UBC SEG-GAC Student Chapter Annual Ore Deposit Fieldtrip to the Philippines

April 29th - May 15th, 2012

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1. FIELDTRIP OVERVIEW

The University of British Columbia's student chapter of the Society of Economic Geologists and Geological Association of Canada (UBC SEG-GAC) seeks to promote better understanding and deeper interest in the science of economic geology. Our activities are aimed at advancing our members' comprehension of mineral deposits and how geological science is applied to exploration, evaluation and production. With this goal in mind, we organize courses, meetings, field trips, lectures and literature. We place a great value in the experience of our fellow geologists and strive to develop stronger ties between students and professional geoscientists in the industry, academia and government.

Over the past twelve years the annual UBC Ore Deposits Field Trip has enjoyed great success, creating an opportunity for enthusiastic students and industry participants to interact and experience world-class geology. It is also an opportunity to visit a variety of mineral deposits and regions while gaining a hands-on understanding in a short period of time. The 2012 Philippines fieldtrip participants are eight UBC-SEG students, two students from the University of the Philippines, and eight members of industry from Canada.

The focus of the 2012 trip is to gain an understanding of the regional metallogeny of Luzon, including the distribution of mineral deposits within Philippine's tectonic framework. To achieve this goal we will visit several mines including the Coto Chromite Mines, The Santa Cruz Nickel Laterite project, the Padcal Gold Copper Mines (Santo Tomas II deposit), the Acupan Gold Mine, the Lepanto Gold Mine, the Taysan Copper-Gold project, and the Batangas Porphyry copper-gold project. In addition, individual mineral deposits such as copper-gold porphyry systems and gold-rich epithermal systems will be studied to develop a better understanding of their genetic link. We will also visit two active volcanoes, Mount Pinatubo and Taal volcano, which will also contribute to our understanding of the regional geodynamic setting.

The University of the Philippines will host us upon our arrival at the NIGS (National Institute of Geological Sciences) with an introductory presentation on the geodynamic setting and metallogeny of Luzon, where most of the trip will take place. We will spend several days looking at other sites of interest in the Philippines the historic center of Manila and the World Heritage Rice Terraces of northern Luzon.

2. LIST OF PARTICIPANTS

Alfonso Luis Rodríguez Madrid	MSc Student - UBC	alrodrig@eos.ubc.ca
Ben Hames	MSc Student - UBC	bhames@eos.ubc.ca
Britt Bluemel	MSc Student - UBC	britt.bluemel@gmail.com
Dave Cox	MSc Student - UBC	davidcox2@gmail.com
Dave Nickerson	Industry Professional	dn@tyhee.com
Elizabeth Hollingsworth	Senior Exploration Geologist at the Greens Creek Mine, Alaska	EHollingsworth@hecla-mining.com
Esther Bordet	PhD Student - UBC	ebordet@eos.ubc.ca
Jena Joie Lamson	Undergraduate Student - University of the Philippines	jaelamson@gmail.com
Jennifer Kononoff	Undergraduate Student - UBC	jennifer@kononoff.com
John Thompson	VP Technology and Development at Teck Resources Limited	john.thompson@teck.com
Kristine Joy Taguibao	MSc Student - University of the Philippines	ktaguibao@gmail.com
Leif Bailey	MSc Student - UBC	leif.bailey@gmail.com
Linda Dandy	Industry Professional	lindadandy@telus.net
Lindsay McClenaghan	MSc Student - UBC	lmcclenaghan@eos.ubc.ca
Mario Aurelio	Professor - University of the Philippines	maurelio.nigs@gmail.com
Mike Roberts	Geologist at Kiska Metals Corp	MikeR@kiskametals.com
Paul McGuigan	Geologist at Cambria Geosciences	pmcguigan@cambriageosciences.com
Peter Daubeny	Industry Professional	peterdaubeny@hotmail.com
Uwe Schmidt	Industry Professional	contactuwe@yahoo.ca

3. TRIP ITINERARY

Important things to note:

- **Please keep your boarding passes and return them to Lindsay.** We will collect all boarding passes from students and industry members for tickets that were purchased by the UBC-SEG Student Chapter. We require boarding passes for receipt/accounting purposes. If you purchased your own flight, you may keep your boarding pass.

- **Upon arrival we will meet at the Miramar Hotel in Manila.** For the industry members who have arranged their own flights, please meet us at the hotel on the evening of April 30th or on May 1st.

- **We plan to purchase a 'pay as you go' cell phone upon arrival.** This phone will be for emergency and mine contact purposes throughout the trip.

- **Our emergency contact while in the Philippines is Mario A. Aurelio**, Associate Professor at the University of the Philippines and Head of the Structural Geology and Tectonics Laboratory
  Address:
  National Institute of Geological Sciences
  College of Science - University of the Philippines
  Velasquez St., U.P. Campus
  Diliman, Quezon City 1101
  PHILIPPINES
  Tel Admin: +632-9242485
  Mobile: +6329178242404
  Email: maurelio.nigs@gmail.com, maurelio@nigs.upd.edu.ph

Sun	**29-Apr**	12:05 PM	Flight from Vancouver
Mon	**30-Mar**	9:50 PM	Arrive Manila (evening)
			Overnight Manila
Tue	**1-May**		Enjoy Manila, recover jet lag
		TBD	**Group Dinner**
			Overnight Manila
Wed	**2-May**	8:00 AM	Drive to the University of the Philippines, Quezon City **(1h)**
		9:00 AM	Presentations at the University of the Philippines, Quezon City
		12:00 PM	Lunch in a local Filipino restaurant
		1:30 PM	Drive to the PhilVolcs Institute, Quezon City **(30 min)**
		2:00 PM	Visit of the Philippine Institute of Volcanology and Seismology, Quezon City
			Overnight Manila
Thur	**3-May**	8:00 AM	leave Hotel
		10:00 AM	arrive in Capas to start tour
			Tour on Mt. Pinatubo: driving up with Jeepneys, hiking, discovering the volcano
			Overnight Mt Pinatubo (camping)
Fri	**4-May**	7:00 AM	Drive down Mount Pinatubo **(1h)**
		9:00 AM	Drive to Coto Chromite Mines via southern road **(4h)**
		12:00 AM	arrive Coto Chromite Mines -Coto Consolidated Mines Inc. (not operational)
		4:00 PM	Leave Coto and drive to Dagupan City **(2h)**
			Overnight Dagupan
Sat	**5-May**	tbd	Santa Cruz Nickel Laterite -Benguet Corporation **(1h45)**
		tbd	AND/OR Hundred Island National Park **(1h)**
			Overnight Dagupan
Sun	**6-May**	7:00 AM	Drive to Padcal Gold Copper Mines **(2h)**
		9:00 AM	Visit Padcal Gold Copper Mines (Santo Tomas II deposit)-Philex Mines
		3:00 PM	Drive to Baguio City **(1.5 h)**
			Overnight Baguio City

Mon	**7-May**	8:00 AM	Drive to Acupan Mine **(30 min)**
		9:00 AM	Acupan Gold Mine-Benguet Corporation
			Overnight Baguio City
Tues	**8-May**	5:30 AM	Drive to Lepanto via Makayan **(3h)**
		9:00 AM	visit of Lepanto Gold Mines (Lepanto Mining/Goldfields)
		3:00 PM	Drive to Bontoc via Haselman Highway **(2,5h)**
			Overnight Bontoc
Wed	**9-May**	tbd	Driving to rice terraces enjoy the views
		day	Explore Rice Terraces
		evening	**Group Dinner**
			Overnight Banaue
Thur	**10-May**	morning	Enjoy the morning views on the rice terraces
		12:00 PM	Drive to Quezon city **(5h)**
			Overnight Quezon City
Fri	**11-May**	6:30 AM	Drive to Taysan Copper Mine **(2.5 h)**
		9:00 AM	Visit Taysan Copper-Gold Project-Crazy Horse Resources
		3:00 PM	Drive to Anilao **(2h)**
			Overnight Anilao
Sat	**12-May**	7:00 AM	Drive to Batangas **(2h)**
		9:00 AM	Visit Batangas Porphyry copper-gold- Mindoro Resources Ltd.
		1:00 PM	Drive back to Anilao. Beach Diving/Snorkelling
			Overnight Anilao
Sun	**13-May**		Beach Diving/Snorkelling
		4:00 PM	Drive to Tagaytay City **(1.5 h)**
			Overnight Tagaytay City
Mon	**14-May**	8:30 AM	Drive to Talisay and sailing center **(30 min)**
		9:00 AM	Visit Taal Volcano located within Taal Lake
		5:00 PM	Drive back to Manila **(1h)**
			Group Dinner
			Overnight Manila
Tues	**15-May**	5:00 AM	Drive to the airport
		9:00 AM	Fly back to Vancouver
Tues	**15-May**		Arrive Vancouver

4. LIST OF HOTELS

Date	Hotel name	Address	Phone
April 30th-May 1-2 & May 14th	**Miramar Hotel**	1034-36 Roxas Blvd corner UN Avenue - **Manila** 1000	(+63-2)-523-4486
May 4-5th	**Lenox hotel**	Rizal Street - **Pangasinan** 2400	(+6375)-515-8889 (+6375)-515-7094
May 6-7th	**Bloomfield Hotel**	No. 3 Leonard Wood Road - **Baguio City** 2600	(074)-446-9112 (0917)-510-0044
May 8th	**Ridge Brooke Hotel**	**Bontoc**	(0919)-675-5252
May 9th	**Uyami's Greenview lodge**	**Banaue**	(074)-386-4021 0920-540-42-2
May 10th	**Stonehouse Bed & Breakfast**	1315 E. Rodriguez Avenue Brgy. Kristong Hari - **Quezon City**	(+63-2)-724-7551
May 11-12th	**AquaVenture Reef Club Resort**	**Anilao**, Batangas	
May 13th	**Cool Breeze Hotel & Villas**	865 11th Airborne St., Maharlika East - **Tagaytay City**	(046)-860-3032

5. LIST OF HOSPITALS

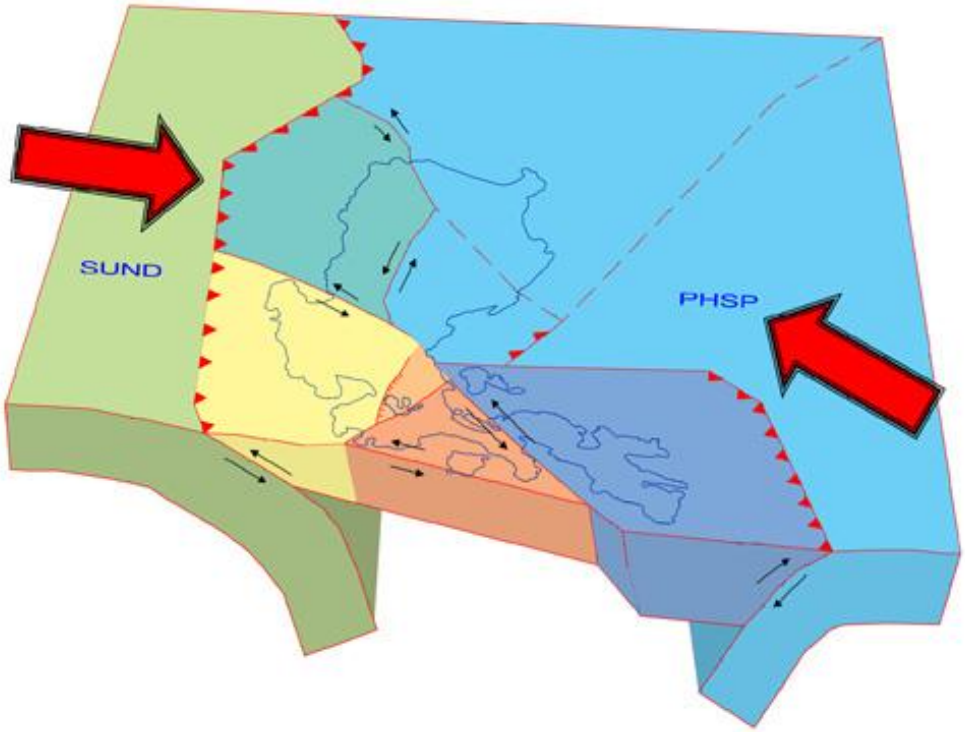
Date	City	Hospitals
April 30th-May 1-2 & May 14th	**Manila**	Metropolitan Medical Center 1357, Manila, Philippines Phone Number: (63) 2 254 1111
May 4-5th	**Dagupan**	Dagupan Doctors Villaflor Memorial Hospital National Highway, Dagupan City, Pangasinan Phone: (63)075 515 7440, (63) 075 515 6494
May 6-7th	**Baguio City**	St. Louis University Hospital of the Sacred Heart, Assumption Road Extension, 2600 Baguio City Phone Number: Office: (074) 442-7606
May 8th	**Bontoc**	Bontoc General Hospital (Ipho) Bontoc, Mt. Province 2616 City: Mountain Province Phone Number: (074)445-6539
May 9th	**Banaue**	Ifugao Good News Clinic and Hospital Banaue, Ifugao 3601 Phone Number: (074) 386-40-45 Fax Number: (074) 386-4092
May 10th	**Quezon City**	St. Luke Medical Centre - Quezon City, Rm. 701, Cathedral Heights Bldg. Complex 279 E Rodriguez Sr. Blvd Quezon City 1102 Phone Number: (63) 2 723 03 01
May 11-12th	**Anilao**	Bauan Doctors General Hospital Bauan-Mabini Circumferential Road, Bauan 4201, Philippines Phone Number: (63) 43 727 2237
May 13th	**Tagaytay City**	Estrella Hospital Emilio Aguinaldo Highway, Silang 4118, Philippines Phone Number: (63) 46 414 1483

6. GEOLOGY AND METALLOGENY OVERVIEW OF THE PHILIPPINES

Text below is from by the Minerals Development Council, Republic of the Philippines, 2007

The Philippines may be viewed as a collage of metamorphic terranes, magmatic arcs, ophiolitic complexes, sedimentary basins and continental block of Eurasian affinity subjected to tectonic processes such as subduction, collision and major strike slip faulting. The subduction zones are represented on the east by the west dipping Philippine Trench traversing the eastern seaboard of the Philippines from Mindanao up to a point in Luzon and the East Luzon Trough. East dipping subduction zones include the Manila Trench, Negros Trench and Cotabato Trench. The southern termination of the Manila Trench is characterized by the transformation of the subduction of the South China Sea Plate into an arc-continent collisional deformation within Mindoro Island.

The continental block is represented by northern Palawan, southern Mindoro, Romblon Island Group and Buruanga Peninsula in Panay Island, known collectively as the North Palawan Block. Rock suites in this block include schists that are characteristically rich in quartz and chert formations that have been dated Late Permian to Jurassic.

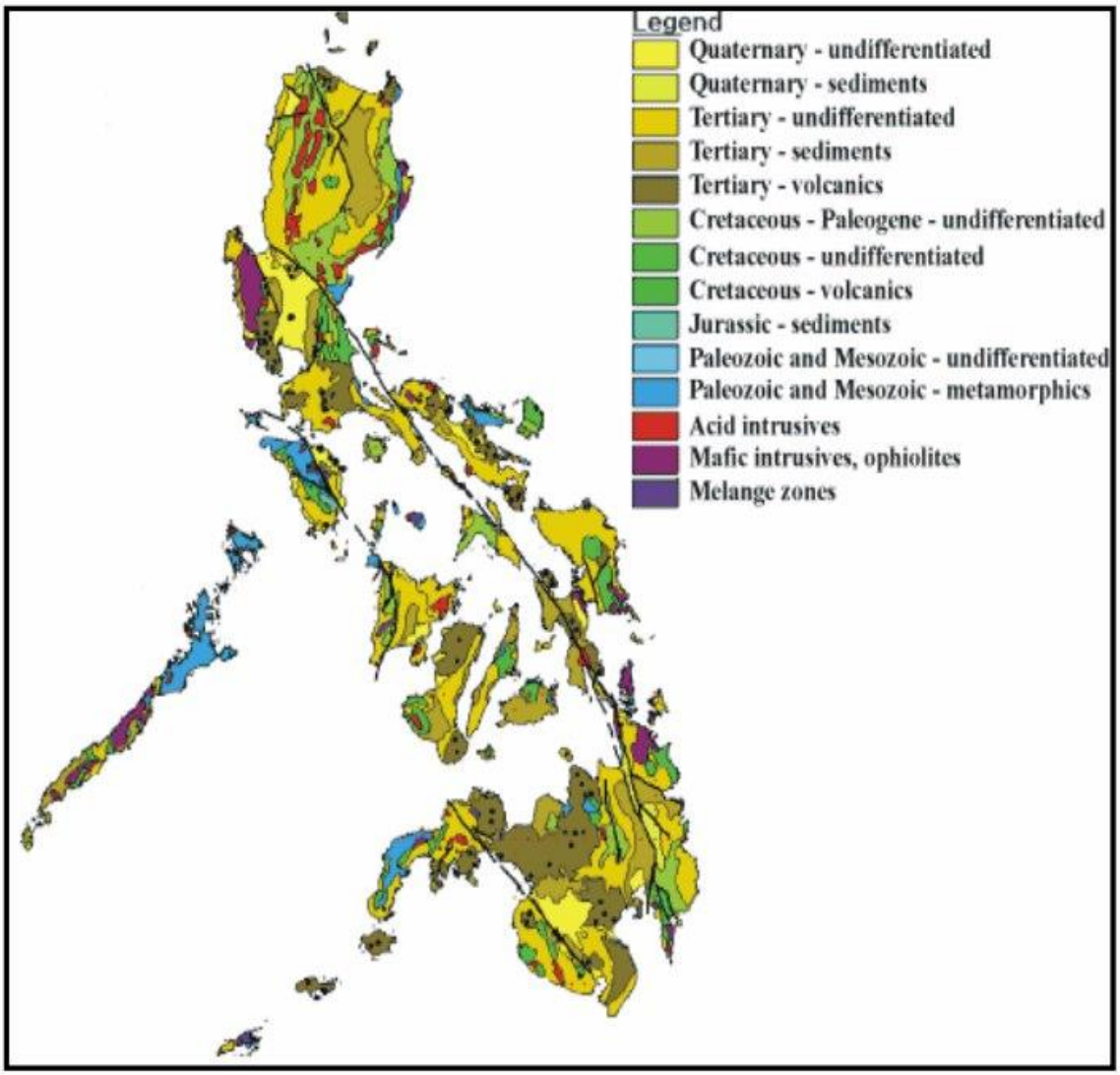


Tectonic model for the northern Philippine Island Arc (from Hamburger, M.W. – Indiana University)

The rest of the archipelago is considered as the Philippine Mobile Belt. Approximately co-axial with the mobile belt is the Philippine Fault, a major strike slip fault that apparently developed partially in response to the kinematic forces from the subduction from the east and west of the mobile belt.

Many areas of this mobile belt are underlain by ophiolitic complexes. Usually occurring together with pre-Cenozoic schists and phyllites, the ophiolitic rocks represent basement on which magmatic arcs have developed. The ages of the ophiolitic complexes range from Jurassic to early Paleogene. One of the best-studied complete ophiolite sequences is the Zambales Ophiolite where tectonized peridotites progress

to layered and isotropic gabbro, sheeted dike complex, pillow basalts and finally pelagic sedimentary rocks. Other ophiolitic complexes include those in Isabela, Polillo Island, eastern Rizal, Camarines Norte, Caramoan Peninsula, Mindoro, southern Palawan, Panay Island, Bohol Island, Leyte Island, Samar Island, Dinagat Island Group, north central Zamboanga, Mindanao Central Cordillera and Pujada Peninsula. Ultramafic rocks of these ophiolites are hosts to significant deposits of chromite and nickel. Laterites over these rocks also contain economic deposits of secondary nickel minerals. On the other hand, massive sulphide and manganese deposits are associated with the volcanic and sedimentary carapace of the ophiolite.



Simplified geological map of the Philippines

Ancient magmatic arcs in the mobile belt are characterized by thick volcanic flows intercalated with pyroclastic and sedimentary rocks and intrusions of diorite, quartz diorite and andesitic to dacitic rocks. Some intrusions, however, have a more alkalic character such as the syenites in Isabela and monzonites in Quirino and Nueva Vizcaya. The ages of the diorite intrusions vary, from late Early Cretaceous (Albian) in Cebu to Late Miocene-Pliocene (Black Mountain Quartz Diorite in Baguio District). Younger volcanic rocks, occurring as flows, intrusions and volcanic edifices disposed in linear belts are associated with

active subduction processes. These are best exemplified by the Bataan volcanic belt and Bicol volcanic chain.

Sedimentary basins located between arcs include the Ilocos-Central Valley Basin, Cagayan Valley Basin, southeast Luzon Basin, Visayan Sea Basin, Agusan-Davao Basin and Cotabato Basin.

Gold and copper deposits in the Philippines tend to be clustered in certain areas such as Luzon Central Cordillera, Camarines Norte, Surigao and Davao, although large deposits may also be found elsewhere, as in Zambales (Dizon mine), Cebu (Atlas mine) and South Cotabato (Tampakan project). Many copper-gold deposits are associated with intrusions (mostly diorite and quartz diorite, but also monzonites and syenites) as well as Pliocene – Pleistocene volcanism (Lepanto mine at Mankayan, Benguet). Iron deposits are also associated with Neogene intrusions of diorite and quartz diorite.

The text below is from The Philippine Mining Outlook*, by An ORO-East Mining Co.,Inc. and SKYNIX Holdings Corp.*

The Philippines indeed has been affirmed within the global mining industry as still an overly under-explored and under-optimized country in terms of its untapped potential mineralized areas.

Out of the 30 million hectares of Philippine land area, 30% is estimated to be mineralized equivalent to about 9 million hectares for potential mineral exploitation. So far though, a little over than 500,000 hectares are covered only with approved mining permits for exploration and development.

The mineral resource of the Philippines is estimated to be close to US$ 900 billion worth of deposits waiting to be mined out especially theorized from its geological position within the Pacific Rim Ring of Fire where major volcanic and tectonic movements historically took place giving way to massive mineralization within the countries along this transpacific volcanic belt.

The Philippines enjoyed its mining glory days in the 1970s and early 1980s when it was ranked within the top 10 global exporters of minerals, accountable to about 50% of total Philippine exports. This figure has dwindled down to less than 2% annually from the 1990s till the present.

The apparent resurgence and revitalization of the mining industry in the Philippines came about once again from 2004 onwards triggered primarily by the relaxation of foreign ownership restrictions and regulatory laws by the Philippine government, improvement in world metal market prices, the sustained demand in China, enhanced further by very significant and world class deposit discoveries primarily in gold and copper and nickel to a great extent.

The influx of major global corporate mining players and giants into the Philippine exploration and mine development arena even more confirms that indeed a bull run for mining is now being enjoyed in the Philippines. All the more that the government has affirmed its claim that the Philippine mineral wealth in terms of ore deposits globally ranks 3rd largest for gold, 4th for copper, 5th for nickel and 6th largest for chromite.

7. DAY BY DAY TRIP SUMMARIES

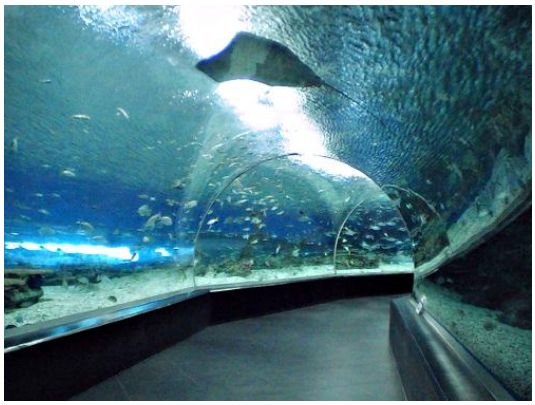
Tuesday, May 1st : Manilla

Manila is the capital of the Philippines. It is one of the sixteen cities forming Metro Manila. It is located on the eastern shores of Manila Bay. Manila has a total population of more than 1,660,714 according to the 2007 census. Areas of bustling commerce can be found in Manila, as well as some of the most historically and culturally significant iconic landmarks in the country and the seat of the executive and judicial branches of the government.

Among attractions Manila can offer there are:

1. Intramuros ("within walls") is the historic fortified city of Manila built during the Spanish colonial period. Located along Manila Bay and South of the Pasig river entrance, before 20th century reclamation obscured the city from the Bay. Buildings and sites of interest include the **San Agustin Church, the Manila Cathedral, the Rizal Park.**

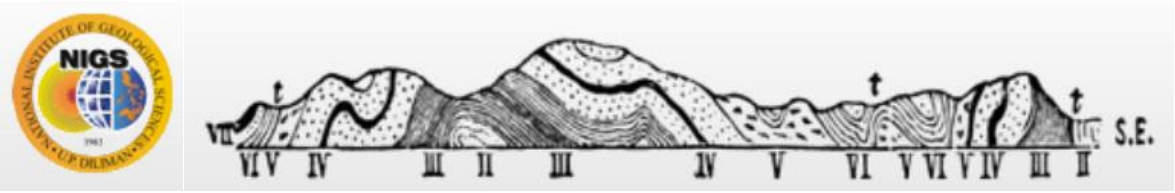
2. Museums: the National Museum (collection of artifacts dating back to pre-historic times) and the **San Agustin Church Museum** (a UNESCO world heritage icon a repository of relics of the catholic church).



3. Manila Ocean Park: the first marine theme park in the Philippines whose main attraction is a 25 meter long walking tunnel with 220 degree curve tunnel 8,000 square meter in size. Divided in 6 section featuring different forms of sea life in the Philippines. Entrance fee for **Oceanarium**: Php 400. Operating hours: 10:00 am to 7:00 pm

4. SM Mall of Asia: One of biggest Mall in Metro Manila, a great place to shop, to eat, relax and unwind, it also has seafood market that offers fresh, variety of seafood product, in seaside area. Operating hours: Monday - Sunday 10:00 am to 11:00 pm.

Wednesday, May 2nd: University of the Philippines and PhilVolcs Institute



University of the Philippines, Quezon City

On the morning of May 2nd, Dr. Mario Aurelio will be hosting us at the National Institute of Geological Sciences (NIGS), University of the Philippines, for a series of talks on the geology, geodynamics and metallogeny of the Philippines. The presentations will start at 9 am, until about 11:30 am. Mario will present the geodynamic setting of the Philippines, as well as the geology and mineralization of selected deposits that we will be visiting during the fieldtrip such as the Padcal Gold Copper Mines (Santo Tomas II deposit), the Lepanto Gold Mines and the Lobo deposit. Additional talks on other deposits may be organized as well. This will also be the opportunity to meet two students from NIGS who will be accompanying us on the fieldtrip, Kristine Joy Taguibao (2nd year MS student) and Jena Joie Lamson (Undergraduate student, incoming 4th year).

After the talks, we will have the opportunity to enjoy some delicious Filipino food at a local restaurant, before we continue with a tour of the PhilVolcs Institute in the afternoon.

Philippine Institute of Volcanology and Seismology, Quezon City

The PHIVOLCS is responsible for the mitigation of risks and damage associated with natural disasters such as volcanoes, earthquakes and tsunamis. It is part of the Department of Science and Technology government agency. This Institute was started in 1952 after the 1951 eruption of the Hibok-hibok volcano that resulted in considerable casualties and damage. The following are the major programs that PHIVOLCS is currently involved with: earthquake and volcano monitoring, active fault mapping and paleoseismology, ground deformation studies of active faults by GPS, earthquake-related and volcano-related hazards mapping, identification and characterization of volcanic systems, development and dissemination of information on volcanoes, community preparedness and earthquake and tsunami. The Geology and Geophysics Research and Development Division are involved in monitoring the active volcanoes looking out for signs that would indicate an eruption. This monitoring is done through seismic networks, chemical testing of springs and lakes surrounding the volcano and changes in the landscape and architecture of volcano. More information at www.phivolcs.dost.gov.ph

Thursday, May 3rd: Mount Pinatubo

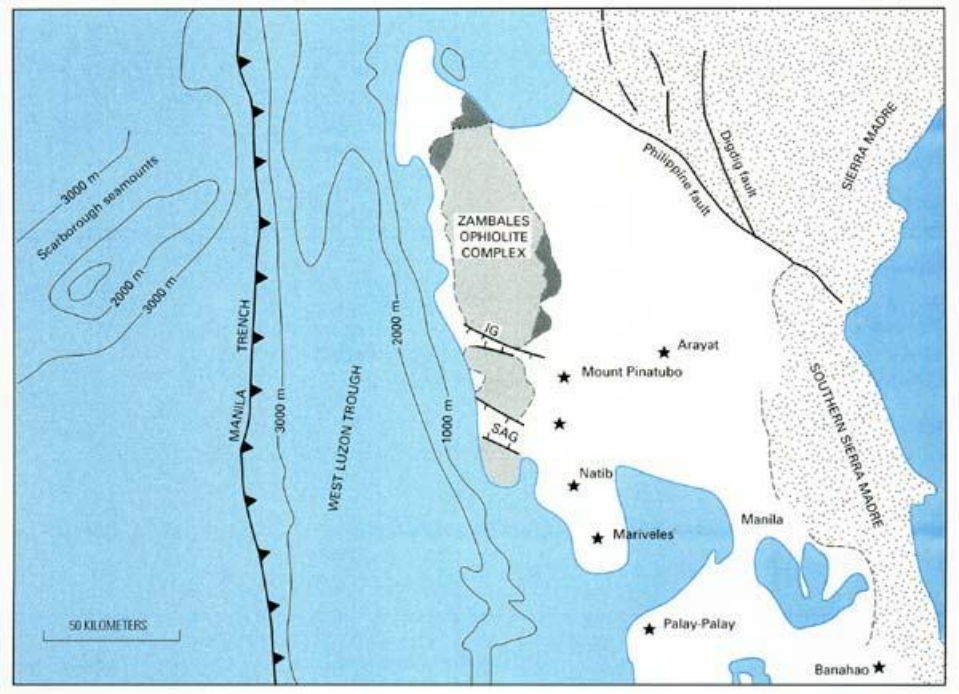
Mount Pinatubo is an andesitic island arc volcano located 130km North West of Manila, on the Island of Luzon. The volcano last erupted in 1991 and since then stands 1485m-high. The 1991 eruption consisted of vertical explosions and alternating dome growth and pyroclastic flow. The climactic phase erupted mainly dacite magma while the pre-climactic phase erupted both andesite and dacite magmas. During this eruption a plinian column extended up to 40 km high, which then deposited 3.4 to 4.4 km^3 of tephra on to most of Luzon Island (Rosi et al., 2001). The danger of the ash cloud was compounded by the arrival of typhoon Yunya, which resulted in the falling of ash laden rain. Successful prediction of the climatic eruption led to the evacuation 60,000 inhabitants from the area, saving the lives of tens of thousands of people. This successful prediction was hailed as a major success for volcanic eruption prediction. The eruption removed the top 260 m of the summit of Pinatubo and formed a 2.5 km wide summit caldera, which now contains a beautiful intracaldera lake, which we will be camping by on May 3rd. Since 1991 Mt Pinatubo has remained quiet, and the temperature and pH of the lake have dropped to 26°C and pH 5.5, making it a popular tourist destination. Our visit to the mountain will involve transport to the caldera lake in a fleet of Jeep 4x4s, where we will camp the night on the shore of the lake. All the necessary camping equipment and food will be provided.

Rosi, M. R., Paladio-Melosantos, M. P.-M., Di Muro, A. D. M., Leoni, R. L., and Bacolcol, T. B., 2001, Fall vs flow activity during the 1991 climactic eruption of Pinatubo Volcano (Philippines): Bulletin of Volcanology, v. 62, p. 549-566.

Friday, May 4th: Coto Chromite mine

Chromite deposits in the Philippines are classified into two major groups: primary podiform deposits and residual/transported deposits. The Coto Mine falls into the former category and is the largest refractory type chromite deposit in the world. It is hosted in the Zambales Peridotite Complexes; these chromite-bearing peridotites form the lowermost level of the Zambales ophiolite, and are overlain by a complete ophiolitic sequence including layered mafic cumulates, sheeted dikes, pillow lavas, and marine sediments (Bacuta 1978). Mineralization occuring near the surface and was initially extracted using bench mining, and by 1984 the operations had moved underground. In July 2010, police officers, Army soldiers, and the Zambales Provincial Mining Regulatory Board (PMRB) took custody of the chromite mine operated by Compania Minera Tubajon Inc. (CMTI, which was formerly Coto Mines Inc.), following reports of large-scale chromite theft at Sitio Coto in Barangay Taltal, Masinloc. The mine has been tied up in a legal dispute and so has remained inactive since the raid.

The discovery of chromite (FeO·Cr2O3) in the Philippines dates back to the early American occupation. Chromium was first discovered in 1907 in laterite deposits as well as in unaltered serpentine bedrock, occurring as grains, small masses, and lenticular bodies. In 1925, during a geological reconnaissance survey of the Zambales Range by the Bureau of Science, the largest Philippine chromite deposit was discovered along Lawis River, 24 km east of Masinloc, Zambales Province. The deposit was originally estimated at 10 to 15 million tons with grades ranging from 30% to 37% Cr_2O_3.



Petrology and Geochemistry of the 1991 Eruption Products of Mount Pinatubo (Luzon, Philippines). (From Bernard et al, 1996)

Bacuta, G.C.: Geology of some alpine-type chromite deposits in the Philippines. Philippine Bureau of Mines, Manila, 22 p. (1978)
Bernard, A., Knittel, U., Weber, B., Weis, D., Albrecht, A.; Hattori, K., Klein, J., Oles, D. (1996). Petrology and Geochemistry of the 1991 Eruption Products of Mount Pinatubo (Luzon, Philippines). In: Newhall, C. G. & Punongbayan, R. S (eds) *Fire and Mud. Eruptions and Lahars of Mount Pinatubo, Philippines.* Seattle: University of Washington Press, pp. 767-798.

Saturday, May 5th: Santa Cruz Nickel Project – Benguet Corporation

The Santa Cruz Nickel Project is an advanced exploration project operated by the Benguet Corporation. The project area is located within the Zambales Ophiolite Complex, which covers a large area of the western coast of Central Luzon and is the major source of chromite ore in the Philippines. The Zambales Ophiolite is a typical ophiolitic complex consisting of basalt flows, diabase dikes, gabbro, and ultramafic rocks. The complex is Eocene in age, and is believed to have been exposed through uplift rather than faulting.

The Santa Cruz project is hosted in the Acoje Ultramafic Belt, in the northern part of the Zambales Ophiolite Complex. The main bedrock units in the project area are harzburgite and dunite. The harzburgite is medium to coarse grained and moderately serpentinized. The dunite is massive, granular, and consists of olivine with disseminated chromite and magnetite. Economic chromite and nickel sulphide mineralization commonly occurs adjacent to pyroxenititic lenses, which occur within the dunite unit.

The deposit was originally discovered in the 1960's by Benguet, and was explored sporadically from then until the 1980's. Exploration on the project has included auger drilling, trenching, and test pits. Portions of the project area are laterized: Laterization is well developed on relatively flat plateau surfaces and gentle slopes, but poorly-developed on steeper slopes. Currently, the deposit has a resource of 15.6 million tonnes at 1.37% nickel. The entire property area has approximately 50 million tonnes of nickel resources and reserves (Hock et al., 1986; Benguet Corp. website, 2012).

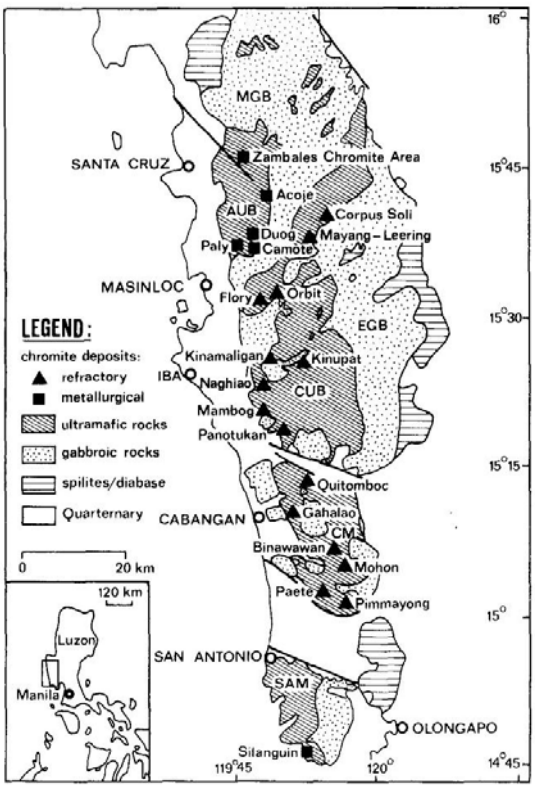


Fig. 1. Geological map and structural units of the Zambales Range (adapted after Bacuta 1978) and localities of investigated chromite deposits: AUB = Acoje ultramafic belt, CUB = Coto ultramafic belt, MGB = middle gabbro belt, and EGB = eastern gabbro belt together form the Masinloc massif; CM = Cabangan massif; SAM = San Antonio massif

Figure from: Hock et al., 1986, Refractory and Metallurgical-Type Chromite Ores, Zambales Ophiolite, Luzon, Philippines, Minerallium Deposita, vol. 21, pp 190-199.

Saturday, May 5th: Hundred Islands National Park

The Hundred Islands National Park is located on Lingayen Gulf near the city of Alaminos. The one hundred and twenty three islands are formed by ancient corals in an area that was previously a shallow seabed. The corals are believed to be about two million years old, and were exposed by lowering of the sea level. Islands in the park have a characteristic mushroom-shape that results from erosion caused by waves. The water of Lingayen Gulf is often murky, and much of the coral has been destroyed by overuse, and by dynamite and cyanide fishing. Since 2005 the city of Alaminos and the University of the Philippines Marine Science Institute have been working together to protect the Gulf from illegal fishing and to repopulate the ocean ecosystem.

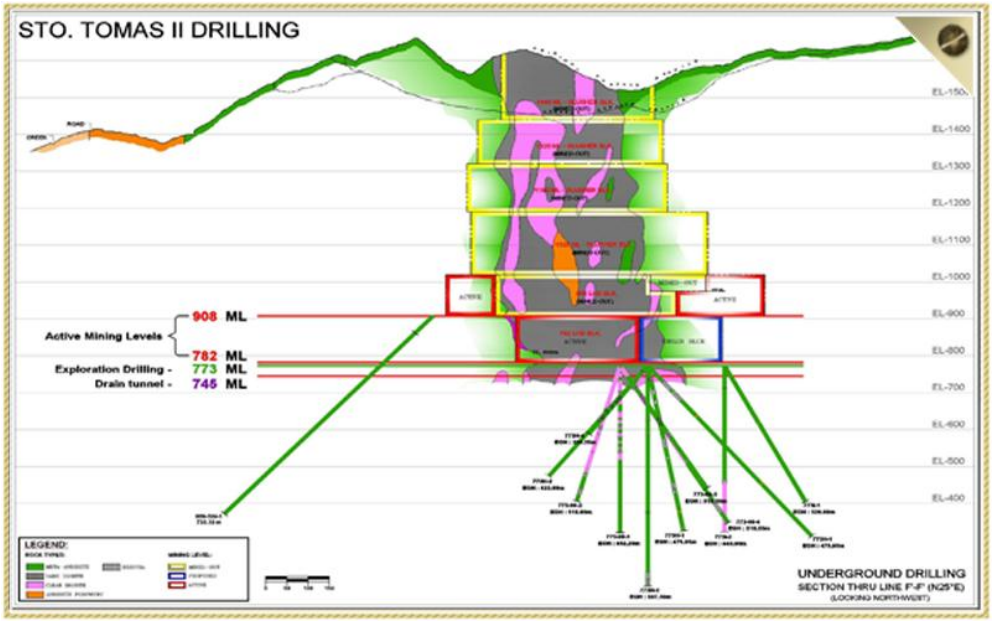
The park is one of the National Geologic Monuments of the Philippines, and is a popular tourist destination. Tourist activities in the park include snorkelling, kayaking, fishing, spelunking, and swimming. The three most popular islands to visit are Governor's Island, Quezon Island, and Children's Island, which each have some tourist activities and vendors.

Sunday, May 6th: Philex Padcal mine and Sto. Tomas II deposit

The Santo Tomas II (Philex) deposit is a porphyry Cu-Au deposit, located in the southern part of the Baguio mineral district, Benguet Province, northern Luzon, Philippines. The Santo Tomas II deposit is associated with an intrusive complex consisting of four rock types that are distinguished based on petrography. They are 1) post-ore clinopyroxene-bearing hornblende andesite porphyry, 2) ore-generating hornblende andesite porphyry, 3) hornblende quartz diorite porphyry and 4) porphyritic hornblende quartz diorite. K-Ar age of hydrothermal biotitization was estimated to be 1.5±0.4 Ma. (Imai, 2001)

The ore minerals are chalcopyrite and bornite associated with gold and silver. The alteration zones consist of potassic and propylitic. A pyrite halo is also present.

Photo from Aksel Osterlof, website: www.mindat.org



From: Philex Mining Corporation (www.philexmining.com.ph)

Cited Material:

Akira Imai (2001). Generation and evolution of Ore Fluids for Porphyry Cu-Au Mineralization of the Santo Tomas II (Philex) Deposit, Philippines

Monday, May 7th: Acupan Gold Mine – Benguet Corporation

Acupan Gold Mine is a low sulfidation type epithermal gold deposit with a long history of production. The mine was in nearly continuous production from 1923 until 1992, when mining operations were suspended following flooding that resulted from an earthquake in 1990. During this time the mine produced 5.5 million ounces of gold; an estimated combined reserve and resource of 8.25 million ounces was left in the ground after mining operations were suspended. Much of this historic production was from selective mining of narrow veins with grades ranging from 15 – 4 g/t Au. The deposit consists of epithermal quartz-calcite-rhodochrosite-rhodonite veins, breccia pipes, and quartz stockwork vein zones. Gold occurs freely, with tellurides, with electrum, and encapsulated in sulphides such as pyrite. Silver and galena are common by-products, but are generally only present in minor amounts.

Acupan is a very young, shallow epithermal deposit associated with an extended period of magmatism and hydrothermal activity. Underlying rocks include pre-Miocene andesite volcanic flows, Late Miocene diorite, and Pliocene granodiorite. These rocks are intruded by Late Pliocene to Quaternary diorite plugs and diatremes, which are crosscut by gold-bearing epithermal veins at Acupan. A possible nearby Pliocene copper-gold porphyry called the Ampucao prospect has been inferred from drill intersections at the southern edge of the area explored during mining. Geothermal activity was a major issue during mining, and included problems such as high rock and water temperature, superheated steam, and roaring fumaroles (Cooke et al., 1996; Benguet Corp. website, 2012).

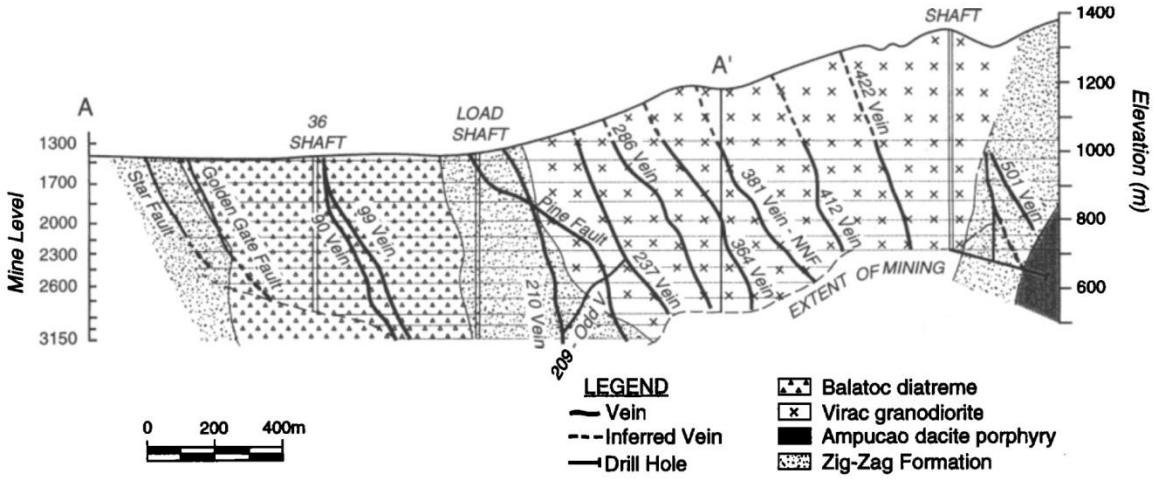


FIG. 3. Schematic cross section A-A′–B showing the vertical extent of mining and the spatial relationship between epithermal veins, the Ampucao dacite porphyry, and the Balatoc diatreme. Constructed from level plans courtesy of Benguet Consolidated Inc. The vein systems and stockworks studied are represented by the 210 and 209-Odd veins between levels 2600 and level 3150, and by the 381 vein. Vertical scale equals horizontal scale.

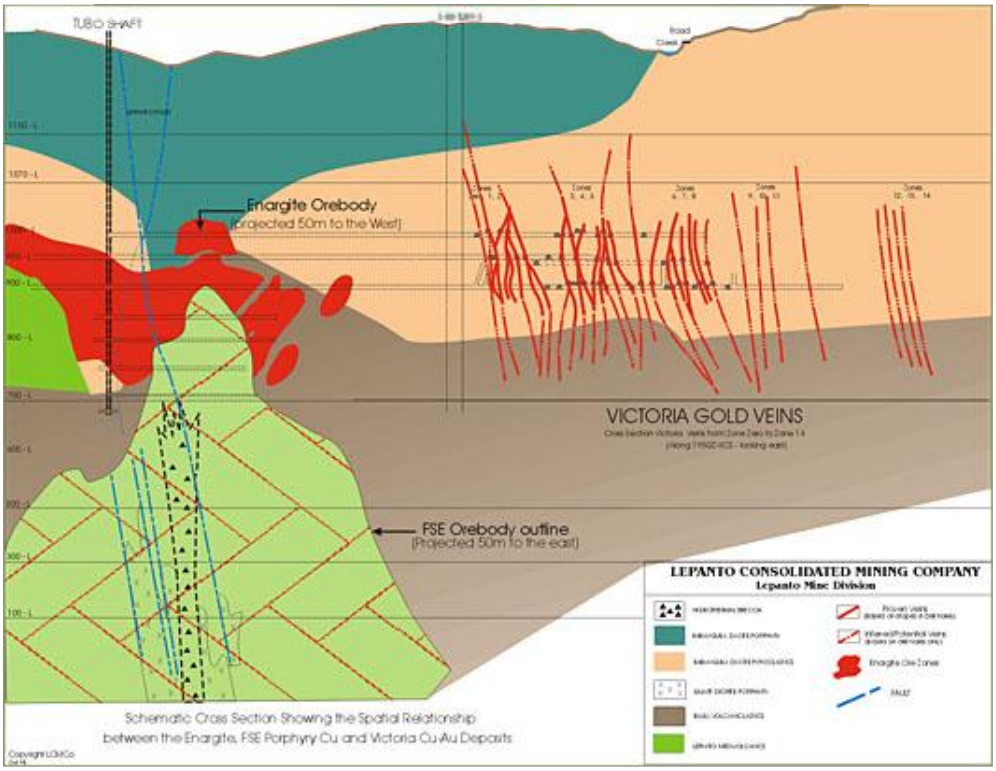
Figure from: Cooke et al., 1996, Epithermal Gold Mineralization, Acupan, Baguio District, Philippines: Geology, Mineralization, Alteration, and the Thermochemical Environment of Ore Deposition, Economic Geology, vol. 91, pp 243-272.

Tuesday, May 8th: Lepanto Gold Mine – Lepanto Mining/Goldfields

The Lepanto Gold Mine is part of a large porphyry-epithermal complex within the Mankayan mineral district located in the Central Cordillera of Northern Luzon. This district is one of the Philippines richest mining districts, and one of the districts with the greatest potential for future discovery. Lepanto is a high sulfidation epithermal ore body that has now been mined out. The mine produced 0.74 Mt Cu, 3.24 Moz Au, and 13.8 Moz Ag at an average grade of 2.9% Cu, 3.4 g/t Au, and 14 g/t Ag during ~60 years of underground mining. Other parts of the porphyry-epithermal complex include the Far Southeast porphyry deposit (drilled resource) and the Victoria epithermal vein system (currently being mined). Ar-Ar dating by Arribas et al. (1995) determined that Lepanto and Far Southeast both formed around 1.41-1.42 Ma, while the Victoria veins formed at 1.31 – 1.14 Ma (Chang et al., 2011). The Lepanto deposit and the Far Southeast deposit are a classic example of a coeval porphyry-high sulfidation hydrothermal system

The Lepanto ore bodies are hosted in silicic and advanced argillic alteration zones. Approximately 70% of the ore is hosted by a brecciated fault structure called the Lepanto fault. The remainder of the ore occurs in a subhorizontal blanket within the overlying lithocap. Ore minerals at Lepanto include enargite, luzonite, chalcopyrite, tennantite, gold, electrum, and tellurides. The mine is the type locality for luzonite (Cu_3AsS_4). The top of the nearby Far Southeast ore body consists of copper and gold mineralization that is spatially associated with porphyritic dikes and potassic alteration. This potassic alteration is partially overprinted by chlorite-hematite and sericite-clay-chlorite alteration assemblages. Ore minerals at Far Southeast include electrum, chalcopyrite, bornite, tennantite, and pyrite (Chang et al., 2011).

Figure from: Lepanto Consolidated Mining Company website, 2012.



Wednesday, May 9th: Ifugao Rice Terraces

The rice terraces located in the Philippine Cordilleras, on the northern island of Luzon are a UNESCO World Heritage-listed site. They are 2000 years old and were carved into the mountains by the Ifugao ethnic group, a minority community that has occupied these mountains for thousands of years. The techniques used to build these terraces have been passed down from generation to generation; the Ifugao Rice Terraces represent a lasting example of an ancient civilization that overcame the influences of modern civilization.

The terraces reach a higher altitude and were built on steeper slopes than many other terraces in the world. The Ifugao rice terrace complex demonstrates a mastery of engineering illustrated by the stone or mud walls, the careful carving of the natural contours of hills and mountains to make terraced pond fields, the development of intricate irrigation systems, where they harvested water from the forested mountain tops, and the elaborate farming customs.

The farming and maintenance of the living rice terraces reflect a cooperation of the communities of this area. This is accomplished by their detailed knowledge of the diversity of biological resources existing in the Ifugao agro-ecosystem, a planting and harvesting system based on lunar cycles, zoning and planning, extensive soil conservation, expertise of pest control methods based on the processing of a variety of herbs, and by religious rituals.

This beautiful terraced landscape is highly vulnerable because technological and evolutionary changes are threatening the social traditions that existed for the past two millennia. Rural-to-urban migration are diminishing the available agricultural workforce to maintain the extensive area of terraces, climate change has caused certain water sources to dry out and massive earthquakes have shifed the locations of water sources and dams.

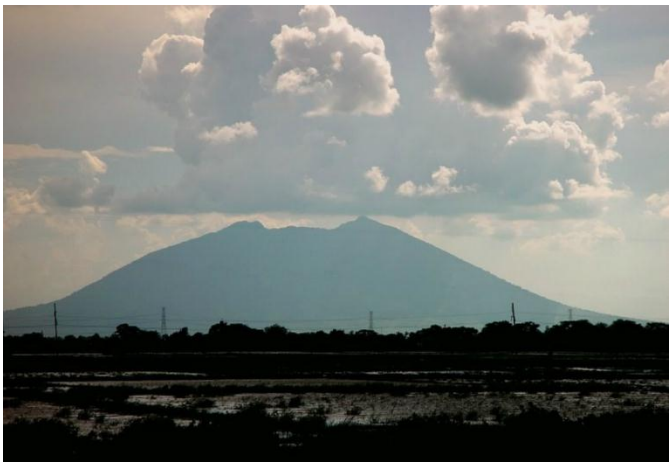
National agencies and provincial government programs are working alongside the indigenous people to address the potential threats to the rice terrace culture to ensure the sustainability and conservation of this wonderful living landscape.

For more information: http://whc.unesco.org/en/list/722

Thursday, May 10th: Drive from Banaue to Quezon City

On Thursday May 10th, we will leave Banaue. The day will begin driving through rice terraces and mountainous jungle. Beyond the mountains, we will pass through several Filipino towns and cities, and see some spectacular country-side scenery. We will end the day in Quezon City.

Images below are from Google Maps.



Friday, May 11th: Taysan Porphyry Copper-Gold Deposit – Crazy Horse Resources

On Friday morning we will drive approximately two hours from Quezon City to Taysan.

The "Taysan Deposit" is a porphyry copper-gold system which lies on the south-western segment of Luzon in the industrial province of Batangas. This advanced exploration prospect is currently 100% owned by Crazy Horse Resources based in Vancouver BC, and is currently undergoing a prefeasibility study. The magmatic-hydrothermal system is associated with the San Juan quartz diorites of the Tolos Batholith, and hosted in the San Juan metavolcanic sequence (Sowerby 2010).

Copper mineralization is hosted within potassically altered quartz diorite porphyry. Copper occurs as disseminated chalcopyrite with biotite and magnetite within the quartz diorite and as vein-hosted chalcopyrite in stockwork quartz-magnetite veins. Beyond the potassic alteration zone, zoned sercite-chlorite-carbonate, and propylitic assemblages are observed (Sowerby 2010).

Mineral Resource Estimate March 2011						
Category	Cut-off	Cu, %	Au g/t	M tonnes	Contained Cu, M lb	Contained Au, M oz
Inferred	0.10% Cu	0.23	0.11	944	4,720	3.3

(Taylor & Binks 2011)

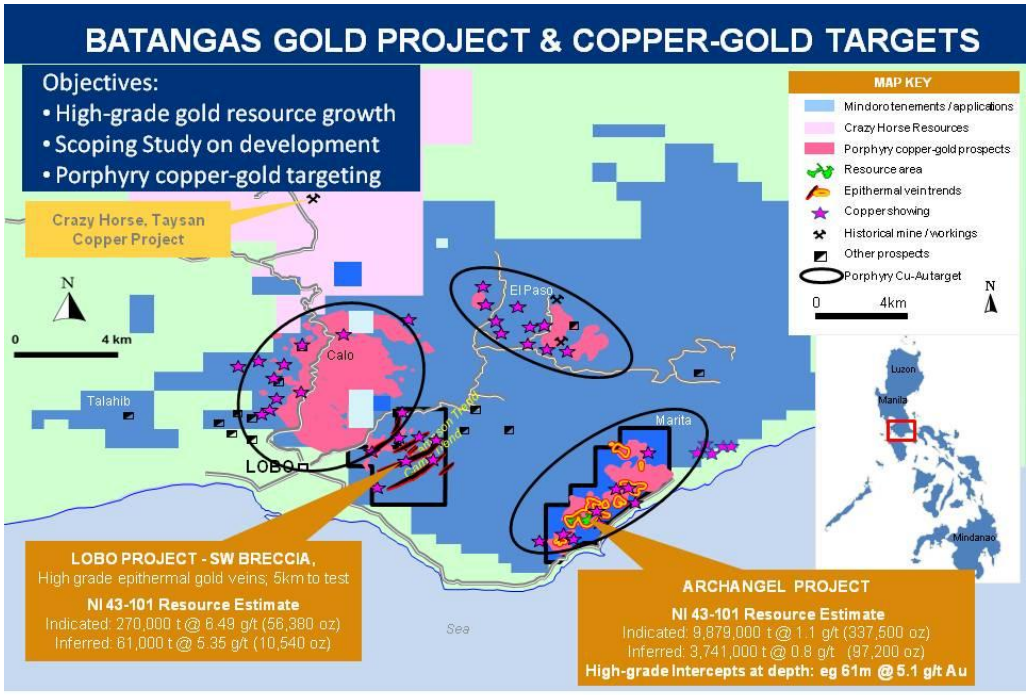
Left: View looking North over the Taysan Copper-Gold Deposit.
Right: Chalcopyrite mineralization in quartz diorite

SOWERBY, R. 2010. *A technical review of exploration and resource estimates of the Taysan Project, Batangas Province, Philippines*. NI43-101 Technical Report. Geosynthesis Pty Ltd. www.sedar.com

TAYLOR, I. & BINKS, G. 2011. *Mineral resource estimate and preliminary economic assessment, Taysan Project, Batangas Province, Philippines*. NI43-101 Technical Report. Mining Associates Limited. www.sedar.com

Saturday, May 12th: Batangas Porphyry Copper and Gold Prospects – Mindoro Resources

The Batangas properties cover a large complex of porphyry related gold and copper-gold prospects including both high and low sulphidation gold systems at Kay Tanda (Archangel) and Lobo as well as numerous porphyry copper-gold prospects including Pica (Lobo), El Paso, Calo and Archangel. Gold mineralization observed at Kay Tanda (Archangel) is a combination of the upper part of a porphyry Cu-Au system that was overprinted by several stages of epithermal veining. Mindoro geologists will guide us looking at drill-core and outcrops of some of these prospects.



We will return to our accommodation in Anilao in the afternoon for free time, optional diving, snorkeling, beer, and sun.

Cox, D. 2010. *Mineral resource estimate upgrade on the Kay Tanda Project, Luzon, Philippines. NI43-101 Technical Report*.www.sedar.com

Sunday, May 13th: Beach Diving/Snorkelling in Anilao

The word "Anilao" refers to various dive sites scattered along the coastline of this part of the Philippines, and is regarded as the birthplace of Philippines diving.

This morning, after waking up with the sound of waves hitting the beach, everything you will have to do is enjoy the rest of your day with your favorite activity: yoga session on the beach, snorkeling, diving, or just read some of the geology papers included in this guidebook…

Before sunset, we will drive to Tagaytay City, where we will appreciate the view on the Taal Lake and volcano from our resort.

Monday, May 14th: Visit Taal Volcano located within Taal Lake

The Taal volcano (311m high) is a young active volcano (5380 +/- 170 ybp; Radiocarbon age, Listanco, 1994) constituted of the following features:

- **Main crater lake**: 1.9 km in diameter, 4 m above sea level, maximum depth of 76 m
- **The Taal caldera**: 25 km diameter, formed between 140,000 to 5,380 BP
- **The Taal lake**: located inside the caldera, 267 km^2, 2m above sea level.

The Taal volcano is surrounded by a number of volcanic edifices such as the Makiling (NE), Malepunyo (E), Batulao (W) and Macolod (SE). These volcanoes are associated spatially with the Macolod Corridor which is a main regional tectonic feature. The main lithologies at the Taal volcano are olivine basalts and andesites. A total of 33 eruptions have been recorded, the last one occurred on October 3, 1977. The style of eruption evolved from Plinian, Strombolian, Phreatomagmatic to Phreatic along the life of the volcano.

Activity of the volcano is monitored from the Taal Volcano Observatory, located about 9.7km from the Main Crater. Monitoring is conducted through seismic monitoring, visual observations, ground deformation, Main Crater Lake chemistry, temperature and level.

In the morning, we will be sailing across the Taal lake on “bancas”, reach the volcanic edifice in the middle of Taal lake, and hike the "1965 eruption" trail, or alternatively the “secret trail”. We will also have the option of renting horses to access some of the trails. The tour will end around 3pm.

And as every good moment has an end, we will drive back to Manila in the evening where we will spend a last night before flying back to Vancouver the next morning.

Compilation sources:

World Organization of Volcano Observatories (http://www.wovo.org/0700_0704.html)
PhilVolcs Institute (http://volcano.phivolcs.dost.gov.ph/update_VMEPD/Volcano/VolcanoList/taal.htm)

8. SCIENTIFIC PAPERS

Regional geology, volcanism and tectonics

M.J. Defant, D. Jacques, R.C. Maury, J. De Boer, J.L. Joron (1989). Geochemistry and tectonic setting of the Luzon arc, Philippines. Geological Society of America Bulletin, V.101, p.663-672.

R.H. Sillitoe and I.M. Gappe (1984) Philippine Porphyry Copper Deposits: Geologic Setting and Characteristics. CCOP Project Office, UNDP Technical Support for Regional Offshore Prospecting in East Asia (RAS/81/120) (Bangkok, Thailand) p. 89

M. Rosi, M.L. Paladio-Melosantos, A. Di Muro, R. Leoni and T. Bacolcol (2001) Fall vs flow activity during the 1991 climactic eruption of Pinatubo volcano (Philippines). Bulletin of Volcanology, v.62, p.549-566.

T.A. Vogel, T.P. Flood, L.C. Patino, M.S.Wilmot, R.P.R. Maximo, C.B.Arpa, C.A. Arcilla, J.A. Stimac (2006) Geochemistry of silicic magmas in the Macolod Corridor, SW Luzon Philippines: evidence of distinct, mantle-derived, crustal sources for silicic magmas. Contributions to Mineral Petrology, v. 151, p.267-281.

Coto Chromite mine

Hock, M., Friedrich, G., Plüger, W. L., Wichowski, A. (1986) Refractory- and metallurgical-type chromite ores, Zambales ophiolite, Luzon, Philippines. Mineralium Deposita, v.21, no. 3, p.190-199.

Padcal mine and Sto. Tomas II deposit

A. Imai (2001) Generation and Evolution of Ore Fluids for Porphyry Cu-Au Mineralization of the Santo Tomas II (Philex) Deposit, Philippines. Resource Geology, v. 51, no. 2, p.71-96.

Acupan Gold Mine

Acupan Gold Mine Summary report - http://www.benguetcorp.com/

Lepanto Gold Mine

Z. Chang, J.W. Hedenquist, N.C. White, D. R. Cooke, M.Roach, C.L. Deyell, J. Garcia, J. B. Gemmell, S. McKnight, and A.L. Cuison (2011). Exploration tools for linked porphyry and epithermal deposits; example from the Mankayan intrusion-centered Cu-Au district, Luzon, Philippines. Economic Geology and the Bulletin of the Society of Economic Geologists, 106(8):1365-1398

Taysan Porphyry Copper-Gold Deposit

R. Sowerby (2010) A technical review of exploration and resource estimates of the Taysan project, Batangas Province, Philippines.

Archangel Project, Mindoro Resources

D.M. Cox (2010) Mineral Resource Estimate upgrade on the Kay Tanda Project, Luzon, Philippines, NI 43-101 Report.

9. THANKS TO OUR 2012 SPONSORS!

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