass filled stones and other funny stones we could not see many recently mined specimens: Only two sapphires and a small ruby crystal specimens were going from hand to hand around the tables. Sadly their clarity

Figure 28: Randy Price (right) and Cambodian miners and dealers at the gem market (Mr. K center front). *Photo: V. Pardieu, 2009*

was not good, but this was to be expected in a mining area where the activity is only residual compared to what it was in the past.

Figure 29: A parcel of rough rubies and sapphires seen at the Pailin market. *Photo: V. Pardieu, 2009*

After visiting the market we went to see again Mr. K. sapphire mining site in order to witness the mining near his house. Our party could then witness miners digging the ground between the houses using some iron pick and filling bags with the potentially gem rich ground.

Few minutes after our arrival Mr. K. came to tell me that one of his friends, Mr. T. a local dealer just arrived and that he had a large parcel of Pailin rubies and sapphires to show us (Figure 29). We could then see a parcel weighting about 5 kilos of mixed rubies and sapphires. After a rapid study of the parcel the stones were looking similar to the Pailin stones that VP saw during his previous expeditions. Most of the stones were not heated but obviously the parcel was also containing some "funny stuff": Small broken faceted stones, heated stones, glass. The possibility to study such parcel was of course a real pleasure for the gemology students in our group and they had good time checking them. Nevertheless the author did not buy any stones from this parcel as there was too much uncertainty regarding its origin. Nevertheless such stones coming from a secondary source in a local market would have been E type samples if they had been found suitable for our research work.


Figure 30: Three gemology students learning river gem panning in Pailin. *Photo: V. Pardieu, 2009*

Around 10.00 am we left Mr. T., Mr. K., and the Pailin gem market to drive to Suon Umpal area where Votha told us that some people were mining. There after about 200 meters walking along the stream we found 2 men mining the river gravels. The older man was digging and collecting the gravels using his hands and feet while the younger one was washing that gravel in order to isolate and then pick the sapphires and zircons they were containing. After witnessing the mining process for a while we could here again negotiate the few sapphire and zircon samples mined so far as additional "B type samples" (Annex 1).

We returned then in Pailin in order to check out from our hotel and to get an early lunch as our breakfast was already far away… It was also a good occasion for several people in our group to visit the Samaki market where several local jewelers were working.

When everything was finished we then took the road to the Thai-Cambodian border. On the way we stopped for about 45 minutes at Mr. D. ruby mine in order for the younger members of our group to practice some high pressure water mining and document a little bit more the mining process there.

About 16.00 we were at the border and took the road back to Bangkok with sadly no samples from Phnom Trop but with several interesting parcels from mining areas around Pailin…

Annex 1

Introduction to GIA's sample collecting protocols.

Gemology has become over the years more scientific and technical, it is then logical that a special care is taken regarding the way reference samples are collected. Collecting samples should be also performed following a strict methodology and the whole process should be fully and properly documented.

The 3 main rules regarding the way samples are collected followed by GIA Field Gemologists are:

- Collect samples as close a possible from the source: An "A type" sample is better than a "B type" sample, etc…
- Collect samples from at least 3 reliable and independent sources: Even an "A type" sample should get confirmed by other samples collected from other independent and reliable sources.
- To document fully and honestly all the process regarding the way samples are collected (movies, photos, GPS data, notes…)

Two separate databases to store both **Origin-Specific** and **Origin-Opinion** data are in development at GIA: The database of **origin-specific stones** shall only contain stones in which the degree of certainty on their country of origin is 99% or better. All data from stones with a less than 99% certainty shall be stored in the **origin-opinion** database.

The 99% origin-certainty rule:

Stones with 99% origin-certainty are those that have been retrieved in-situ or have been retrieved from an operating jig, or other type of mechanical or primitive washing plant, as part of a mine run by the Field Gemologist (Type A or B of GIA's Cataloguing classification).

Another situation were a stone may pass the 99% origin-certainty rule is when a stone or stones are purchased from a miner at the location of the mine, e.g., what is stated to be the results of several days mining (Type C); and following detailed laboratory examination they are found to match, in every aspect, material from 2 other trustable and independent sources that has been retrieved in-situ or from an operating jig as part of a mine run from the same area.

In the case of stones present in GIA's old collection (any type) this rule may not be relaxed with the exception of the involvement of the Field Gemologist. If stones in the old collection were obtained from traders away from the mining area concerned but who gave exact origin locations that can be fully demonstrated, e.g., where the properties of a stones match (well within the outer markers) in every way (optical, chemical and inclusions) material that fulfills the 99% rule for the stated origin, these and only these would be acceptable as stones with 99% certainty of origin.

The 3 independent-sources:

Regarding building an Origin Specific Gemstone Reference Collection, the first difficulty is that only the miner knows where a gemstone is really from: and gemologists should not trust all what the miner could say…

In gemological laboratories, one of the rules of proper gem identification is to confirm the results provided by an instrument with at least another instrument. Collecting samples in the field should follow the same wise laboratory methodology:

Thus the best way to collect samples is to always collect samples from at least 3 different and independent sources.

Possible / probable samples:

When mining areas are very difficult to access and thus when samples complying with the 99% origin-certainty rule cannot be obtained, the "3 independent sources" rule is even more important: Stones collected from a single reliable source (type E or F of the GIA cataloguing system) should be tagged as "possible".

"Possible" samples can become "probable" if we can find at least 2 other independent and trustable sources providing stones matching in every way (optical, chemical and inclusions) that possible material and of course if the information about the samples provided by the 3 independent and trustable sources are matching.

The Verification Committee:

"Probable" samples which match in every way with material that fulfills with the 99% origin-certainty rule might then be acceptable as stone with 99% certainty of origin if they are accepted by the "verification committee". For the stone to be accepted all the members of the committee shall be confident in the integrity of the specimen and the data collected before agreeing to its inclusion in the origin-specific database.

A simplified version of GIA's cataloguing classifications:

Stones complying with the 99% Origin Certainty rule:

"**A Type Stone**": The stone was mined by a GIA Field Gemologist.

"**B Type Stone**": The stone was collected on site at the mine from the miners and a GIA Field Gemologist witnessed the mining process.

Stones collected at the mines but not in accordance with the 99% Origin certainly rules:

"**C Type Stone**": A GIA Field Gemologist collected the stone from miners, at the mine but without witnessing the mining process.

"Possible" and "probable" samples not collected at the mines:

"**D Type Stone**": A GIA Field Gemologist collected the stones from the miner, but not at the mines".

"**E Type Stone**": A GIA Field Gemologist collected the stones from a secondary trustable source close to the mines (like a local gem market)

"**F Type Stone**": A GIA Gemologist collected the stones from a secondary trustable source in the international market (trade show, etc...)

Stones with no trustable information available:

"**Z Type Stone**": No information about the conditions the stone was collected or stone collected from a poorly trustable source.

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