



NTNU – Trondheim
Norwegian University of
Science and Technology

Main field trip 2010

Brazil



Geology



Geophysics & Petroleum Engineering

PREFACE:

The human beings have the last 10 000 years gone through a development from the Stone Age, via Bronze- and Iron Age, to what we today could name the Oil age. The Oil age started in Pennsylvania in 1858 when "Colonel Drake" found oil at 21 meters depth. Since then new technology within drilling, production and exploration have led to several oil discoveries around the world.

Up to the end of the 1940's there were only performed onshore drilling. By the discovery of oil on continental shelves (e.g. In the North Sea and The Gulf of Mexico) the new challenge became how to produce from constantly increasing water depths. Another challenge was to make high quality seismic images of the subsurface, which is more complicated with the presence of salt structures. It is quite common to find Salt structures in sedimentary layers, which was created by the evaporation of previous seas. In the Southern North Sea you can find thick packages of Permian salt (Zechstein). A distinctive characteristic of salt is that the density is not affected by the burial depth. This means that with a certain stress from the overburden, the density contrast between the salt and its surroundings is large and causes the salt to move upwards due to buoyancy. This, in addition to the plastic behavior of salt, causes mushroom-shaped structures to develop (so called salt diapirs.), which in many cases can reach all the way up to the surface. Salt related structures have been a popular exploration target in the oil industry since the giant "Spindletop" discovery in Texas in 1911. In the Gulf of Mexico reservoirs sealed by salt is the main play.

Brazil and Angola have been successful finding oil in Tertiary turbidite depositions. These depositions are created by submarine slides, which transport sand from the shelf out to deep water by currents. This sand is often sorted well, and will create stratigraphic traps with pelagic ooze as sealing.

The challenges by drilling new wells at water depths larger than 2000 meters made the next challenge, to drill through a 2000 meter thick salt layer beneath the Tertiary sand- and shales technical impossible before British Gas started the drilling of the "Tupi"-prospect in 2006. This well was drilled through the salt layer and into a carbonate formation containing oil. This discovery, which was the largest since 2000, changed the whole picture of the potential of what now is being named "Pre- Salt" in Brazil, and next in Angola. The Tupi field is estimated to have recoverable reserves of 8 Billion barrels (almost twice as big as the Statfjord field). The most interesting thing is that the Tupi field is only one of many similar structures in this area, which will make Brazil an important oil producing country in the years to come. This could also influence a possible legal amendment in Brazil, by withholding this new area from non-Brazilian companies in the future.

With this as a backdrop, the 4th year students at the Institute of petroleum engineering and applied geophysics traveled to Brazil in the spring 2010. The aim of this excursion was to visit industry which could illuminate this new development in Brazil, and present cutting edge technology. It was interesting to see the great optimism in the companies we visited; everybody was interested in being a part of the new industrial fairytale. A short look at the Brazilian continental shelf shows how big the potential of this country is.

Rio de Janeiro is now, together with Houston and Stavanger/Aberdeen focals in respectively South-America, North-America and Europe. Many Norwegian companies are seated in Rio, and all the important service contractors have offices here. It is not without a reason Rio has been the destination for half of the main excursions the last 8 years. The stay in Rio was successful, and I believe the students have gotten a more balanced insight in the oil industry in general, the oil industry in Brazil and not least the Brazilian culture.

Trondheim, 16.05.2010

Egil Tjøland

SUMMARY

In order to give the best possible program to all of the students, we decided to divide the excursion participants into two groups.

The geologists and the geotechnologists first travelled to Sao Paulo. Here they visited Parque Estadual Turístico do Alto Ribeira (PETAR) and the Cajati Phosphate Mine together with students and professors from the University of São Paulo. Their stay in São Paulo ended with a visit and a tour at the University of São Paulo. The night bus took them to Rio de Janeiro, where they met with the rest of the group, and their educational program ended with a visit at Statoil and dinner at a Brazilian barbeque house – a churrascaria. During the visit they got to see a lot of Brazil's great nature and their heavyset mineral production.

The geophysicists and the petroleum technologists spent their time in Rio de Janeiro. Here they visited many companies from different areas within oil and gas, both large oil companies and service companies. It was of great educational interest to see equipment used in logging and production, and to learn about new technologies used in the business.

During the academic program, we visited the following companies:

- Petrobras
- PGS
- Schlumberger
- Subsea 7
- Statoil
- Aker Solutions

Prior to the excursion, Weatherford Petroleum Consultants and Weatherford Laboratories came to our university and held a presentation for us.

Our trip to Brazil was inspirational and educational, and we are sure it will be fondly remembered by all the participants. Without the support of our sponsors, it would not have been possible to realize this excursion and we therefore express our deepest thanks to you all. We would also thank the companies who welcomed us at their facilities in Brazil, taking time to lecture us about their work and the industry, and the University of São Paulo who took great care of us and made this trip wonderful. Back at the university in Norway, we remember the trip with warmth and are all inspired when entering our final year/final months of study. During the stay we also met many foreigners working in the oil and gas industry in Brazil. This has given us experience and showed us the great opportunities we, as Masters of Science, have outside the Norwegian borders.

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WEATHERFORD PETROLEUM CONSULTANTS AS AND WEATHERFORD LABORATORIES.



Monday, March 1st 2010:

Prior to the fieldtrip we had a company presentation with Weatherford Petroleum Consultants AS and Weatherford Laboratories. Weatherford Petroleum Consultants AS is a technology and service company in the Weatherford group with head quarter at Lade in Trondheim co-located with the head office of Weatherford Laboratories.



First David Lysne gave a presentation of Weatherford in general, who they are and what they do. We learned that Weatherford helps build innovative mechanical solutions, technology applications, and services for all phases of oil and gas developments and is one of the 4 largest consultant companies in the world. They have over 800 locations in 108 countries, with head quarter in by, Switzerland. Weatherford has over 50000 employees and is at the time in great expansion. Their main product is field design, development, production and increased recovery methods. Weatherford

interpret, build models, simulate, and plan the economical aspects of a field development amongst other services. One of their projects right now is the Chicontepec field in Mexico, which is the seventeenth largest in the world, onshore. This field is a turbidite field and very challenging to produce from. Another project Weatherford is working on now is the Gamij field in India.

Weatherford Petroleum Consultants AS has their own license on software, for example Eclipse/Petrel and they have developed software called SENDRA SCAL Tool Box which is used by over 30 oil companies. SENDRA is a core flow simulator for simulation of SCAL experiments and determination of relative permeabilities and capillary pressure.

Some of Weatherford Petroleum Consultants AS clients are Statoil, Det norske oljeselskap and Conoco Phillips. One of the benefits with having Statoil as a client is that there is a short way from the lab to the field, so they test out a lot on field scale to for example increase oil recovery.

Why we as students should choose Weatherford Petroleum Consultants AS:

- Competitive salary
- Possibility to work international
- Flexible hours
- Dynamic and friendly environment
- Opportunity to write project and master thesis

After this presentation it was Johan Tronvoll's turn to present Weatherford Laboratories (Reslab). Weatherford Laboratories offers laboratory services in North America, in Latin America, in Asia/Pacific Rim, in the Middle East/North Africa, and in Europe.

Johan Tronvoll told us that the company provides a full value chain of core and fluid services. They work on many different types of challenging reservoirs, including high pressure/high temperature (HPHT), heavy oil,

tight gas and shale gas. In addition they do PVT and core analysis regarding enhanced oil recovery (EOR), and risk analysis on storage of CO₂ . Weatherford laboratories also provide services regarding geochemical assessment, formation evaluation, fluid analysis, rock mechanics and storage of cores. Johan Tronvoll told us about how important it is to have good advisors and to have credibility in this industry. He also emphasized that new technology regarding enhanced recovery will get more and more important in the future.

During these two presentations we were provided with coffee, fruit and some snack. I believe that all the students thought it was two inspiring presentations by two exciting companies, which have a lot of experience worldwide.

PETROBRAS

Tuesday, March 23rd 2010:



When we arrived at Petrobras University Ricardo Solomão, general manager at the university welcomed us. He showed us an introduction video in order to present their company and their agenda. Further on, Izeusse Braga Jr, International Communication Manager, held a presentation called "From Monopoly to Free market Challenges - a Petrobras Overview". After a short coffee break, Gustavo Tamara, International Coordinator, presented "Petrobras University-Corporate Education". After a good lunch at the university we went to their headquarter to visit Petrobras E&P Virtual Reality Center.

Petrobras is a state-owned Brazilian energy company and a leader in the Brazilian oil industry. They have recently expanded their operations aiming to be amongst the top five integrated energy companies in the world by 2020. Petrobras' headquarters is located in Rio de Janeiro. In addition they also have an office in Salvador and they are present in 28 other countries. Altogether they are almost 70 000 employees making it the 4th biggest energy company in the world. The 2009-2013 business plan foresees investments in the order of \$174.4 billion.

Petrobras was established in 1953 and kept a monopoly in the Brazilian market until 1997 when they lost the monopoly. They are operating in different sectors, amongst exploration and production, refining, oil and natural gas trade and transportation, petrochemicals, and derivatives, electric energy, biofuel and other renewable energy source distribution.



We would like to thank Petrobras for a good insight in how a Brazilian energy company operates. It was interesting to learn about their recruitment and training process, and how it is organized compared to Norwegian standards. The overall impression is that Petrobras is a desirable company to work for, which can also be seen from their two received Distinguished Achievement Awards given by OTC in 1992 and 2001.

PGS

Wednesday, March 24th 2010



Petroleum Geo –Services (PGS) was founded in 1991, after the merge of Geoteam and Precision Seismic.

The PGS Ramform vessels are the only seismic vessels capable of towing more than twelve streamers. The Ramform streamer fleet includes 8 vessels, where the S-class are the most powerful seismic ships in the world, and Ramform Sovereign and Ramform Sterling are the most advanced seismic vessel in use today.

Today airguns are used as the seismic source, earlier they used dynamite. During a seismic survey 62 airguns are fired at the same time to create the source signal. The streamers are 6 – 12 km long. It is typical to tow 10-15 streamers at the time. It is 12.5 meters between the hydrophones. The shot interval is approximately 25 meters. It takes 6 to 7 days to get all the equipment (streamers and guns) out in the water. The streamers are at a depth of 8 meters and 15 meters apart. Every 300 meter there is GPS attached to the streamer along with “birds” which controls the position of the streamer. The GPS position has an error of 3-5 meters.

Tupi is the largest discovery during the last ten years. There it is 2 km with salt above the reservoir. The first well drilled down to the reservoir had a price of about 200 million dollars, now the cost is down to approximately 60 million dollars because of the experience gained after the previous wells.

In Brazil the vessels needs to have a marine biologist aboard to look for marine mammals. If the mammals get closer than 500 meters to the vessel, the acquisition is shut down until the mammals have left.

It takes approximately 6 to 8 months from acquisition to the data is processed. A typical survey takes 6 months to acquire.

In Brazil PGS has approximately 120 000 km² of data, for comparison they have approximately 79 500 km² of data in the North Sea.

Seismic acquisition

A part of the lectures held was an introduction to the acquisition of seismic. PGS started with traditional 2D-seismic acquisition, but this is subject to biased interpretation. The industry has now moved on to 3D-seismic and also repetitive 3D-seismic (4D-seismic). This development brought an increased amount of detail in seismic, which has been further developed by HD3D, high definition 3D-seismic.

During the lecture we were also introduced to PGS’ passive seismic project. Being a topic that has not been covered to any extent in our lectures at university, it was therefore very interesting. Detecting reflections from the subsurface without an active source, i.e. using noise as a source, passive seismic could be used to, hopefully, track fluid movement etc. in the reservoir.

We were also introduced to the PGS geostreamer. Being equipped with both a geophone and a hydrophone it is useful in noise attenuation.



Noise reduction

Bill Cafarelli told us about noise reduction. He introduced a few of the many methods available for reducing noise on seismic data by showing the group examples on real datasets. One example was the low cut filter, which is very primitive but efficient and is always done. When applying this, noise is attenuated but some of the signal may also get lost, and we have to be careful not to throw the baby out with the bath water. Therefore, we learned the golden rule; If noise suppression can only be achieved at the expense of signal loss, the price is too high.

Despike filter, F-K filter, Tau-P filter and radon filter were all explained and Bill said that it is the customer's preferences that decides which filters to apply. SINK removes swell noise and interference noise and a SWOOP, which runs iteratively, removes the rest of the swell noise and some white noise (same amplitudes over the whole frequency spectrum).

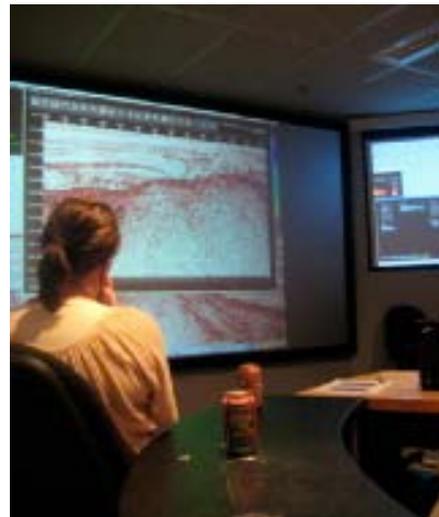
One good tip that we got is to run the tests over more than just one line to assure that the parameters fit.

holoSeis

Chang Yu Fen gave us a really nice introduction to holoSeis. holoSeis is a trademarked true VR system developed by PGS for high-end visualization of geodata. It is used to view and quality check the seismic volume, because having a clear and better image is essential for processing.

By using the space mouse, Chang scrolled through the seismic cube and picked several points on a reflector, mis-ties got other colors and were easy to take out. A cross correlation was applied and the horizon was made with the greatest ease.

Our visit to PGS was very interesting and fun and we were treated to a nice lunch at a Churrascaria.



SCHLUMBERGER

Thursday, March 25th 2010

After an early start and a long bus ride we arrived at Schlumbergers base in Macaé outside Rio de Janeiro. Zenobio Matos welcomed us before we started dressing up in all the necessary safety gear required for entering the base area. Due to the large size of the group it took a while before we were all ready and we were divided into two groups.

Slumberger Macaé was divided into four separate bases located in the same area with a total of twelve subdivisions or so-called segments. We got to visit two of these: Wireline and Drilling and Measurements (D&M).

Laura who has a background in chemical engineering had worked at the Schlumberger Macaé base for three months. She showed us around the wireline section with great enthusiasm. She explained how this segments was divided into smaller cells and how everyone knew what their role was i.e. some had the responsible of cleaning the tools when they arrived back from a job and some had the responsibility of looking over the electrical systems. Laura had previously worked in Angola and made some comparisons on how differently the bases around the world could be organized and how she really liked it here in Macaé since everything was organized very efficient.

Walking around on the base, we got to see some of the workers performing quality checks and trims of some equipment. We got to meet William at the electrical department showing us how samples are taken. Laura also told us about how large the request for multi dynamic tester (MDT) had been recently and that there were around twenty people working on this at the moment since it requires a lot of work due to all the attributes. We also got to see the calibration station, some seismic equipment and how they measure the tension on the cables.

After wrapping it up with Laura we walked the short distance down to the other base where we met Antonio who showed us around on the Drilling and Measurement department. Unfortunately there was some noise present under the presentation so it was somewhat hard to follow everything that was being said. He gave us a short guided tour around the base where we could see for instance a power drive, which is used for directional drilling, and an extender which is used to prevent the cable from being exposed to too much heat, which could result in the cable breaking. He also emphasized the importance of the modulator, which sends the information up to the surface.

When we were finished with the tour around the base we were served pizza and refreshments in the meeting room where we first arrived. We were supposed to have a short presentation about how Schlumberger works worldwide, but due to some time delays caused by the long bus ride and the dressing up we had to return back to Rio before it got too late.



It seems like the collective impression of the students were that it was a long and warm day, but also very interesting to get up close and personal with some of the equipment we've all been reading about for so many years.

SUBSEA7

Friday, March 26th 2010

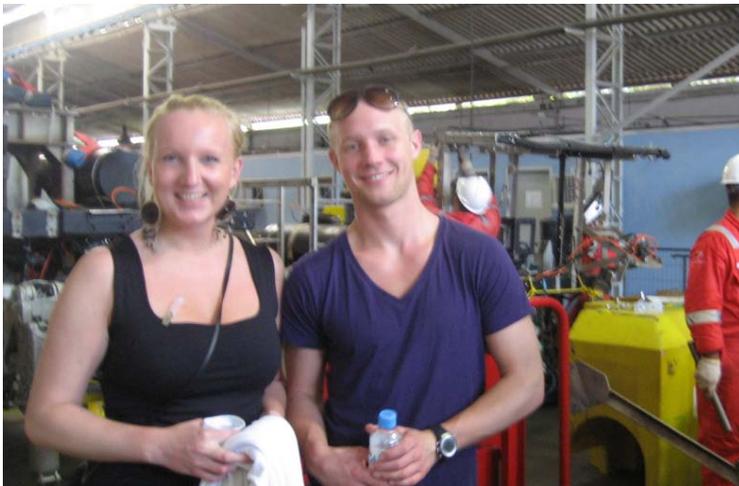


Friday morning on the 26th of March, we visited the Subsea 7 base in Niterói in Rio de Janeiro. Alexandre Salles Beilo welcomed us. Mr. Beilo and his team gave us a brief, but informative and interesting, company presentation. After some coffee and cake we got a guided tour through the workshop on the base. We got to see the cable shop and how they were working with the ROVs.

Subsea 7 is one of the world's leading engineering and construction companies servicing the oil and gas industry. The company employs 5500, working onshore and offshore around the world. There are 1040 working in Brazil, and 740 in Norway. Operations that Subsea 7 performs are mainly supported out of the North Sea, North America, Brazil, Africa and Asia Pacific. Subsea 7 has been working out of Brazil for 20 years.

Offshore, Subsea 7 has a fleet of dynamically positioned vessels capable of reeled steel and flexible pipelay, subsea construction and saturation diving, which rank amongst the largest, most modern and technically advanced fleets in the world. Subsea 7's main values are SAFE, CLEAN, SMART, FAIR and ANYWHERE. Their goal is to be the best partner in subsea projects.

The company visit on the Niterói base was interesting, and we learned about both Subsea 7 as a company and about their vessels and offshore equipment. We would like to thank Subsea 7 and the employees on the Niterói base for having us.



STATOIL

Friday, 26th 2010 and Monday, 29th 2010



Statoil welcomed us to their office in Rio de Janeiro in the Botafogo area. The petroleum students had their visit on Friday together with another group of NTNU students, Chemistry. The geology students had their visit on Monday. We were welcomed by Statoil employees in one of their auditoriums.



The view from Statoil's offices

The presentation started with an HSE (Health, Safety, Environment) introduction, where they showed the emergency exits location and introduced us to the office safety rules, etc. Afterwards we were presented to Statoil's portfolio in Brazil. This includes the Peregrino field and seven exploration licenses. Peregrino is the largest field in Brazil, and Statoil is doing the field development at this moment. Peregrino is located to the south of the Campos basin, 120 meters below the sea level and is Statoil's largest international field. We also got an introduction to the geological history of Peregrino.

Afterwards we were shown the field development plan for Peregrino. The first well will be drilled this year; the plan includes two rigs and one FPSO, 37 wells; 30 production wells for oil and 7 water injectors. In addition ESP pumps is to be installed to optimize the production. Heavy oil is to be produced from Peregrino.

At the end of the presentation we had time for questions and comments. Statoil commented what an interesting experience it is to work in Brazil, this because of a very different culture and system compared to the Norwegian. The differences did however not make any large difficulties for the company, and Statoil are ready to conquer new targets in Brazil. The plan is to be able to employ a Brazilian CEO at their Rio office.

At the end of the day we were taken to PORCAO, a Brazilian restaurant, where we ate Churrasco, Brazilian barbeque. It was a very pleasant evening, where we had the opportunity to talk to and get to know the people working in Statoil.



Dinner at Porcao

AKER SOLUTIONS

Monday, March 29th 2010



Our last company visit during our stay in Brazil was at Aker Solutions. Their Office, training facility, and workshop are situated between Rio das Ostras and Macaè, about three hours by bus from Rio de Janeiro. A big part of the operation involves manufacturing and maintenance of marine drilling risers, as well as maintenance of MH equipment used in the Aker drilling systems. They also have a local engineering staff, working on development and maintenance of drilling rig equipment and drilling risers. The third Part of the base, which is under construction, will be the state of the art training facility. The new building will house classrooms, advanced simulators, and staff.

To begin with there was an introduction about the facilities and what they did at the Rio das Ostras base. After this, there were presentations on Aker Solutions different equipment and technical solutions used for drilling rigs. We learned how their business in Brazil has expanded rapidly from a one-man operation in 1997 to about 45 people and two large bases today, and how they are still growing. This was proven in their schedule over Aker rigs in operation today, and future rigs scheduled for operation in Brazil.

An interesting point was to see how Aker deliver drilling packages to rigs owned by other companies, and also have rigs of their own. At the Rio das Ostras base most of the work was focused toward equipment and training for drill ships, and semi subs; with dynamic positioning solutions or moored systems. Most of the services performed are routine lifecycle service of equipment.



Akers customer portfolio includes large drilling companies such as Pride, Noble, Sevan, and Seadrill, to mention a few. The new training facility, which is under construction, will be used for training drilling contractors' employees to use the Aker Solution equipment and software.

After lunch the students were divided into two groups, to take a tour around the facility. This tour involved a visit to the MH storage and maintenance building, a walk through the riser manufacturing facility, and a look at the new training facility currently under construction.

We all felt it was a very interesting and rewarding visit.

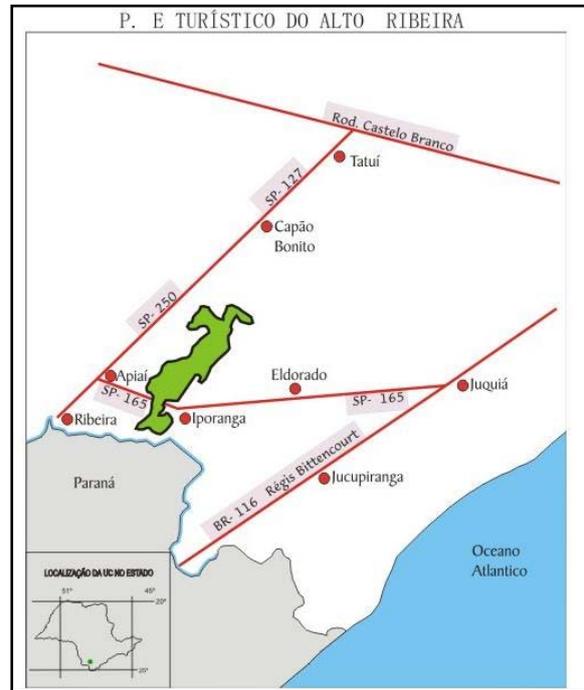
CAVE EXPEDITION IN “PETAR”, SOUTHERN BRAZIL

Friday, March 19th to Monday, March 22nd 2010

Parque Estadual Tuístico do Alto Ribeira, shortened and noted Petar, is a preserved state park located in the southern part of the São Paulo State, Brazil. See figure. The park constitutes an area of 36 000 hectares of one of the best preserved Atlantic rain forest in the world. Not only are there one of the greatest concentrations of natural limestone caves in the world; the area is highly mountainous with numerous of waterfalls, valleys, and crystal clear rivers. The flora and fauna are rich and various.

Petar represents the rich interaction between geology and biology and is extremely interesting for students and earth scientists to visit. The geological conditions prevailing there form the basis for the lush vegetation, mountainous topography and the special groundwater conditions.

The Norwegian students were met and taken good care of by the Brazilian delegation consisting of Professor Paulo Boggiani and a group of earth science students from the University of São Paulo (USP). The whole cave expedition, including accommodation, transport and guides, was organized by them. The stay at Petar lasted for two and a half day with two nights at a very idyllic hostel close to the caves. Four different caves were visited; the “Caverno do Diabolo”, “Caverna de Santana”, “Caverno do Morro Preto” and “the cave of the dirty water”. The expeditions were thrilling adventures and gave an extremely valuable geological experience.



LOCATION OF THE PARK.

The students obtained an insight in karst phenomena by directly observing its development and its behavior. The caves were several kilometers long with large caverns with span and heights of 50-100 meters. However, at other locations, the width was so small that one had to crawl in order to get further ahead. The local guides took us far into them by following the underground rivers. Sometimes it was needed to swim into it. The temperature was relatively low; 18-19 degrees Celsius, compared to an outside temperature of about 30 degrees.

The caves are also subject for intense research on paleo-climate for scientists at the University of São Paulo. The stalagmites contain well preserved archives of climatic conditions prevailing in the past. These climatic stalagmite records can be correlated and compared with glacial ice cores records from the Antarctica and with sediment cores records from around the world. Because of this, the Institute of Earth Science at USP is collaborating on climatic research with colleagues around the world; including Norwegian research institutes on Svalbard and in Tromsø. The interest for this type of research is huge and the stalagmites are valuable and important elements in climatic research.



CAJATI PHOSPHATE MINE

Monday, March 22nd 2010

On the 22nd of March 2010 the geology group visited the Cajati Phosphate Mine, which is run by Bunge Fertilizer S/A. The main product is calcium phosphate from apatite, which is used as a fertilizer. Byproducts of the production are used for cement. The income from selling the cement and magnetite helps making the mine economical. In Brazil the largest phosphate occurrences are in the carbonatite complex as opposed to the rest of the world, where the phosphate occurrences come from marine phosphorites.



During the visit we got an overlook of the open-pit mine and a presentation of the general geology along with some history. The mine opened in 1940, and until the 1970's it was driven on supergene deposits, which had approximately 20% phosphate content. From the 1970's the flotation processes had become more efficient, so hard rock mining could be started. The phosphate content of the hard rock is only 3-5%. The mine produces 450 000 tons of ore per month, which results in a concentrate production of 50 000 tons per month of 35% P_2O_5 . The mine is 150 meters deep, and lies 70 meters below sea level at the lowest.

The mine is in an alkaline ultramafic carbonatite complex, which is surrounded by the Asungi Group, consisting of diorite and mica schist. The host rock is clinopyroxenite, and the geology varies with geography, being more olivine (and magnesium)-rich in the north, and more rich on calcite in the south. A transversal fault divides the mine in two, and because of this it is possible to see breccias and cataclasites.



After a first look and short introduction, we were transported down into the pit to see the carbonatites for ourselves, and also collect interesting samples to bring home with us. The tourist bus driving down into the mine took the mineworkers by surprise, and we got a lot of strange looks as we were stuffing our pockets with rocks. After this experience we went back to the administration building, and got a tour in the mineral processing facilities. This day was maintenance day so no mills or separators were running, but still we got a fairly good idea of how the processing was done.

The main goal of the processing was to enrich the apatite concentrate from 3-5% to 35%. It starts with steel rod mills, and the magnetite present is removed by magnetic separation. The impression was that nothing were done further with the magnetite, it was just thrown away. After that, the coarse and the fines were separated by hydrocyclon, and the fines went to column flotation while the coarse went to mechanical flotation. Here the apatite rises and goes to the column flotation along with the fines, and the calcite, dolomite and phlogopite sinks and goes to cement production. Then everything is dried, and the concentrate contains 85% apatite, 30-35% P_2O_5 .

UNIVERSITY OF SÃO PAULO

Tuesday, March 23rd 2010



We were picked up by bus at the hotel and arrived early at USP. The visit at the University of Sao Paulo started with a presentation, held by the director of the geological institute. He presented the institute, and we got to know what equipment they had available, in what areas they did most research and he told us about their prospects for the future. The institute has 400 students, 63 teachers and 123 technicians. They have a lot of equipment, different laboratories and a big car fleet available. The students are divided into two different studies “mineral and techniques “and “sediment and environment geology”. In the future the institute hopes to offer subjects in English and by that make it easier for exchange students not speaking Portuguese to visit the university.

The research done on stalagmites from the “devils cave” was presented. The research is a category of climate science, where different layers in the rock represent different climate, similar to the research done on ice drill core from Greenland. Terje Malvik presented NTNU, where he submitted a wish for better contact between the two universities.

After this we visited the “Museum de Geociencia” situated on campus, where there was displayed different minerals and rock. We were happy to find our own Larvikitt in the Brazilian collection. After lunch there was a guide tour in the different labs on campus. Some were very similar to the one we know from NTNU, Los Angeles- and Mill – test. However, labs especially made for research on stalagmites were unknown to us.

A long day on the university ended with a presentation of the national dance, Capoeira, before we joined the party the Brazilian students had arranged for us. There were live music, samba dancing and traditional caipirinha.



BUDGET

| Expences | NOK | Revenue | NOK |
|----------------------------|--------------|-----------------------------------|------------|
| Plane tickets | 659440 | Student payment a 6000NOK pr pers | 438000 |
| Bus Trondheim-Gardermoen | 27300 | Faculty support a 1500 pr pers | 109500 |
| Hotel | 369 727,62 | Sponsors | 561950 |
| Bustransport in Brasil | 47225,62 | | |
| Charge 2 VISA bedriftskort | 459,58 | | |
| Sum Expences: | 1 104 152,82 | Sum Revenue: | 1109450 |

LIST OF PARTICIPANTS

STUDENTS OF PETROLEUM TECHNOLOGY AND GEOPHYSICS:

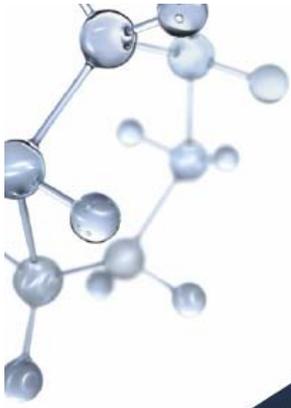
| | |
|----------------------------------|-------------------------------|
| Anders Onarheim Tonning | Kjersti Selstad Thingbø |
| Andreas Wilson | Kristin Reksterberg |
| Arild Iversen Langseth | Kristoffer Tellefsen |
| Asgeir Kristian Dahl Lien | Linn Skundberg Jensen |
| Borgarr Gerisønn Stangeland | Madelen Moore |
| Charlotte Alstad | Margrethe Stange Overå |
| Eirik Tvedt | Marit Rossing |
| Eli Langseth | Marwan Adel Hameed |
| Eline Duhs Nilsen | Nathalie Hemmingsen |
| Eline Warland | Nils Petter Wærp |
| Erik Hallberg | Ola Terjeson Miljeteig |
| Federico Estuardo Juarez Perales | Rikke Norberg |
| Gaute Håland | Sigrid Ingebjørg Hidle Kalvig |
| Halvor Holmsen Tellefsen | Stine Baardsgaard |
| Hamid Reza Arian | Susanne Nesse |
| Hilde Berg | Therese Jørgensen |
| Hilde Tveit Håland | Tollef-Ingebret Svenum |
| Iina Caroline Kristensen | Tone Hansen |
| Ingebjørg Johnsen | Torill Haaland |
| Ingve Hebnes | Torkel Ristebraaten |
| Johan Storseth | Trond Eggen Sivertsen |
| Jon Rykkelid Thunshelle | Øyvind Heskestad |
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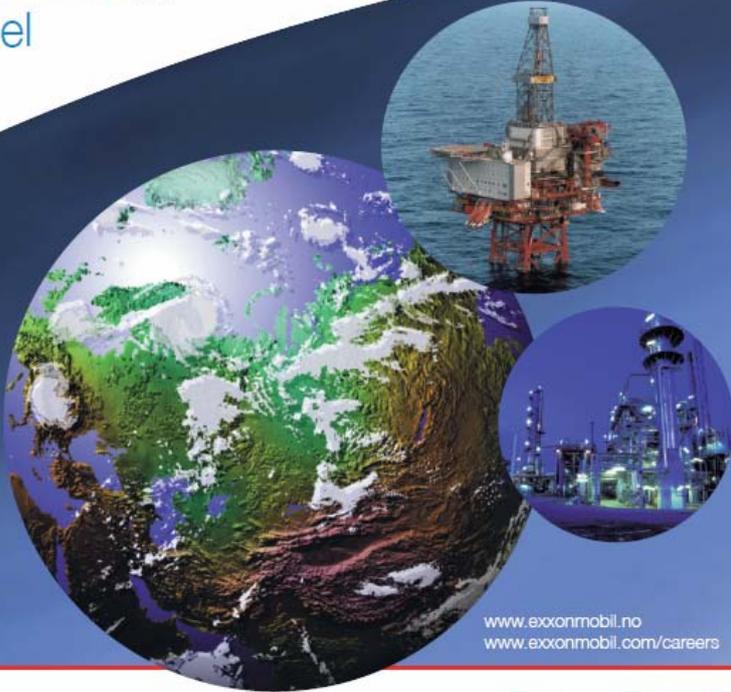


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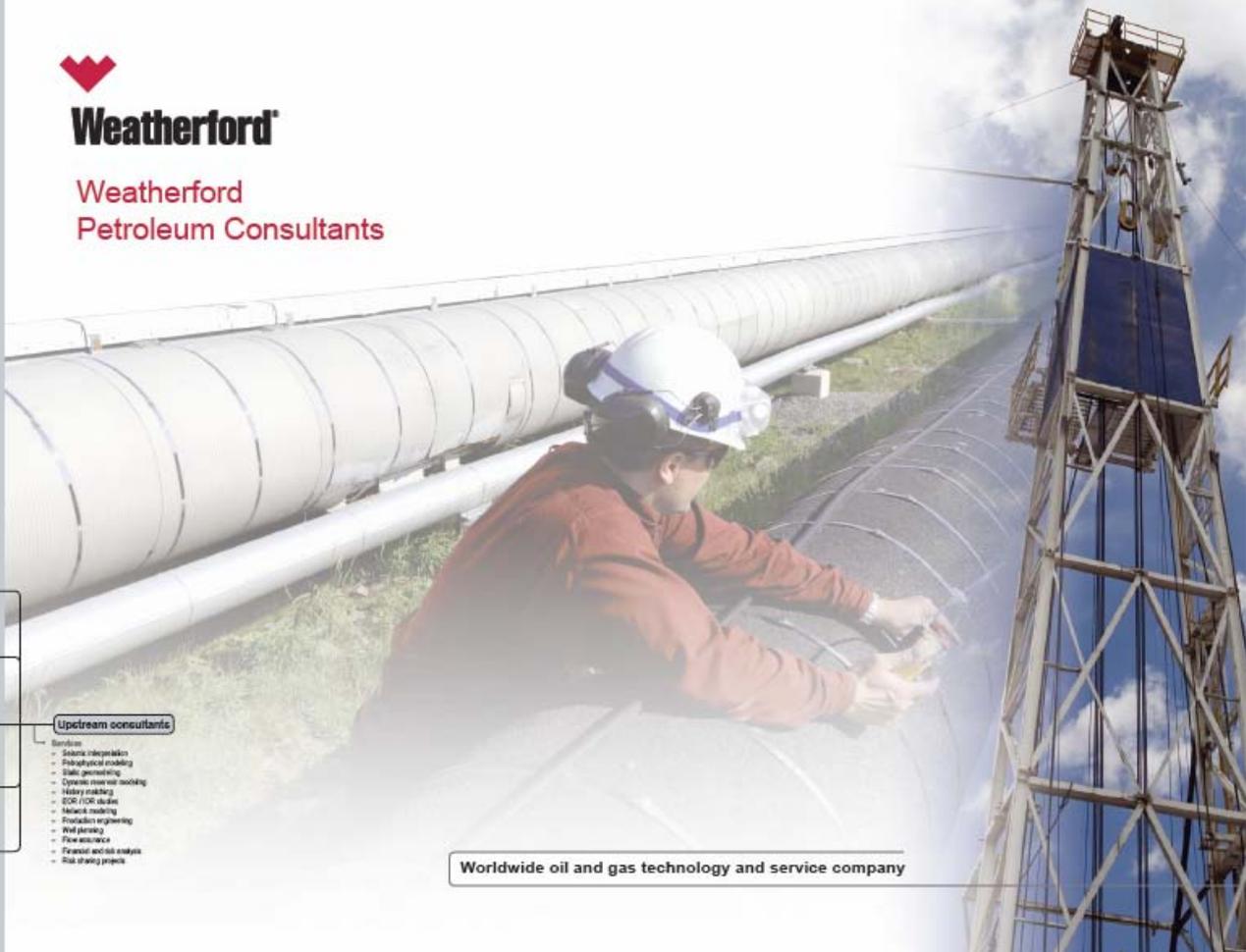
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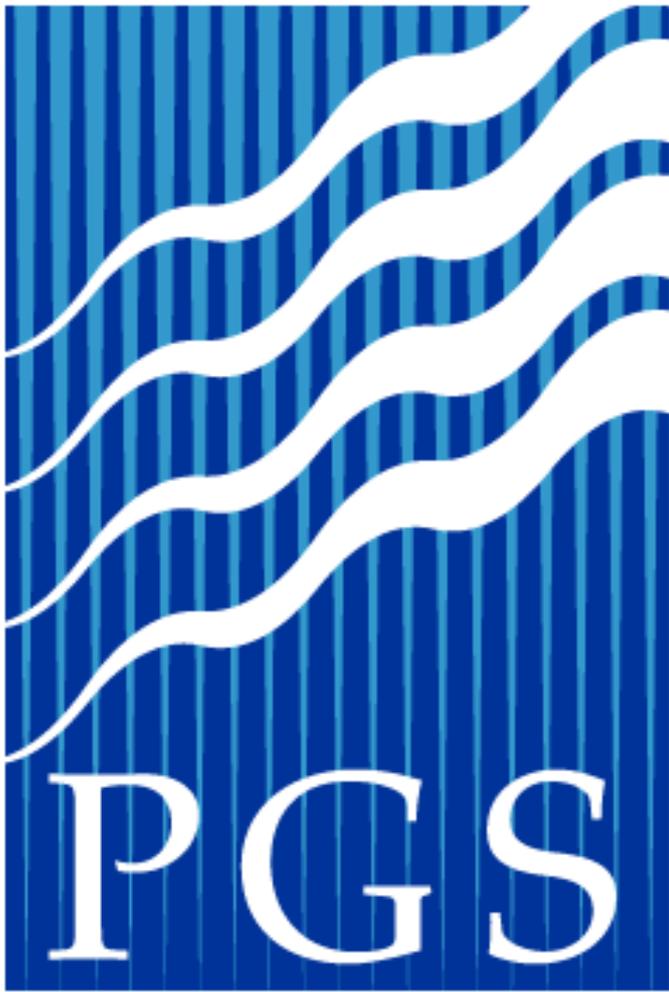
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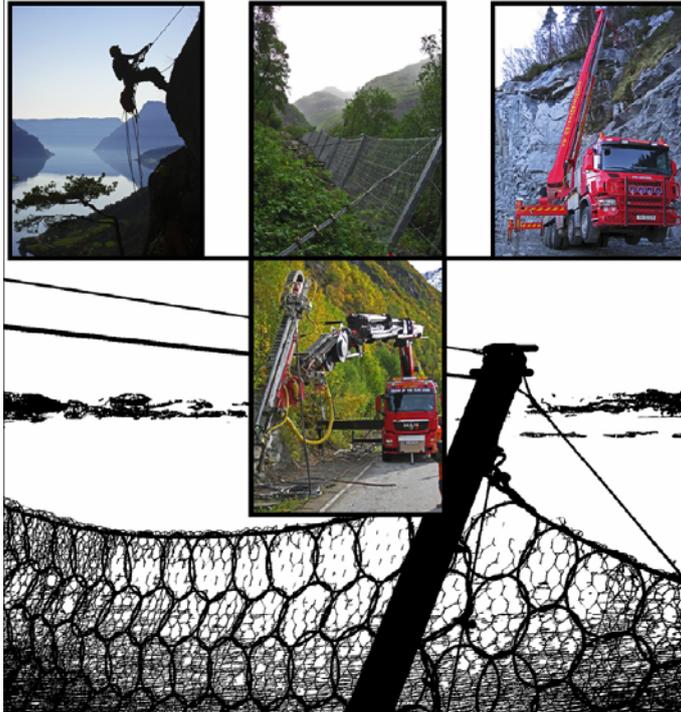


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