

Natural Resource

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Natural Resource



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Editorial

Dear reader,

Spring arrived, the days are extending, the sun shines brighter every day and the new Natural Resource is lying in front of you. So take your time, have a nice drink and take a relaxing moment to read the new Natural Resource. We have some new inspiring articles for you.

We start of with some abroad trips. Lars Gebraad wrote an article about his minor in Vancouver, Canada and Chiel Fernhout will tell you all about his internship in Kazakhstan. Renske Taylor went with two other students to Phoenix for a SME Annual Conference. She wrote an exciting article about the conference days.

Of course we also have a Phd article for you. Feven Desta wrote about sensor solutions for raw material characterization. For this edition we interviewed Jan- Dirk Jansen to get a quick run through his life in Delft, abroad and with the MV. For our periodical topic about student run organizations we have an interesting article about De Kleine Consultant, written by

Hans van Dam. De Kleine Consultant gives advice to organizations that cannot afford strategic advice of a large consultancy company.

We haven't got much response on the Weber puzzles; so don't forget to send your solutions to win the crate of beer!

On behalf of the editorial staff I want to thank all contributors for their articles and photographs.

Glück auf!

Caroline Zaal
Chief Editor

Presidential

Dear members and other readers,

The days are getting longer and it is time again to drink your Glück Auf beer in the last sunrays in front of 'het Noorden'. It is also the time for the fieldtrip season, the Master students are in the sunny Huesca at the moment and the first year students have been exploring the field on their famous first year trip. Due to the technological development, we as the board got a perfect photo report including geological jokes from their excursion in the freshmen WhatsApp group.

Although drinking is still the most favourite sport of the miners, we sometimes try to challenge ourselves with some other sports. During the Batavierenrace, a weekend long, running relay from Nijmegen to Enschede, records are probably broken. The Gluck Acht, the 8-person rowing boat with miners is training for the 'Ringvaart'. On May 11 they will row 100 kilometres in one day. You are all invited to encourage them to the finish, especially in the last stage.

Another, less exhausting but very exciting sport event is the Rally on the 30th of April. Of course I cannot say anything about the route and location, but it will be great again!

With all these nice things in mind, we might forget that sometimes, less nice things are happening. To memorialize the miners and all the others who died during the second World War, we organize a small and personal ceremony in the old Mining faculty, on the 4th of May. Please feel free to join as well for this event.

Enjoy reading the 3rd Natural Resource!

I would like to conclude with a firm and harmonious,

Glück Auf!

Floor Crispijn
President der Mijnbouwkundige Vereniging

March 31, 2016

Slow growth, production cuts, divestment expected for Europe mining sector

Europe's mineral production growth will slow as low mineral prices drive further consolidation, production cuts and divestments among metals producers, according to BMI Research's latest report. Analysts see five key themes that should be dealt with by resource companies in Europe. 1. The weak metal prices will result in further divestment of assets, output costs and bankruptcies as mining and metal companies remain under significant stress. 2. US dollar strength will influence trade dynamics. 3. The potential Brexit impacts the nation's ability to fund research to develop exploration and extraction technologies for mineral products. 4. Russia's coal output growth will be the regional outperformer due to the supportive government investment and increasing exports to Asia. 5. Greenland and Russia's rare earth sector will gain market share over the coming years.

According to the report, Russia and Greenland will gain rare earth market share as a result of continuing headwinds facing the China's industry. BMI says it expects Chinese government to tighten environmental regulations surrounding rare earth production in an effort to curb pollution.

<http://www.mining.com/slow-growth-production-cuts-divestment-expected-for-europe-mining-sector/>

March 17, 2016

Biodiesel from sugarcane more economical than soybean

A team of the Department of Energy's Advanced Research Projects Agency-Energy altered sugarcane metabolism to convert sugars into lipids, or oils, which could be used to produce biodiesel. The natural makeup of sugarcane is typically only about 0.05 percent oil. Within a year of starting the project, the team was able to boost oil production 20 times, to 1%. At the time this is written, the so-called oil-cane plants are producing 12% oil. The ultimate goal is to achieve 20%. These numbers were compared with normal sugarcane, which used to produce ethanol, and soybean. An advantage of the oil-cane is that the leftover sugars in the plant can be converted to ethanol, providing two fuel sources in one. The analysis showed that oil-cane with 20% oil in the stem, grown on under-utilized acres in the southeastern US, could replace more than two-thirds of the country's use of diesel and jet fuel. Furthermore, oil cane could achieve

this level of productivity on a fraction of the land area that would be needed for crops like soybean and canola, and it could do so on land considered unusable for food crop production. The current full production cost of biodiesel from soybean is \$4.10 per gallon. Using oil-cane the costs will be \$3.30 per gallon for 2 percent oil cane and \$2.20 per gallon for 20 percent oil cane.

<https://www.sciencedaily.com/releases/2016/03/160317151305.htm>

March 25, 2016

This country just ended its coal power production

Scotland has stopped generating electricity from coal for the first time in more than 100 years, as its Longannet power station, north of the capital Edinburgh, switched off the last of its four generating units Thursday afternoon. It was the largest power station in Europe when it went online in 1970, capable of producing 2,400 megawatt of electricity for the national grid and powering over two million homes each year. The Scottish government has outlined ambitious plans to meet 100% of its electricity needs from renewable supplies only by 2020.

<http://www.mining.com/this-country-just-ended-its-coal-power-production/>

March 17, 2016

Early Earth may have been ice cold 17 March, 2016

Many researchers believe that Earth's early oceans were very hot, reaching 80° Celsius, and that life originated in these conditions. New findings may prove the opposite to be true. Harald Furnes, Professor Emeritus at the Department of Earth Science, has analyzed volcanic and sedimentary rocks in the Barberton Greenstone Belt, South Africa. The volcanic rocks were deposited at depths of 2 to 4 kilometers.

"We have found evidence that the climate 3.5 billion years ago was a cold environment," says Furnes. as ocean temperatures are measured by analyzing the relations between oxygen isotopes in rocks known as chert. These rocks have been exposed to high temperatures. This is related to hydrothermal activities or springs of extremely hot water, pumped from the ocean bed. Additionally, the researchers found more proof indicating that these rocks had been exposed to cold water. By examining finely grained sedimentary rocks (originally a clay-like mud), that exists along with the deep-

submarine volcanic rocks, the researchers found gypsum. Gypsum is produced under high pressure and at very cold temperatures, as in the present deep ocean. In other words, we have found independent lines of evidence that the climate conditions at this time may have been quite similar to the conditions we have today," says Furnes

<https://www.sciencedaily.com/releases/2016/03/160317144620.htm>

March 24, 2016

Current oil price rally reaching its limits

Baker Hughes reported that the oil rig count actually turned positive last week, rising by one to 387 (the overall rig count declined by four to hit 476, due to the loss of five natural gas rigs). Obviously, one data point does not prove a trend, but the dramatic declines in rig counts in 2016 have slowed and basically come to a halt in March. It is too early to tell, but drillers could begin to add more rigs if oil prices rise above various breakeven points. That is not good news for oil prices.

<http://www.mining.com/web/current-oil-price-rally-reaching-its-limits/>

On my first day, I went from the office to the furnace. Walking there, especially in the control room, I saw sleeping people during working hours. Well, that was something I didn't expect. At first, it was hard not to laugh at the weirdness of sleeping for example in the control room. But in a while, you except it and discovers that it is quite the norm in most parts of the world.

Around September, I went to Kazakhstan for a 6 week internship for SMS Siemag. Maybe a bit surprisingly that most people who I spoke about it did not know where Kazakhstan is located since it is 66 times larger than the Netherlands. However, population wise it has the same size.



▲ Figure 1: The old factory originated from the Second World War

The Project

Near the city of Aktobe, NW Kazakhstan, SMS Siemag is building 4 x 72MW DC Submerged Arc Furnaces. These furnaces were built for the Kazakh company KazChrome, in order to melt fine Chromium ores into FeCr.

Kazakhstan is rich in Chromium ore deposits and it 3rd largest Chromium producer after South Africa and India. The lumpy ores are being processed in the old factory originated from the Second World War. In order to make use of the high grade fin ores this new ambitious plant is being built.

The team of metallurgists I worked with was consisted of 2, later 3, Mining Engineers from Delft and metallurgists from Slovenia, Germany, and Portugal.

The Internship

During the first 2 weeks I run along with the day shifts. They taught me all the ins and outs of the furnaces. The process was way more complex than I thought it would be. Especially operating with a furnace with a

diameter of approximately 18 meters and high power, give of course problems with temperatures.

After I got to know the place better I joint the meetings, and there were a lot of meetings. You had the morning meeting, mainly in German, the 10 o'clock meeting in Russian, and the 4 o'clock meeting

luckily for me in English, on a daily basis. The morning and 4 o'clock meetings were quite short and very informative about how the process was running and what everyone was doing.

The 10 o'clock meeting could take up quite some time from time to time. Although for me, these were the most interesting ones. Not only the technical details, but the group dynamics when you have different cultures working together and whose priorities or goals doesn't always align. The head engineer, who was leading the meetings could sometimes easily lose his temper. With a red head, slamming his fist at the table, shouting in Russian. Most of the time, our translator only could cover the summary of what he said. Only 10 minutes later he could have a smile on his face from ear to ear. He was very genuinely at showing his emotions. In the beginning of the meeting almost 20-30 people are present. From electrical engineers to operators.

After the first part only the metallurgist were present and the metallurgical aspect was discussed. How to react on disturbing parameters and how to ramp up further the furnaces. These discussion were the most difficult.



▲ Figure 2: The new factory where I worked



▲ Figure 3: Opening the taphole

You don't speak the same language, and are assisted by a non-technical educated translator. If you disagree on a technical issue, it is much harder to convince the other. And since this kind of furnace with this kind of dimensions, ore, and power is never have built before, it is not always possible to fall back on existing knowledge. These discussions could go continue for a long time, but for me were very valuable. For me this was a good way to get to know the process and mostly the distance between the ideal cases taught in textbooks and non-ideal real processes.

After 2 weeks I was assigned a research project. It was mainly concerned about the mass balance, and how to make it more accurate. Thus, extracting data from the systems and analyzing it. Because the data is not perfect and not about every aspect was data avail-



▲ Figure 4: Chiel inside the new factory

able, I had to make and question assumptions in order to make it more precise.

Alumni and the Expat Life

But how did I ended up in Kazakhstan of all places? A couple of months before, I received a mail from the SME-TMS that if you were interested, you should contact Harmen Oterdoom for an internship in Kazakhstan. Directly from the first contact on, I went all smoothly, except arranging the visa from the camping at Vesc. Harmen was very helpful through the whole process although I never met him. On the whole, my experience with my internship confirmed that for once the stories are true. Our alumni are involved with students and helping out where they can.

I arrived at my place in the morning at 7:10 AM after being picked up at the airport. From the driver I got a note that I was to be expected to be ready at 7:30 for the bus to work. However, it should have said tomorrow 7:30 AM. I was actually glad that I could go home after a couple of hours, since I got no sleep in the airplane.

The next morning I met Adriaan Scheltema Beduin and I he introduced me to most of the team and the good tradition to get diner together when somebody comes or leaves. Lucky for my, it was a quite dynamic team of metallurgists, so we went out a lot. For example, later on Stephanie Lier arrived for her first job. Besides that, you had the BBQs, bowling and other stuff with other colleagues.

During your student time in Delft, you get to meet a lot of alumni, from company visits to Barbaraborrels, but you get to know them a little and speak with them for a short time. Working together for a longer period, you hear not only the great stories about wild adventures, but also the difficulties of living as an expat. The complexity of building relations and traveling all the time. To cope with sometimes insanity of an expat life. Everything can be a bit in the extreme and it can changes your own standard and expectations.

To experience it yourself, is something that doesn't weight up against all the stories that you've been told. I became sick for a couple of days and I can tell you, that can be pretty

lonely if the only thing you can do laying on bed. All together you get a real, nuanced impression of the expat life.

Even though it has some downsides. The overall experience was overwhelming. It took me a couple of days to process everything. Something I want later on, is what I saw in the Mining Engineers. Doing a job that is so exciting that you want to do it 70 hours a week.



▲ Figure 5: Chiel enjoying some time off

Fresh meat in town

Luckily I didn't had to work 70 hours a week and had the weekends off. At work, before the weekend started, I was invited for dinner by some girls from the office. In the end, we spend the next couple of weekends or evenings together. After all, I was the fresh meat in town and I didn't mind.

It made it much easier to explore town and order food with people who actually spoke the language. I could manage most things with only knowing 5 Russian words: hello, good day, thank you, beer, and bill. Also they could keep an eye on me while we were going out. Some locals don't like foreigners and try to start a fight. They were really good in deescalating situations. A couple new colleagues didn't went out without good company, and got beaten up.

I am really glad that I got this opportunity. I would advise everyone, if you get the change, take it or just make it. The same goes for the alumni. After this internship I know metallurgy is exciting and a serious career option. Since it is not widely taught in the bachelor.

Glück Auf!

The TU Delft, and especially the Applied Earth Sciences Bachelor, gives students the option to complete 30 ECTS (half a year worth of studies) in any (academic) way they want. I already knew before ever coming to university that I wanted to learn (and in due time work) at home as well as abroad. When the option of doing an exchange was explained to all second years students, I directly thrust myself into the fray of unclear exchange policies, strange cultures and waiting for paperwork to go round.

I had initially set my sights on going to Australia, and when that didn't work out I almost didn't go anywhere. In some random AES-newsletter there was an announcement which sparked my interest again; 5 spots for CEG students at the University of British Columbia. More interesting to me than other Canadian cities, because my family lived awhile in British Columbia. But also academically interesting; they have a pretty good earth science faculty, as well as being in the top 50 of world top universities.



▲ *Figure 1: Doing our own karstic cave exploration*

UBC is a huge university. Especially compared to Delft. With well over 55,000 students it's the largest university of Vancouver (out of 3) and the oldest university in British Columbia. Although it's not a technology focused institution, they have a pretty good course selection for AES students. Along the mining and petroleum courses they offer, there's the very good faculty of Earth and Ocean Sciences, where I did most of my courses.

The campus itself is huge, but also beautiful. It's in the middle of a regional park, the University Endowment Lands, and right on the cliffs to the ocean. To the North the first peaks leading to Whistler rise up, while in the distance to the south you can see the solitary peak of Mount Baker in the US. There's a few very nice spots on campus where you get the feeling you're walking in the forest, but it also has the luxuries of good coffee and lots of study spaces.

The story of my exchange actually does not start in September, the beginning of the academic year, but in July. I flew the thirteenth

of that month for the beautiful west coast of Canada. We spent almost two months travelling with a RV through the most impressive nature I've ever seen; the Sunshine Coast north of Vancouver, the whales and bears at Vancouver Island and a good part of the American Cascades in the Evergreen State. I have to admit, the region offers more for nature-lovers than for culture freaks, but Seattle makes up for it. If you're ever that north in the US, be sure to check out all that cool stuff. I'm glad I took the time to survey the surroundings two months prior to studying. Otherwise I don't know if I'd ever seen enough of British Columbia.



▲ *Figure 2: Off course we couldn't keep ourselves out*

One of the biggest 'problems' I had was finding housing. All five students from CEG applied for on campus housing, and just as well all five of us got waitlisted. I think I was the first to register, so highest on the waitlist. I initially held spot 8546, giving a good indication of how big of a university it actually is (although students from every year apply for housing each year). I checked back in December at which spot I ended; somewhere

around 1500. This housing predicament gave some acute troubles during my first two months of travelling. Beforehand had been looking on all kinds of housing advertisers on the web, but didn't find anything suitable. From the UBC's English Language Institute came an offer to stay with a host family, normally receiving teens who want to study English. I thought that if I couldn't find any student housing, I might as well try this for the first few weeks. Cooked meals and a furnished room, great!

Big mistake! After the first night, I realized this was not the place to be spending 4 months on an exchange. Being accustomed to a student house, with student rules and student habits, this was way different. The host family was the kind that grows their veggies themselves, recycles the shower water (walking buckets to the garden) and that kind of stuff. Big on the hippy stuff, which is not necessarily a bad thing, but they were doing it to an exhausting extend. I also honestly believe the women (which was the one who was home the most) was not sound of mind, cuddling with the dog on the floor for hours and having pointless arguments with her husband late at night, as well as other unsettling quirks. I still cannot believe they let minors who do not speak English that well stay in a strange country and in such a house. I did some Craigslist research, as well as messaging some contacts also attending UBC this semester, and lo and behold; one of my Dutch housemates (Jan, Mijnbouwhuis de Teerput) was still looking for an additional student for their house. 1 Dutch guy and 3 Danish guys. So here I'm studying 7700 kilometres from home, but am still with my Delft housemate.



▲ *Figure 3: Vancouver downtown Harbour*

This, however, proved to be no problem. The three Danish guys were from DTU, Denmark's Technical University, and putting engineers together with engineers works perfectly. The house itself was a huge 100 year old wooden dump without furniture. I was the first of us to be in Vancouver, so I was tasked with scouting the place, and subsequently also spending the first night alone. It was, to say the least, a bit scary. During the day I discovered some unsettling things in the house; dolls prepped in the freezer staring out and some toenails hidden in random rooms with notes. We're still not sure if that really was the previous inhabitants or just a random prank, but it made sleeping in an empty old house on my own a whole lot more exciting.

After I was joined with the rest of the European league we hoarded a lot of furniture from the neighbours and the nearest salvation

army, making the house the perfect student place. We had a sauna, a ping-pong table, a fireplace, about 6 couches and so much space we had a few rooms empty. There was also a swimming pool, but the half meter of black grime didn't make it a very inviting thing, even for some kind of polar bear swim. The best part of the house might actually have been its state. It's planned for destruction, so we basically got the approval of our landlord to literally not give a crap about the house. We refurbished one of the handrails of a staircase as a ladder to the roof, and spent some very nice sunsets with the delicious bocht; Pabst Blue Ribbon beer.

The first months started a little bit rocky, but I guess that's part of finding your way in a new city and at a new university. You start out with a flying start; doing all your course work, exercising by swimming each other

day (that didn't make December) and doing all the exchange-stuff. By the end of September me and Jan, doing 5 courses (30 ECTS) were quite burning up. The other guys in our house were taking it slow by doing 3 courses initially (by December this would be reduced to 1 or 2) but we were saddled with even more than the local students normally did. This gave some stress for this first month, but in the end I passed all mine, and I'm pretty sure he did too.

One of the courses I did gave me something I desperately wanted out of my exchange; some more geology with of course the mandatory fieldwork, Physical and Chemical Volcanology. It was a bit like AESB's second year sedimentology, but a fourth years level course and extended with two fieldtrips. Me being the blunt instrument an engineer is as he's placed between geologist at their Ge-



▲ *Figure 4: Main Mall (on campus) in the autumn*



▲ *Figure 5: The Ocean and the Sunshine Coast from Main Mall (on campus)*



▲ *Figure 6: Snowmobiling in Whistler with Jan and other housemates*

ology section I couldn't even work a microscope, but miraculously I passed the course, while enjoying the hell out of it. One day of the field trip was ruined by torrential rain, but the other two days were characterised by beautiful vistas of volcanoes and valleys in the Pemberton area, north of Whistler. Didn't bring my Estwing for nothing!

The second course I want to highlight wouldn't have been a consideration until a professor in Delft mentioned it to me. It was a little trip to uncharted waters for me; General Relativity at the physics faculty. The course, itself not in the mandatory program for any undergraduate students, was taught pretty relaxed and loose, and really opened me up to many aspects from physics, while giving me a glimpse of some horribly complicated math (fun, right?).

The last course worth mentioning is Advanced Physics of the Earth and Other Planets. If you're a bit into science (meaning; research) or geophysics, and you have the opportunity of going to UBC, this is the must have course. You're reading the latest research while applying very basic physics to numerically (yes, with Matlab) compute the moon's trajectory, carbon feedback from deforestation or deep earth dynamics. For an applied geophysics student it was a great introduction to the non-applied branch.

We concluded with a few lectures by Paul Hoffman, a very prominent researcher specializing in snowball earth. Through this course I also got in contact with SLIM, the

Seismic Laboratory for Imaging and Modeling. Headed, of course, by a TU Delft alumnus and having some time on the biggest Matlab cluster in the world (they're pretty proud of that one).

Not all courses were as enjoyable. I think, of the five, I really enjoyed three (Volcanology, Relativity and Advanced Geophysics), and was okay with the fourth (Complex Analysis). But the last one, Groundwater Hydrology, was just plain boring. Not going to ruin too many words on it. I learned some stuff about water underground, but it's more like a small extension of soil mechanics.

In the end, the four months in my head solely allocated to studying were not wholly spent behind a desk. I think I went outside a few times (to see Spectre and The Force Awakens in Super-Mega-Awesome-Ultra 3D or something), and I vaguely remember spending Halloween roaming the streets of Vancouver in football attire, a memory not only blurred by time. Someone somewhere also obtained those flavoured Jelly Beans, which either taste pretty good or awfully bad. I think we only had the bad ones, but it made for an exciting drinking game.

My housemates even talked me into two amazing trips, both to Whistler. We went skiing in November (suck it, Alps) for a weekend with the exchange students at UBC. The

snow skiable although still a little bit meagre, but when we returned in December it was almost 2 metres. Perfect for our second trip; snowmobiling up the mountain. One of the most amazing things I've ever done, racing with +100 km/h through heaps of snow. Of course, that's the day your GoPro decides to stop working, but oh well, we don't really need to prove it to our Facebook friends do we?

I really think I benefited from this half year distance from Delft, and it might have changed me for the better. At least my family didn't recognize me when I arrived at Schiphol. I am really glad the way everything turned out for me. My housing was saved by Jan, my courses were mostly awesome, I got all my EC's and I had a huge blast. On top of that I met so many great people from around the world. If you want to read more about doing an exchange to Vancouver, from me or others, have a look at CEG's international office site. You shouldn't doubt whether or not you're going on an exchange, that choice is obvious. The hard one is where you should go, and Vancouver really makes a solid case.

Glück Auf!



▲ *Figure 7: Volcanology Fieldwork near Mount Meager*

ebn

*Wie de diepte
in gaat, moet
wat in huis
hebben*

www.ebn.nl



De Kleine Consultant is the first international non-profit strategy consultancy ran completely by students. Founded in 2008, the organization has now grown to 150 consultants spread over 3 countries. The philosophy of De Kleine Consultant is to give strategic advice to organizations that cannot afford strategic advice of a large strategy consultancy firm. During a project, each team is coached by a consultant working at one of our partners, which are all renowned large consultancy firms. The concept results in a unique win-win-win situation: students develop themselves both personally and professionally, clients are helped with strategic advice, and our partners come in contact with an ambitious group of students!

In the Netherlands, De Kleine Consultant is active in eight university cities. Each city acquires their own projects, and carries out the projects with their own project teams. Three times a year however, the new project round is kicked off with a National Weekend. In these weekends all Kleine consultants come together to enjoy two days of trainings given by our partners or third parties, to socialize with all colleagues from the other cities and to collectively dine, do drinks and stay overnight in a hotel! De Kleine Consultant gives the unique opportunity to connect with ambitious students of all disciplines, all across the country and even abroad. Besides the National Weekend, trainings at one of our strategy partners are given at regularly basis for interested Kleine Consultants. Not only does this give a valuable insight in the working atmosphere of the partners, the trainings also help to accelerate your professional growth, and of course it is nice to see your friends from other cities!

While doing a project, true impact can be seen for the company or organization the project is done. Clients are regularly very involved in the project and are happy with the objective view of independent people. Often they are very surprised by the quality that is delivered by the team of part-time working students (De Kleine Consultant on average costs around 10 to 12 hours per week). The

interaction with the client is one of the most interesting aspects, and the impact you can have really motivates you to deliver the best strategic advice for the client.

Three project rounds are ran each year, which all last 10 weeks. Each round on average three project teams are formed per city, each containing of around five consultants. While putting together the project teams, we focus on forming an interdisciplinary team that contains students with a variety of backgrounds. Since Delft obviously is a technical university, all students have a technical background. However, the mix of more creativity oriented students with more analytical minded students have proven to perform very well! Specifically in Delft De Kleine Consultant gives the opportunity to meet a group of students that have interests that are broader than only their technical study. Students at De Kleine Consultant Delft seek to develop themselves next to their technical knowledge.

At the start of each project round, so three times a year, there is the possibility to apply for joining De Kleine Consultant. A minimum of 100 ECTS is required to apply. If you are a motivated student interested in strategy consulting, and have strong analytical and social skills, please check our website or keep an eye out for the posters all around the campus to find out when application is possible!



▲ Figure 1: The boards of the eight different cities



▲ Figure 2: The team representing Delft

Interview, A quick run through the life of Jan-Dirk Jansen



▲ Figure 1: Jan Dirk Jansen at his desk as a drilling engineer in Norway

How and when were you introduced to the MV?

I studied Civil Engineering in this building. I got a degree in steel structures and offshore structures and did my final thesis for Shell in 1986. After graduation I joined Shell with an MSc degree. I started to work in collapsing offshore structures, theory of plasticity and wave forces, but around '86 the oil price collapsed, just like we see now. So expensive research and expensive oil production were reduced by Shell and therefore also the research into offshore structures was reduced. Since I just started there I was internally transferred to the department of research on drilling, where drill string mechanics, and a whole variety of vibrations that can occur, were investigated. I did theoretical work and that was so interesting that I made some publications about it, and in the end I did my PhD in mechanical engineering, while working at Shell. So I worked for 7 years in research for Shell. Then I moved more to operations.

I was transferred to Norway for two years, where I worked both in the office and offshore, I was an offshore drilling engineer. Then I moved to Nigeria where I worked for 4 years. The work in Nigeria was also operational but it also involved a lot of side-jobs that were keeping me away from technology. I decided that I wanted to go back to the technology, which brought me back to Shell in Rijswijk. From 1990 and onwards, Shell had reduced its research activity considerably

and merged it with engineering consultancy. However I wanted to do true research, so I talked to one of my former colleagues from Shell who was by then working here at this university; professor Peter Currie. Before, he had been my boss at Shell and I asked him if there would be an opportunity to do something in research here. I also spoke to Cor van Kruijsdijk who is now working part-time for Shell and part-time for the TU Delft. Back in the day he was head of the department and fulltime professor at TU Delft.

In 1999, as a result I started a 50/50 assignment. Half time at Shell and half time at TU Delft. I did that for many years. First as an assistant professor, then as associate professor. I became full professor in 2005, still working 50/50 between Shell and TU Delft. Then in 2010, I got the opportunity to go to the US for a year to Stanford University. Right at that moment I had to decide whether I was going back to Shell or if I would become a fulltime professor at a university. I decided to join TU Delft fulltime and that is where I have been since 2010.

I was thoroughly introduced by the MV when I started here in 1999. They are prominently present in the department. We were still in the old building then, the MV had a very nice room on the top floor. Gradually I got familiar with their activities. I mean, I knew them of course from when I was a student back in the day, but not very actively. I think I had been in 'Het Noorden' once or twice, but I was not really familiar with the MV. Eventually I started to go to Barbara drinks, and I went to a Barbara lecture et cetera, et cetera. Gradually your involvement grows. It is unavoidable to meet them when you join this department, which is a happy matter.

To what extent does a student association add value to the life of a student?

Ah, that question is an open door as we say in Dutch. There is a lot you have to learn in the age between, say, 18 -25, when you are at university. And only a part of that we can offer you as a university. We can train you scientifically and we can train you to take decisions under uncertainty by relying on your own judgement. We are training you to become a good engineer. But there is a lot

more that you need in life. And there is only a limited possibility for us as university teachers to teach that. A lot of it you have to find out as a student yourself by being involved in activities and interactions with others. Taking responsibility, organizing events, forming a critical opinion, being in all kind of situations where you need social skills, social interactions, dealing with other cultures, dealing with people with different opinions, dealing with people with the same opinions. I think the MV plays a great role in that whole development, and in organizing students too. Their formal reason for existence; to be a representative of the students, is of course an important task, but it is much broader than that.

What did you do besides studying and what have you learned from these experiences?

The majority of my extra curriculum activities where related to Laga in rowing, in coaching a lot, and for one year I was part of the committee, looking after the boats. All those activities have taught me a lot. I was also a member of the Delftsch Studenten Corps. I played bassoon in the orchestra, although not very well. I also was a member of the library committee. But the majority of my activities where at Laga. I rowed for just one year in Delft, even though I had also been rowing at secondary school. When I moved to Delft in my first year I decided to go and play rugby, which I really enjoyed, but I was not very talented. In my second year I therefore decided to return rowing, which was a very good decision. In my third year I had to start studying harder. The idea emerged that with coaching I could better organize my time. Although it turned out not to make a large difference time-wise, being on my bike besides the boat worked out quite well. I had a really enthusiastic young crew. I coached with a friend, and that went well. I think I continued coaching for another three to four years. In the end I coached the "Old Four" crew competing at the Varsity. I think that was one of the highlights of my Laga career. I think it has become clear that the majority of my activities were related to Laga. Of course I had other friends too and other smaller activities that we all have in our student lives.

You said you worked in Africa, what was it like over there?

It was an interesting time, I spent four years in Nigeria. I started in research, then I went to operations in Norway. In Nigeria I had several jobs starting off in drilling support and coiled-tubing drilling. I rapidly got involved in drilling waste management. Then after a short stint in a cost review team I spend most of my time in HSE (health, safety and environmental) management, which is strongly related to drilling and production. I was attached to a production station and we were working on implementing environmental management systems, ISO 14000 and EEMAS they were called. We all know that the environmental challenges in Nigeria for Shell were considerable. For many reasons it was difficult to operate there. It was very interesting, I learned a lot. Maybe not so much technically, but certainly in dealing with other people and cultures. When working in a developing country you sometimes have to deal with inefficient government and infrastructure.

But I have gotten great respect for the way that the local population struggled to make something out of their lives in sometimes very difficult circumstances.

You can not generalize with some 150 million people, but to a large extent I had very optimistic and very cheerful and humorous colleagues. I was working in a real Nigerian company there. Shell Nigeria 5000 employees and another 5000 contractors at the time I worked there. Out of these 10000 people, there were less than 1000 Westerners. My general manager was a Nigerian gentleman,

an excellent guy, who had very good education, but in the company there were also people who worked in positions without the proper education just because of their relationships. So not everything worked as efficiently as you expect here. But the most difficult part was the lack of infrastructure. Everything that you take for granted here such as waste management services, administrative systems, financial support, computer systems, telephone lines and email. It was nonexistent or not functioning well. This forces you to come up with creative solutions.

I lived in the compound with my family. My wife stopped working and joined me in Nigeria. We had two children when we came, one daughter of three and a daughter of just a half year old. My son was born in Nigeria in the local clinic. He grew up in Nigeria the first one-and-a-half years of his life. For the kids it was great, I mean with the tropical weather they could walk around in just a t-shirt in a safe environment. But when we left, my oldest daughter was 7 and then the small community already became a little bit narrow for her.

The great thing of course is that you do a lot of things together and, yes, sometimes it is difficult. Maybe a strike outside occurs and the whole compound may be blocked. Sometimes there was no food in the shops and frequently the electricity shut down or the main water supply was broken. You get creative and it brings you together. You develop friendships with a group of people that maybe otherwise you would not have met. So that was a good thing. The atmosphere

was international: There were about 100 houses in our compound. Some 20 were occupied by senior Nigerian management, 20 by Dutch families, 20 by English families and the remaining 40 by all kinds of nationalities. There was a Dutch and an English primary school.

I played field hockey there on a natural grass hockey field. Well, that was in the rainy season, in the dry season there was no grass. There was a Dutch cabaret and it was a great pleasure every year. I personally enjoyed it and made good friends. But especially work-wise I enjoyed being in Nigeria. We also had the opportunity to travel. We travelled all the way to Abuja with some families, which is the capital. Boko Haram was not existing in those days, at least I had never heard of them. Sometimes it was too unsafe to travel, but there were also times that it was OK. In general all the negative stories about Nigeria are true, I have seen some violence, I have seen crime, I have seen corruption, but that is maybe 10% of the time. The other 90% of the time we really enjoyed being there. It certainly wasn't paradise, but when I look on all the pros and cons, the pros most definitely put the cons in the shadow. We really enjoyed our time in Nigeria. I am happy that I have been there.

My recommendation to young people is to give it a try. Interestingly, also in Norway we met several people who complained, whereas we thought Norway was fantastic. If you like a little bit of outdoor life, the quality of life was excellent, the landscape was fantastic and the people were great. We really enjoyed living there and still there were people



▲ Figure 2: Community project Nigeria, the block making crew



▲ Figure 3: Canoeing in Nigeria

that complained that they did not like the facilities or God knows what. That made me realize that all the negative talk about Nigeria maybe should be taken with a grain of salt too. We decided to have a look for ourselves and I am very happy we did, because else I would not have known.

Of all the places you have lived, which was your favourite?

For Shell I spend two years in Norway, 4 years Nigeria and after that I joined the TU Delft. I spend one year with the family in California at Stanford University. That was a great experience too. My oldest daughter had just started studying mathematics in Utrecht, she stayed in Holland. The other two kids did join us, and they went to middle school and high school. For them that was a great experience. My wife could continue her work at a distance. She is at the Daniel den Hoed hospital in Rotterdam, working as a research doctor. For her it was probably the most difficult to go to the US, she missed the direct contact with her colleagues.

It was fantastic for me to be at Stanford University, because it is the top university in our field (reservoir simulation). It was great to work with high-grade people and have the freedom to pursue what you want. This was an amazing year as well. Of course we travelled around there, we went to Oregon and to the big national parks in California. We went to the Grand Canyon and several times to Los Angeles. We made several road trips too.

What are the differences between working in a company and working at a university?

In a company there is a lot more structure, at least in the company that I have worked for and a lot more focus. Here, at the university, there is more freedom to set your own course and it is required to motivate yourself. This also means that sometimes it takes effort to get things organized, because people are generally not willing to do what they are told. I quickly learned that is not the way you manage people here. You have to convince

them and see what triggers them. I think in itself that is a good idea anyway to find out what people may trigger, even in a company.

Shell of course is a really large company, so it has its own bureaucracy and in that way it is similar to the Delft University, which has its bureaucracy too. But of course it is the contact with colleagues that is the most important. The most enjoyable is when things run and goals are reached due to good interaction between people. I think there is a little bit more individuality in the university: All people do things on their own, although you see that a lot of successful research, also here, results from the interaction with others. Then of course the major difference is the presence of students in much larger quantities here than at Shell. Young people in general and the whole teaching component. Although life-long learning, learning new things and following courses is an important part of any job these days, here it is of course part of the job to teach others and to transfer knowledge, which is something you have to like, and if you enjoy it, it is fantastic to be here. That also defines the atmosphere: the presence of the activities and initiatives from students has a very positive influence on the university environment.

If you had to choose one of your prior jobs, which one would you like to do again?

Well I am very happy here, but I really enjoyed my move from the research lab in Rijswijk to Norway. Here I started working in a completely different world, the operational world. I had to work in time scales of two weeks rather than 5 years. After a while at the office I passed my drilling exams and got offshore. This again was completely different to what I was used to. But I surely enjoyed it. In addition to the drilling engineering and the logistics there, I was involved in implementing something that we had developed in the lab. It was a device to dampen vibration in drill strings, the so called soft-torque rotary control system. I had contact with a small company to implement it on the rig where I was working. It was a very interesting experience with a very cynical old drilling supervi-

sor who did not believe much in innovations. But he did give us the benefit of the doubt and we installed the dynamic system in the top drive. I think he gave us half an hour to cut the hoses and connect the whole thing. Of course when we installed it, it initially did not work. But then after some tries, it did work. It is amazing that you are able to first develop something in theory with computer simulations and a lot of analytical work. The moment we actually got it to work was fantastic. We switched it on and the vibrations just stopped. That was a powerful experience and very enjoyable one. Well that was of course just my personal joy and not necessarily related to the country. But living in Norway was a really enjoyable time and I would not mind going back there.



▲ *Figure 4: Community project Nigeria, from waste to building blocks*







In the second year the students are developing preferences of certain subjects over others. Some will have to choose their master at the end of next year. However, many have no idea what it's like to work in the different industries open to AES students. By visiting companies related to all the master tracks, the students get a perfect chance to make up their mind.

Our first stop was Fugro a geo-engineering company working in many different kinds of operations all over the world. Upon arrival we were given a presentation on the life of a Fugro-engineer and we were given a tour of their cone lab where all of Fugro's cones for soil testing get calibrated. Then we were divided into small groups and we had to do a case study on an offshore project which we had to present after having determined the equipment, planning and costs.

ESA, the European space Agency, was next on the list. We were given a presentation on the most recent projects of ESA This included earth monitoring satellites like Cryosat for glaciers, or swarm; three satellites used for measuring changes in the magnetic field of the earth. Afterwards we were given a tour through the exhibition room with a 1:1 model of the latest ESA module that was added to the ISS. We ended our visit with a 3-D virtual tour through the ISS.

The second day started off by going to NedMag, a company extracting magnesium salt from the subsurface in Groningen using salt-creep solution mining. We were given a presentation on the operations of NedMag and discussed the evolution of the underground structure and the subsidence caused by the salt mining. Next we were given a tour on their well site and we also got to see their production of magnesium salt flakes.

The next stop was a small company called medusa explorations. This company used geophysical methods to extract information from the shallow subsurface. After a presentation on the different projects Medusa is involved in, we got to drive their radio-active decay measuring quad and GPR device.

On the third day we went to an operation where the NAM is injecting excess Groningen gas into an 'empty' reservoir in Drenthe to be able to use this gas when production at Uithuizermeeden is too small. We were given a look into one of their core sample labs where a core from the field was displayed. We got to talk to experts in the field on the composition, geometry and layering within the reservoir.

Next was the traditional swimming pool in Germany. The pool offered some much needed relief and relaxation from the formal presentations and the exciting but rather busy program.

Our first stop of the fourth day was the mining museum near the salt mine. After greeting the staff with a powerful Glück Auf!, we explored the museum. The crew had numerous stories about the mine and how it was operated decades ago. Before leaving, we all sang the Steigerlied together with a former Steiger (mine manager) of the salt mine. This was the perfect ending to our visit there.

In the afternoon we visited the sigmundshalle mine from Kali und saltz. A stoping salt mine operating to a depth of nearly 1500 m. We dressed up in paper overalls and headed to the elevator shaft, but not without plenty of water to help with the extreme temperatures inside the mine. The elevator took us down to about 720 meters and here we got into vans and we were given a tour of the mine. At a depth of 1460 m, the air reached a sweat-tastic 54 degrees and the walls were more than 60 degrees Celsius! After taking a well-deserved shower we went out for dinner with the employees that gave us a tour through the mine. I must not forget that a smaller group of students joined Hans de Ruitter to a different salt mine in Borg. Both were amazing experiences.

The final day was entirely in the light of the blast furnaces along the Rhine. The company we visited gave us a nice and detailed presentation on the operations at the plant after which we visited their control-tower, sinterplant and blast furnace. The most striking thing was the immense scale of the factory and the furnaces.

Everyone learned a lot about the many possibilities AES opens for its students. The ability to get an insight into the different master tracks is amazing and really helped in forming everyone's personal preferences. Prospective second years, this is an excursion you don't want to miss!

Glück Auf!



▲ Figure 1: The group of second years that joined the second years excursion, standing in front of the HKM Blast furnaces in Duisburg

The overall aim of Real-Time-Mining is to develop a real-time framework to minimize environmental impact and maximize resource efficiency in the European raw material extraction industry. The project will carry out research and demonstration activities which integrate automated sensor based material characterization, online machine performance measurements, underground navigation and positioning, rapid and sequential resource model update and underground mining system simulation and optimization of planning decisions.

Work Package 4 (WP4) "Sensors for Material Characterization" aims to define, develop and test potential sensor combination concepts for raw material characterization to provide relevant data for real-time online process control and optimization in small scale mining applications. In the context of the WP4, the first task (WP4-Task 4.1) of the project aims to identify suitable technologies and define potential sensor combinations for different commodity styles and the considered case study mines. Achieving this goal involves the following specific objectives:

- Define the production environments in terms of expected variability and throughput rates for raw material properties
- Evaluate potential sensor solutions for material characterization
- Assess the maturity of existing technologies in terms of specification and applicability
- Define specification for sensor combinations to be developed (WP4-task 4.2)

Sensor Solutions Related to Material Properties

Fundamental understanding of material characteristics is crucial in selecting the appropriate sensor solutions for material discrimination. Material property is a broad term which addresses different properties of a certain material; these properties include physical, chemical, optical, mechanical and atomic properties (Figure 1). Of the various material properties the following will be considered for this research; texture, geochemistry, mineralogy, grade, grain size distribution (fragmentation) and hardness. The selection of these properties is solely based on their importance for updating a resource/reserve model using the sensor derived. The geological factors which are considered influence the spectral response of ore minerals or other deposit specific minerals. For example, studies showed the influence of mineralogy, geochemistry and texture for spectral response [1][2][3].

Mine Sites

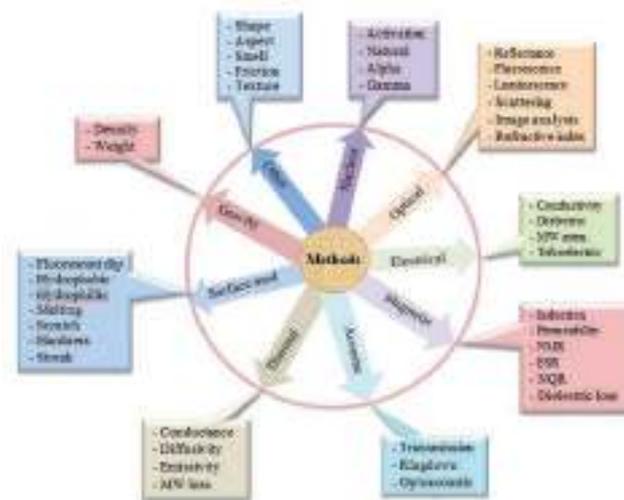
Neves-Corvo in Portugal and Reiche Zeche Freiberg in Germany are the two mine sites the study will consider.

Neves-Corvo Mine

The Neves Corvo massive sulphide deposit is part of the Iberian Pyrite Belt (IPB) discovered in 1977 [4]. It is one of the largest deposits in the IPB, with approximately 300Mt of sulphide-rich rock. Neves Corvo is currently mined for Copper, Tin and Zinc.

Freiberg Mine

The Freiberg area is the oldest mining district in the eastern part of Erzgebirge. It was mined for Silver and for Copper, Lead, Arsenic (from 1168 to 1915) and later mainly for Zinc and pyrite [5]. Due to economic factors in 1969, the mine was closed. Starting from 1976, "Reiche Zeche" and "Alte Elisabeth" shafts were reconstructed as a research and teaching mine.



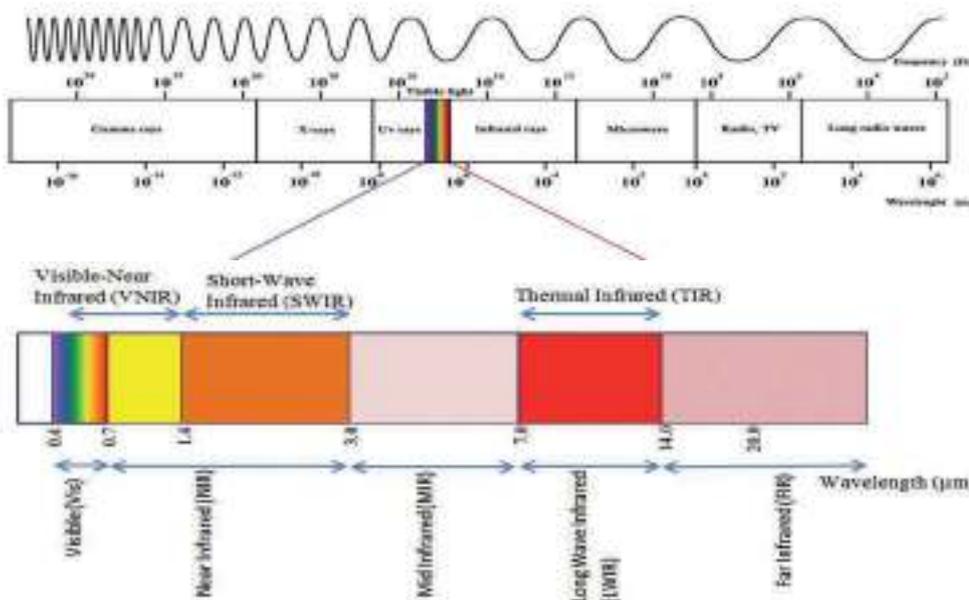
▲ Figure 1: Material Properties: Methods for Material Characterisation

Sensor Technologies

To identify suitable sensors technologies, 18 different sensors were identified and evaluated based on the applicability, technical maturity, and the different parameters of sensor. The evaluated sensor parameters include: Electromagnetic spectrum (EM) range (Figure 2), resolution (both spatial and spectral), data frequency, data volume, sensor accuracy, precision, robustness for environmental conditions (such as vibration, humidity and dust), cost and applicability of the sensor technology in the mining industry.

Taking in to account the above mentioned sensor specification parameters, technical maturity and sensors applicability for material discrimination, a SWOT analysis, detail sensor analysis table and applicability of sensor technologies for mineral and element detection were prepared (The full document is available on real time mining website).

List of the identified sensor technologies and the corresponding electromagnetic range defined for each sensor is presented on Table 1.



▲ Figure 2: a) Electromagnetic spectrum

b) Infrared range of the electromagnetic spectrum

Sensor Type	Spectral Range	Material Property/ Type of Energy transfer	Sensor Type	Spectral Range	Material Property/ Type of Energy transfer
Optical Sensor	0.4 to 0.7 µm	Reflection, Brightness, Transparency	RADIATION Spectroscopy	From UV through visible to near infra-red can be used	Scattering of radiation, Absorption
Near Wave Infra-Red (NIR) / VNIR	0.7 - 1.4 µm	Reflection, Absorption	LIDAR Technology	radio or microwave, can scale	reflection of radio waves
Short Wave Infra-Red (SWIR)	1.4 - 3 µm	Reflection, Absorption	Dual Energy X-Ray Transmission (DEXRT)	X-Ray 0.05nm - 10nm	Atomic Density / Transmission
Mid Wave Infra Red (MWIR)	3 - 7 µm	Reflection, Absorption	X-Ray Fluorescence (XRF)	X-Ray 0.01nm - 10nm	Visible Fluorescence under X-Ray, Emission, Absorption
Long Wave Infrared (LWIR)	7 - 12 µm	Reflection, Absorption, Heat conductivity, heat dispersion	X-Ray Diffraction (XRD)	X-Ray 0.01nm - 10nm	Diffraction, Emission, Absorption
Far infrared (FIR)	15nm - 7	Reflection, Absorption	Terahertz technology	30 µm - 3mm (Between Radio wave and X)	Emission
Infrared Time of flight sensors	IR	Reflection	Electromagnetic Sensor	Radio Waves / Alternating current (AC)	Conductivity
Laser Detection and Ranging (LIDAR)	UV (220 nm - 400 nm), visible (400 nm - 700 nm), and IR (700 nm - 1200 nm)	Reflection	Neutron activation analysis	gamma sensor	Emission - Excitation of neutrons
Laser Induced Breakdown Spectroscopy (LIBS)	Visible UV IR	Emission - Excitation			
Laser induced fluorescence (LIF)	UV Laser (246-255nm) / 320 - 480nm	Emission - Excitation			

▲ Table 1: The identified sensor types with respective spectral range

Overview of Some of the Sensor Technologies considered

VisNIR is insensitive to smaller particles like dust and water in the air, provides high speed of measurement, capable of detecting a wide range of minerals and it enable the determination of molecular composition of surfaces or qualitative analysis of compounds in mixtures. Some of the limitations of the technique include: it has detection limit for black materials and it is least commonly used for qualitative analysis due to matrix effect.

SWIR is rapid technique, can be used for textural and mineralogical analysis, cost effective and it is non-destructive techniques. One of the limitations of the technique: due to biased spectral response from matrix effect, it is least commonly used for quantitative analysis.

LWIR Measurements are non-destructive and independent of ambient light, insensitive to smaller particles like dust and water in the air, it provides highly repeatable analytical measurements, it has precision upto 0.05K and it works in wide range of temperature. One of the drawbacks of LWIR is camera needs robust housing and protective glass (germanium or similar) has to be clean and housing has to be water- and dustproof.

LIBS has proven to be feasible in the field measurement, it can detect all elements of the periodic table within nanoseconds to seconds and it offers highly automated facilities. High cost and complex instrumentation for creating robust system for mine conditions are some of the limitations of the technique.

RAMAN enables both qualitative and quantitative analysis, it has enriched spectral libraries so that it has a great help for identification of minerals and it has potential for in situ analysis. Some of the limitations of the technique include: detection limit (ppm level detection is not attainable) and due to weak scattering it provides the best result under complete darkness.

DE-XRT is non-surface technique so that it is unaffected by surface contamination and moisture. It can detect information about the inner composition of objects and it can be applied for sorting. The drawbacks of the technology include: Expensive (cost), it is restricted to small (<80mm) particles and cannot discriminate high density product from high density waste (it works when there is a density difference between ore and waste).

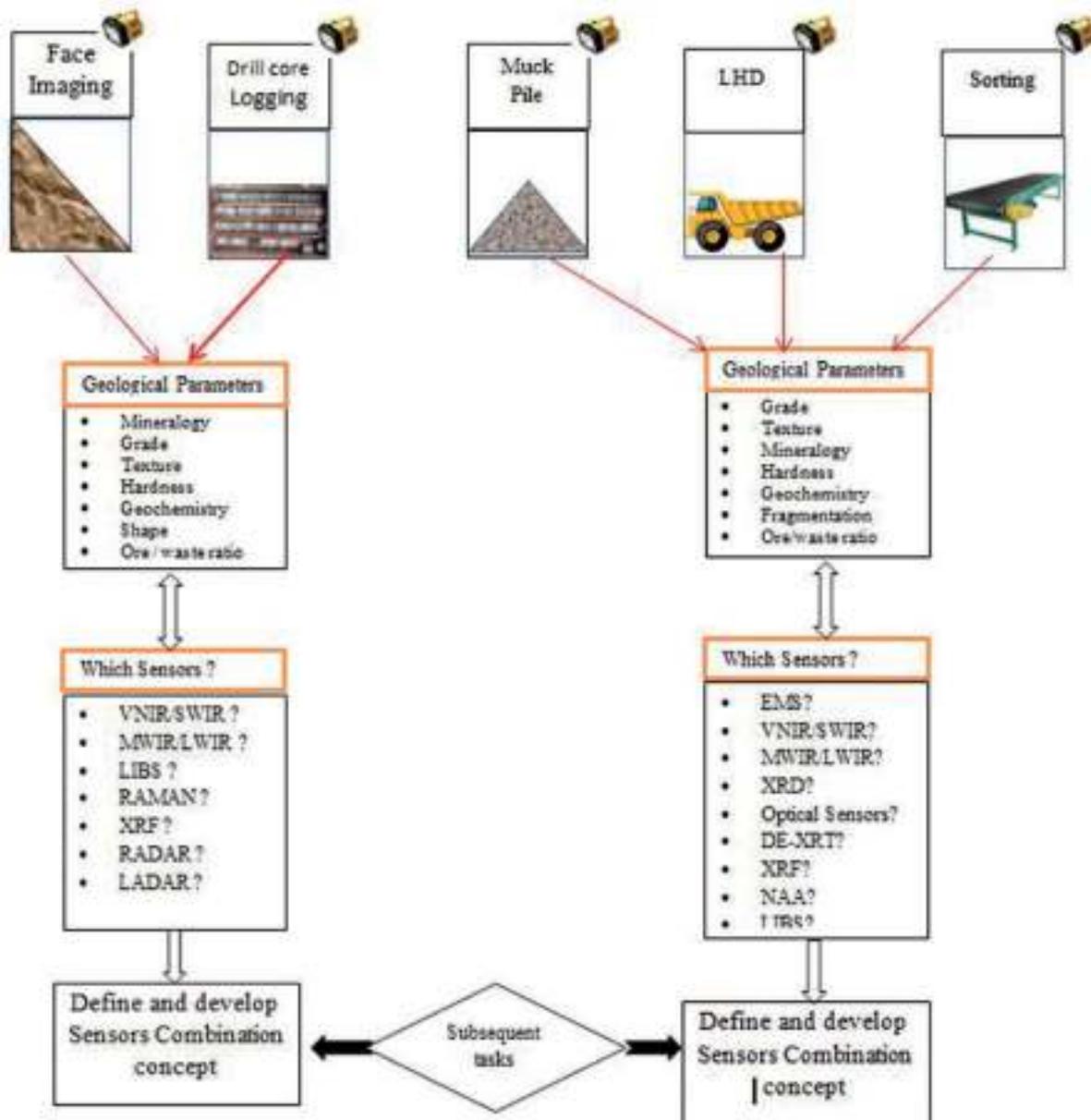
XRF enables qualitative and quantitative analysis. It can be used for identification of metal alloys and for ore grade monitoring in inactive open pit and underground mines. It has potential for sorting application. The need for high precise repositioning of the crystal and the detector is one of the limitations of XRF.

In general, IR, LIBS and LADAR are efficient for automation and they are prospective for mining application. For the identification and quantification of test mine sites minerals and elements, sensors such as VisNIR/ NIR, RAMAN, XRF and LIBS are potential technologies. Technologies such as IR, LIF, RADAR and XRD are robust for environmental conditions (temperature and humidity). Some of the sensors technologies for instance IR, LIBS and RAMAN offers μm scale spatial resolution. Sensors technologies such as IR's, XRF and LIBS are achieving a high level of technological maturity. On other hand, ToF and THz technologies are not very well-developed. Optical sensors, IR's and laser technologies are manufactured by multiple suppliers and commercial availability is not a concern. Technologies such as VisNIR, MWIR, LWIR and RAMAN are non-destructive and needs no sample preparation.

Based on the following factors:

- Advancement of the technologies
 - Capability for identifying and quantifying test mine sites typical minerals
 - Potential for in situ application and automation
 - Availability of multiple suppliers and
 - Parameters for specification
- the research will likely focus on infrared technologies, laser technologies (such as LIBS, LIF, RAMAN) and X-RAY technologies (such as XRD, DE-XRT and XRF).

Overall, applicability of sensor technology for raw material characterization is rapidly growing, and innovative advancement of the technologies is observed. However, due to economically marginal deposits, deeper mine and complex geology, there is still a need to define and develop improved technology which can address the current and future mining challenges. One of the approaches to address these challenges is to define and develop a sensor combination concept for raw material characterization and this will be the subsequent task for this project. The process flow of the undertaken and the following 6 months tasks are illustrated on Figure 3.



▲ Figure 3: . Schematic sketch to illustrate the 1st year objectives of the project. 1) Where in the mining value chain? 2) Which geological parameters and 3) Which sensor technology is potential for material characterization? 4) Define and develop sensor combination concept?

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Board Highlighted



Name: Jasper Snoeren
Age: 22
Year: 4th years AES student
Board function: Secretary

What is the most memorable moment of your year as being board of the MV?

When we went on a night out in Alkmaar, Julian and I decided to get some drinks. Julian was the one who would ask the bartender. However this took so long (the bartender had already passed him several times) that I decided to tap him on his shoulder. It turned out that he had fallen asleep on the bar. This is probably also the place to mention that our trip to South Africa was amazing! As expected Julian also fell asleep many times on this trip.

What is it like to qq the Natural Resource Committee?

It is actually very easy to qq the NRC. They do everything themselves, they get me lunch every Tuesday and they are very fun to work with. The group has different kinds of people, men and women, blonde and brown haired etcetera. Sometimes we struggle a bit with our own deadlines, but every period the Natural Resource can be found on your doorsteps!

What is something you have learned from your parents that became useful this year?

This is not something I have learned from my parents, but from a housemate. He told me, make sure that you chill enough now, when you are going to work you don't have time for it anymore. The biggest difference he said is that as a student you chill and party during the week and study in the weekend, this is switched when you are going to work.

One thing my mom told me is that I need to eat more. This is pretty good advice as I have not gained, but lost weight during this year. When I go to my parents my mom tries to compensate and gives me lots of very nice food because she worries about me.

What is the best moment of a regular day?

The one thing I like to do the most is my walk around the faculty. I start at the secretariat to get the mail (this is my favourite part). Then I go to the service desk. On my way back I usually bump into some professors. A round that in theory only takes 5 minutes usually takes half an hour or even longer. This round is also a good excuse to leave the MV if there is someone with a difficult question.

I try to do this every day, though I have to say that when I am hungover my office chair is very comfortable and hard to leave.

What kind of stuff have you done during your trip to South Africa?

When we landed we immediately hired a car. We saw lots of things around Cape Town, we stayed in four different places in nine days. We have seen lots of different animals; zebras, ostriches, monkeys and turtles. We have also swum with penguins and visited lots of beautiful beaches.

Of course the temperature was amazing, I can really get used to the 30°C every day. As it was such good weather we also went surfing. I had just left the water because the fin of my surfboard had broken, but when I wanted to enter the water again, everyone else was running out because a shark was spotted. The food in South Africa is wonderful as well, unfortunately we weren't able to attend a braai. We were invited for one, but later that

day we were called with the news that the host had to go to the hospital. The braai was cancelled.

One other thing that is very different to our country is that there are security guards everywhere. At first this is very weird, but you get used to it extremely fast.

How would you describe your fellow board members if they were candy?

Max is a 'toverbal' as it is always a surprise what his mood is. Sometimes he is freckled, sometimes he is molten. He can also be tired, very entertaining and fun or hungover.

I think Floor is best described as 'trekdrop'. She can tolerate a lot from her fellow board members without getting angry. It doesn't matter who is in the MV room asking difficult question, she will deal with it.

As Coco is very constant in actually everything, she is a banana. The taste never disappoints. If you need help very badly, Coco is the one who always bails you out.

Finally, Julian is one of those lolly pops with gum on the inside. It may take a while before you get something from him, but the stuff you get is very high quality.

Describe in 124 words a geological phenomenon that you have seen during your holiday.

One of the coolest things we have done is climbing the Loins Head. Our first plan was to climb the Table Mountain, which is the most amazing thing I have seen during our trip. However when we arrived a thick layer of fog could be seen on top. As this happens very often, it is also called the blanket. The Table Mountain is very impressive and an important characteristic for the town nearby. The layers are very clearly distinguishable. The mountain next to it, the Lions Head has not gotten its name by accident. Together with the Table Mountain it forms the body of a lion. The Table Mountain being the body. In contrast to the Table Mountain the Lions Head was very sunny.



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SME-TMS Student Chapter Delft to SME Annual Conference in Phoenix, Arizona

By Renske Taylor

On February the 17th it was time to go to Schiphol International Airport together with Thom and Douwe. As the board of the SME-TMS Student Chapter we always go to the SME Annual Conference, which was held in Phoenix, Arizona. This conference is the biggest in Northern America. We were the only European student chapter, although currently there are more non-American chapters than American, it's always a good opportunity to acquire some contacts. And because of our origin we are mostly remembered by the people we speak to.

The conference was 4 days. The first day of the opening was most interesting for students. There was a student forum by Caterpillar and in the evening we went to a student mixer of Freeport-MacMoRan. Basically this is a student and educational staff party with food, a lottery and some music. During this party we got to know some other students, especially from the University of Arizona, which is located in Tucson. We visited Tucson before the conference to have dinner with their SME board.

The second to the fourth day consisted of walking through the exhibit hall and attending some technical sessions. These technical sessions are basically presentations of 15-30 minutes by students, university staff or companies. It was very interesting to listen to the presentation given by a staff member of TU Bergakademie Freiberg.

He is doing research on "Real-Time Cost Monitoring by continuous Sensor-Based Data Collection and Transmission" together with our own university staff members Mike Buxton and Joerg Benndorf. The wandering around the exhibit hall consists mostly of talking to companies and collecting some gadgets. Every evening was closed with either another student mixer or a reception. The International Reception was given especially for non-Americans and here we got the opportunity to have a small talk with the former SME president.

The day after the conference was finished we had the opportunity to join a student field trip to the Bagdad mine of Freeport-McMoRan. We went from Phoenix with a big bus to Bagdad. Before we went our hostel owner mentioned that Bagdad is a very interesting place in the middle of nowhere. In Arizona this means: desert. Upon arrival in Bagdad we saw that he was right. This village only exists because of this big open pit mine, which extracts copper with molybdenum as a by-product. The excursion started with a safety briefing. After this we were divided in small groups to get in small buses to drive over the edge of the mine to the processing plant. From the car we could look into the pit and we passed a primary crusher on the way. The processing plant was very interesting. It was fairly new built and all the grind lines were nicely lined up. After grinding, the material goes into flotation and after this copper is leached low-grade. It was the first time for

us to see flotation cells standing outside. The molybdenum is pressure leached separately. Unfortunately, we were not allowed to enter the molybdenum plant. Outside we also saw the process of thickening and solidifying the waste so it can be dumped in the tailings pond. At the end we went to a viewpoint of the mine and we were lucky to witness a blast from there. It was a very nice excursion.

After all, we don't get to visit the US this often so we took the opportunity to be tourists the weekend before the conference. At first we went to Tucson to meet with their university's SME board. Because of former contacts with one of their students we had the opportunity to go shooting in the desert with him. One American stereotype confirmed. After this we went off for a road trip and we drove to Sedona and saw the red rocks during sunset. The day after we went from there to Grand Canyon village where we walked around and drove another way back to Sedona. After this we needed to go back to Phoenix for the conference. Although we had very little time it was definitely worth it to sit in the car for a few days and be able to see so much different landscapes: desert, canyons, snowy mountains, etc. Arizona is a beautiful state. We have seen a lot, we have learned a lot and above all we are very grateful that we had this opportunity and if any other student gets the opportunity to visit a conference like this, it is really worthwhile.



▲ Figure 1: Renske, Thom and Douwe at the Grand Canyon



▲ Figure 2: The three visiting the Bagdad mine



▲ *Figure 1: Wesley, Douwe and Pieter in front of a statue in Helsinki*

This adventure to Helsinki started right after the exams. Douwe and I traveled the next day to Helsinki. Wesley wanted to blow off some steam in Sofia first before joining us on our great adventure. We were all really excited to see Finland, Helsinki and all the company's.

So Douwe and I landed on Helsinki Airport on Friday after a quick stop in Stockholm. We had to wait for an hour because two people from Trondheim were coming the same day as well. We were picked up by the Excursion master and the Hostess of the Guild, Samuel and Jenina, one of the sweetest girls I have ever met. From the airport, we drove to Otaniemi, where the university of Aalto is situated. In Aalto we went to the guild room which is very similar to the MV-room at our university. Here we met the rest of the people joining our great adventure in Finland. There were three people from Miskolc (Hungary), two from Trondheim (Norway), two from Cambridge (UK), two from Aachen (Germany) and three guys from Mons (Belgium). It was a very diverse group but they were all really kind.

The next day, we had a day off so we played some games to get know each other a little bit better. In the evening, the legendary toga party was held where Wesley joined the group. The toga party is a party where everybody wears a sheet worn like a toga. During this party, we met some of the Finnish guys who were joining the ISW. They were

all really nice and we all had a really good laugh. Half way during the evening Teemo, the host of the guild, told us that the sauna was hot so we decided to go to the sauna. The Finnish sauna is a lot warmer than the Dutch saunas but way better so the whole group had a really good time in there.

Somewhere at the end of the evening even Hans de Ruiter joined us at the party and in the sauna. As the president of 'Het Zwemmersgilde' and with the support from Hans and a part of the ISW group, Hans and I decided that cooling down in the snow wasn't enough for us, so we decided that we wanted to swim in the sea. So that is what we did, which was a very good idea. We were instantly cooled off and ready for a second time in the sauna.

On Monday, it was time to start the serious part of the ISW. Visiting the companies. The first one was Ovako, this company produces steel bars from mainly scrap. The visit was really interesting and the whole group learned a lot about the steel industry. In the evening, we went to the lake cottage of Ovako, where dinner was served, some more games were played and a lot of mining songs were sung. Ovako also organized a quiz to test how good we paid attention during our visit. The whole group did really well on this test.

On Tuesday, the company we visited was Outotec Filters. From the name you can already tell what the company produces. Yes, filters for dewatering all kind of products. We also visited their new research lab to develop new and better filters for the dewatering industry. During this visit we learned a lot about the dewatering of project. In the evening, we went to the lake cottage from Outotex, where again dinner was served, more games were played and songs were sung. But this cottage also had a sauna, which the whole group used a lot. While we were singing a lot of songs in the sauna, a few of the employees of Outotec joined us in the sauna. They told us a lot about working at Outotec and working in the industry.

On Wednesday, we visited Outotec Turula, a half hour away from the Russian border. This is a machine shop that manufactures components, machinery, equipment and production lines according to the cus-

tomers' wishes. The visit included a tour through their workshop, here we had a good look at some very precise welding done by welding robots. After the visit, we had a very long trip in the bus from the border with Russia to Tampere, a student city in the west of Finland.

On Thursday we had our last company visit and saving the best for last, we visited Sandvik. Sandvik Mining and Construction produces equipment and helps finding solutions for mining exploration, underground mining in hard and soft formations, surface mining and bulk material handling. They also build equipment for quarrying, tunneling, demolition and recycling. It was a very nice visit, we had a tour through their workshop and we visited the test mine where Sandvik tests their new equipment. After the visit we traveled back to Otaniemi.

On Friday, the Great Miners Ball was held. During the Ball, every country brings its own specialty and gives it to the board. Delft was last but that didn't really matter because they will remember the nice Jenny from the clock. We spent the whole night partying and we didn't sleep because some of the group members were leaving the next day at 9:00. The rest of the group spent the rest of the day with sleeping and we visited the center of Helsinki which was really nice.

On Sunday, Wesley, Douwe and I flew back to Delft. Back to the normal life but with a lot of stories to tell. So if you want to hear more stories from the legendary ISW Helsinki 2016. Do not hesitate to ask us about it and we will tell you everything.



▲ *Figure 2: The international group of all ISW participants*

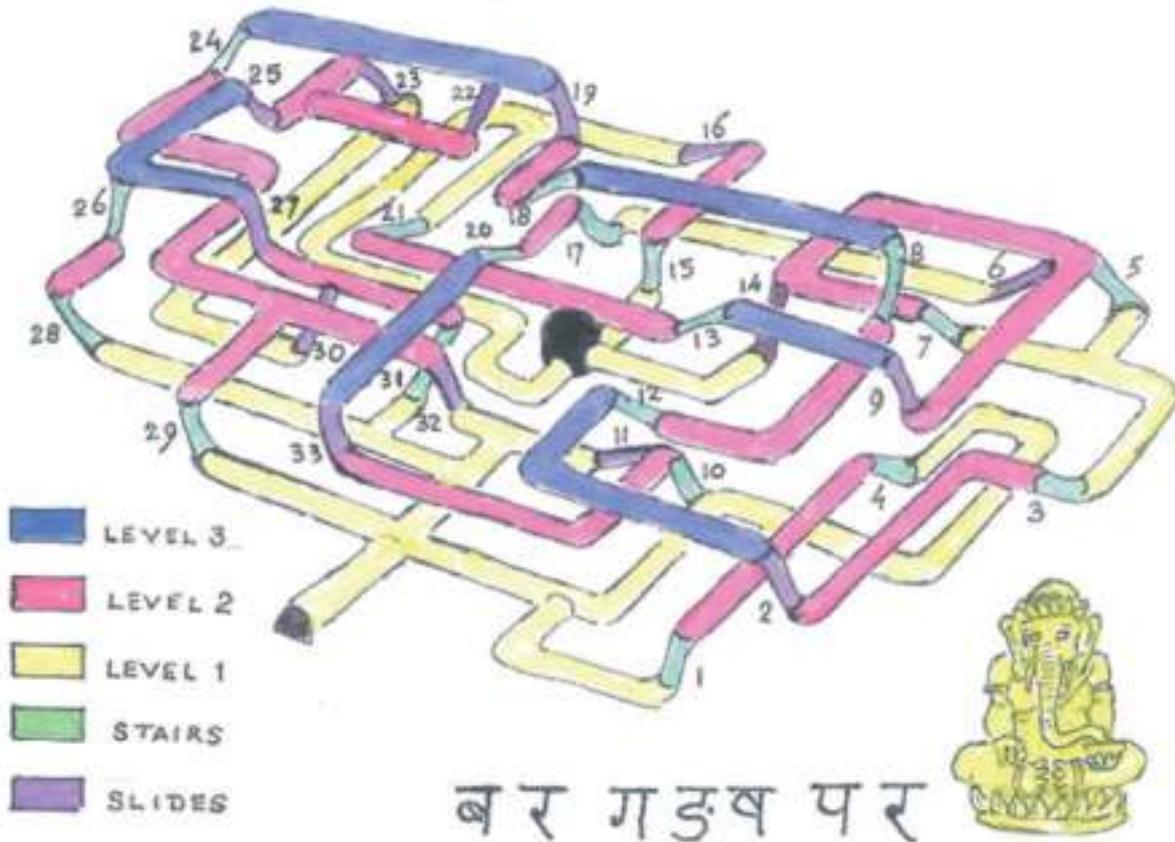
Weber Puzzle

The Puzzle of the Golden Ganesha, The Hindu God of Wisdom

On Java, A strange entrance to a tunnel was accidentally discovered recently during removal of a landslide from a hillside. An exploring party went in but soon got hopelessly lost in a kind of labyrinth.

Hearing about this event, a Dutch archaeologist remembered a puzzling ancient document found by the famous Dr. van Stein Callenfels on Bali 1919. It consisted of a diagram of a complicated tunnel system engraved on a copperplate and the text in Sanskrit. This text told that the purpose of the labyrinth was to hide a golden statue of Ganesha in such a way that it could still be worshipped. The priests, who survived the Islamic conversion of Java at the end of the 15th century, knew the way.

The labyrinth has three levels connected by 19 stairs and 14 slides. You can glide down a slide, but it is impossible to get up the very slippery slopes. Imagine that you had the opportunity to play Indiana Jones and go into retrieve the statue. What route would you use? As a solution you can send in a listing in the right order of the numbered stairs and slides you have passed to get in and even more important to get out again!



Weber Puzzle Solution

Solution of the Vintage Cars Puzzle

Here again you see the pictures of eight vehicles from factories that have stopped making cars. Under each picture you will find the name of the factory that made it.



NSU (model 'Spider' met wankelmotor)



Wolseley (model 'Six')



Bristol (model 407 uit 1962)



DKW (bouwjaar 1957)



Packard (bouwjaar 1934)



Duesenberg (model J350 uit 1929)



Panhard (model 24 CT uit 1966)



Studebaker (model 'Silver Hawk')

Graduation Subjects

Name	Date	Subject
Ahmed Al Ayesh	25 januari 2016	Optimal SAG Design in Heterogeneous Media (PE)
Nadine van Dijk	11 februari 2016	Experimental investigation to the settling and consolidation of dredged glacial till (GE)
Tom Horsten	16 maart 2016	Pipe uplift in liquefied sands: The case of induced earthquakes in the Groningen area (GE)
Tom Hijnekamp	18 april 2016	Site Investigation based on Return Flow in Horizontal Directional Drilling – Marsdiep Project (GE)

Petroleum Engineering	(PE)
Reservoir Geology	(RG)
Applied Geophysics	(AG)
Geo-Engineering	(GE)
Resource Engineering	(RE)
Delft Aardwarmte Project	(DAP)

MV Calendar

Date	Event
April 30 – May 1	Culturally
May 3	Committees event
May 4	Remembrance Day
May 5	Liberation Day
May 6	Barbaradrink
May 9	Yearbook presentation and Annual Dinner
May 10	Excel Workshop
May 11	Ringvaart with Glück 8
May 12	Velzeboerbeker
May 15 – June 3	VESC
May 19	ECTS event
June 2	Visit Nedstaal
June 3	Barbaradrink
June 13	Pieter Steeneken Golf Trophy
June 17	Bachelor Award
June 30	End of the year Barbecue

Colophon

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The greatest care has been taken in compiling this magazine. However, no responsibility can be accepted by the editorial staff for the accuracy of the information presented. Where opinion is expressed, it is that of the author and does not necessarily coincide with the opinion of the Mijnbouwkundige Vereniging or the TU Delft. No part of this publication may be reproduced or used without permission in writing from author and/or the editorial staff.

Press & Printer

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Editorial staff

Jaap van Duijn
Daniëlla Gur
Raimon van Grootel
Marije van Hell
Jasper Snoeren (QQ)
Caroline Zaal

Contact

E-mail: NaturalResource-mv@tudelft.nl

Mijnbouwkundige Vereniging

Faculty of Civil Engineering and Geosciences
Stevinweg 1, 01.120
2628 CN Delft
tel. +31 (0)15-2786039
MV@tudelft.nl
www.mv.tudelft.nl

Cover

Photo taken by: Rob Whittaker
Location: Vinicunca mountains, Peru

Centrefold

Photo taken by: Charly Torres
Location: Tungurahua, Ecuador

