Newsletter

Post-mining risk management in the Netherlands

No.24 Winter 2019-2020

Colophon

Ingeokring, founded in 1974, is the Dutch association of engineering geologists. It is the largest section of KNGMG (Royal Geological and Mining Society of The Netherlands). Ingeokring also forms the Netherlands National Group of the International Association for Engineering Geology and the Environment (IAEG).

With over 140 members working in different organisations, ranging from universities and research institutes to contractors, from consultancy firms to various governmental organizations, Ingeokring plays a vital role in the communication between engineering geologists in The Netherlands.

The objective of the Newsletter is to inform members of the Ingeokring and other interested parties about topics related to engineering geology, varying from detailed articles, book reviews and student affairs to announcements of the Ingeokring and current developments in the field of engineering geology. The Newsletter wants to make engineering geology better known by improving the understanding of the different aspects of engineering geology.

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Subscription to the Newsletter

Each member of the Ingeokring receives at least once a year a new edition of the Newsletter. Membership fee for the Ingeokring is **€18; student membership fee is €9.** Other membership alternatives can be found at:

https://www.ingeokring.nl/become-a-member/

Issue

Post-mining risk management in the Netherlands

Winter 2019-2020 (**digital issue only**)

Cover photo

Old Damage caused by coal mining

Courtesy from Hans Roest (Staatstoezicht op de Mijnen/ State Supervision of Mines)

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Table of contents

Letter from the Chairman

Siefko Slob—Chairman of Ingeokring association (Cohere consultants)

Dear Valued Ingeokring member,

In front of you is the first Newsletter from the Ingeokring in 2020. This is the first Newsletter that you receive on behalf of the new Ingeokring board. This is also the first Newsletter that you only receive in digital format. The Ingeokring has decided that it is imperative to only send it around digitally, since we are now living in a digital age. Printing does not only take much time and effort but is expensive and is harmful for the environment.

The objective of our Newsletter remains to publish articles on research and projects, so please keep providing us with interesting and high-quality materials! By sending the Newsletter in digital format, we can share our news and information more frequently with all of you. Remember that all the past (printed) issues of the Newsletter can still be found in digital format on our website.

The Ingeokring has much in store for 2020. There will be excursions, meetings and of course our annual autumn symposium will be held in November. Please note also the EuroEngeo, the 3rd European Regional conference of the IAEG that will be held in Athens in September of this year. The Ingeokring, as one of the larger national AIEG groups, actively supports this conference and will have a large presence.

Enjoy reading this newsletter and I hope to meet you at our events!

Siefko Slob

Invitation to participate in the 3rd European Regional Conference of IAEG to be held in Athens, Greece on 20 to 24 September 2020

Peter Verhoef *(representative of the IAEG in the Netherlands)*

In 2001 the International Association of Engineering Geology and the Environment (IAEG) decided to establish the European Regional IAEG Conference. The inaugural EURENGEO conference was held in 2004 in Liège, Belgium, and was jointly organized by the Belgian, Dutch and German national groups of the IAEG. The conference theme was "Professional practices and engineering geological methods". This conference was a great success and was followed four years later by the 2nd EURENGEO conference in 2008 in Madrid (theme: "Cities and their underground environment").

Now the European section of the IAEG has taken the initiative to re-activate the European regional conference, with the purpose of making this a recurrent stable event. The theme chosen for the conference is "Leading to innovative Engineering Geology practices". The main topics addressed in the conference will be: Characterisation and Behaviour of Soils and Rocks / Environmental Engineering Geology / Advances in Site Investigation for Engineering Geology / Engineering Geology for Engineering Works / Engineering Geology for Urban Environment / Analysis and Mitigation of Geo-hazards / Recent Advances in Geomatics and Remote Sensing for use in Engineering Geology / Engineering Geology and Cultural Heritage Protection / Engineering Geology for the Society. The IAEG will also hold its annual Executive Office and Council at the European conference and a meeting of the Young Engineering Geologists group is planned as well as meetings of the IAEG's Technical Committee Sessions.

The Ingeokring board fully supports this initiative and helps preparing this conference. We like to draw your attention to this event that puts focus on European methods and practices in our field of expertise. To endorse your participation and encouraging sharing of recent work, contributions are invited in the form of extended abstracts. You are invited to prepare extended abstract(s) of your contribution before the end of April 2020.
Further details can be found on the website of the conference: http://euroengeo2020.org/
We are looking forward to seeing you in Athens!

Athens (Greece). Three itinerary excursion options are available during the event: 1 day, 2 days or 3 days. Transfers by plane, bus and boat

Ingeokring Summer Excursion to the Palatinate region (Germany)

Siefko Slob *(Cohere consultants, Amersfoort, the Netherlands)*

On Saturday 7 and Sunday 8 September 2019, the Ingeokring organised a summer excursion to the Palatinate region in Germany. The Palatinate (in German: Pfalz) is known for its rich history and beautiful scenery. More importantly, the geology is very interesting and there has been extensive mining for gemstones in the past and currently there is mining for construction materials.

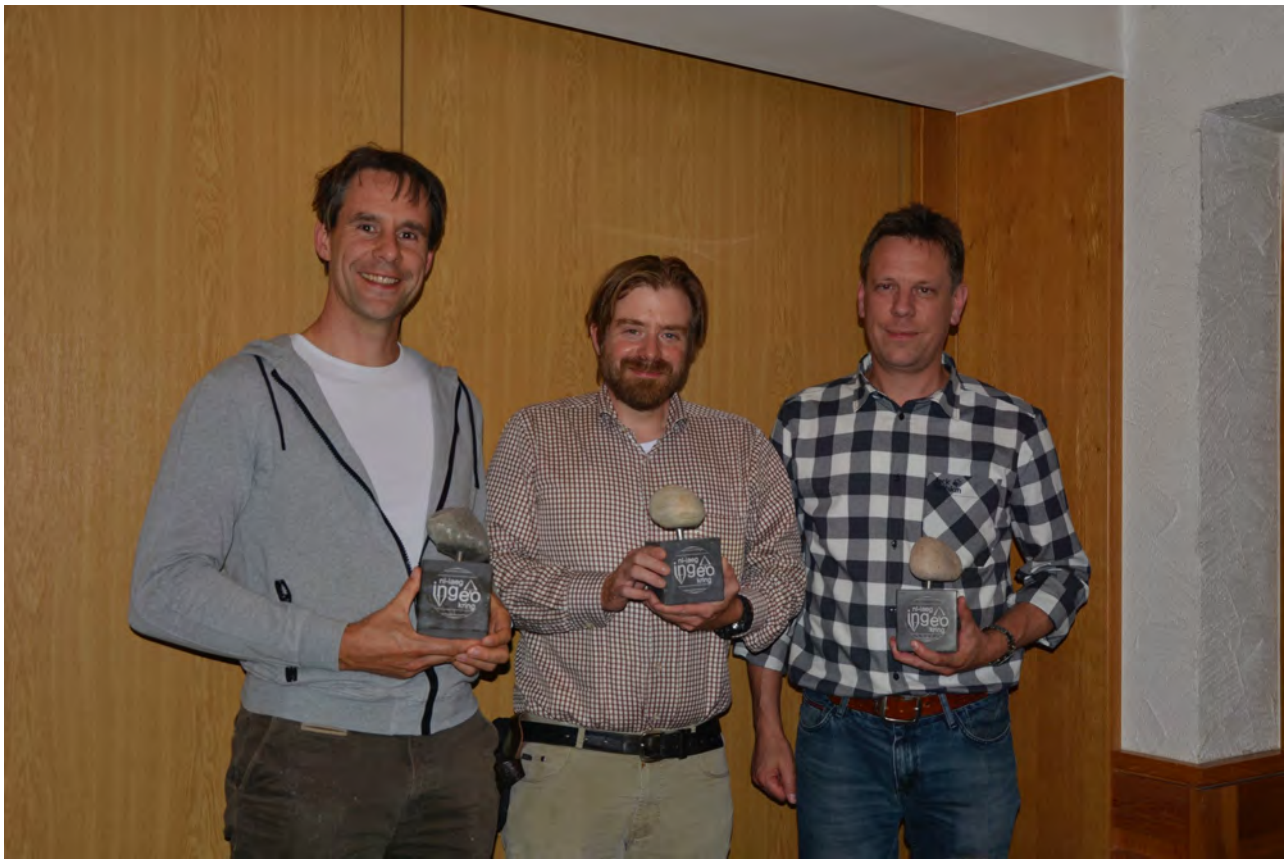
The excursion started on Saturday with lunch with a great view. Here we met with our guide for the afternoon, Dr. Sebastian Voigt, who is director at the Geoskop museum. After lunch we went to visit the quarry at Remigiusberg. The quarry is used to mine aggregates. The source for the aggregates is a micro-diorite intrusion into shales and sandstones from the Rotliegend. Although the shales and sandstones are not useful as construction material, they contain extensive amounts of fossils. During the Rotliegend period (late Carboniferous, middle Permian) the area was at the centre of Saar-Nahe basin. Due to sea level variations the area was intermittently immersed (forming a shallow sea) and changed into a tidal flat and shoreline environment.

During the early Permian, the first sea-creatures started to change into land-dwelling animals. For paleontologist this is a very important evolutionary phase. The Remigiusberg quarry is therefore a paleontologist's heaven. Especially after the discovery by Dr. Voigt of a complete fossil of a Tetrapod, a crocodile-like creature. Although fossils of Tetrapods have been found all over the world, this is the only location that a complete intact and undisturbed fossil was preserved.

After the (very wet) quarry visit, the excursion continued to the Geoskop museum, where we had a very interesting private tour and we could look at the original and very rare Tetrapod fossil. They were still in the meticulous process of extracting the fossil from the surrounding shales in which it was encapsulated.

Dinner was at the hotel Reweschnier where the

Panoramic view of the Remigiusberg quarry, one of the points of interest visited during the summer excursion in Pfalz, Germany.



The previous Ingeokring board, from left to right: Milcar Vijbrief, Robrecht Schmitz and Robert Vuurens.

participants stayed. During dinner, the previous board of the Ingeokring (Robrecht Schmitz, Milcar Vijlbrief and Robert Vuurens) was present. The new Ingeokring board took the opportunity to thank the old board for their tremendous effort during the past years and especially Robrecht for organising this Summer Excursion.

On Sunday the excursion went to the underground Gemstone mine/museum Steinkaulenberg at Idar Oberstein. This historic area has been extensively mined in the past for gemstones like agates, amethysts and jaspers. There have also been mining for copper, barium sulphate and cinnabar. The rich mineral deposits are associated with volcanic activity (lava effusions) during the early and late Permian. In the visited mine in Steinkaulenberg the typical rock type is referred to as Latite-Andesite. Almond-shaped gas chambers are present in the lave flows, where the crystals could develop, forming spectacular geodes.

In all, a very successful and interesting excursion. The excursion showed aspects of geology (paleontology and gemology) that may not have a direct professional importance to engineering geologists but demonstrated that geology is highly diverse and certainly very stimulating.

St. Barbara Stollen entrance with some Ingeokring members joining the excursion.

IAEG activities report 2018

Peter Verhoef, *IAEG representative for the Netherlands (Delft University of Technology)*

August 25th, 2018 – Visit to Bad Bentheim, Germany for a hands-on rock mass classification training.

Dr Helmut Bock, who has been a very active chairman of the German National Group of IAEG welcomed the group in the Sandstone Museum in Bad Bentheim. First, Helmut introduced the stratigraphy, palaeography and engineering geology of the famous Bentheim sandstone and led the group around the Sandstone Museum to inspect several sandstone outcrops, masonry walls and prominent buildings. Then, Dr Robert Hack presented the Slope Stability Probability Classification (SSPC) System and initiated the group to the acquisition of the SSPC parameters in the Gildhause quarry near Bad Bentheim.

October 16th 2018- Visit by Dr Vasilis Marinos, the vice-president of IAEG, president of the European Group

Vasilis Marinos, the newly elected vice-president of IAEG took the opportunity to visit the Netherlands to meet with the Ingeokring board. He presented his plans to stimulate the activities of the European National groups of IAEG at the European and international levels. At the occasion, Vasilis gave a well-attended lecture on landslides and pipelines at TU Delft.

November 23rd, 2018 - The yearly Autumn Ingeokring symposium:
A tribute to Peter Verhoef: Engineering Geology as an eye-opener for Civil Engineering.

The lectures presented during the very well attended symposium were on invitation by Peter Verhoef, on the occasion of his retirement from practice. He invited previous students and colleagues to talk about subjects he dealt with in his career. Peter has been active as a lecturer and associate professor of Engineering Geology at TU Delft from 1982 to 2002 and as an engineering geologist for the marine contractor Boskalis from 2002 to 2018.

Effect of high hyperbaric pressure on rock cutting process by Mario Alvarez Grima

Offshore geotechnical site investigations for the Fehmarnbelt Fixed Link Project by Erik Schoute & Jordy Mollé

The enigma's in the current practice of geotechnical modelling by François Matthijssen

Dewatering design and engineering for a near-shore deep excavation – Case study of Duqm Port, Oman by Buu-Long Nguyen

Ground improvement – from an engineering geological perspective by Jeroen Dijkstra

Ground investigation and armour rock supply for the Material Offloading Facility on Barrow Island by Peter Verhoef & Robert Vuurens

The presentations can be found on the website: https://www.ingeokring.nl/2018-ingeokring-autumn-symposium-a-tribute-to-peter-verhoef-engineering-geology-as-an-eye-opener-for-civil-engineering-update/

The bi-annual Professor Price Prize for outstanding contributions to the field of Engineering Geology in The Netherlands was awarded to Dr. Peter N.W. Verhoef for his contributions to education and research in Engineering Geology in the Netherlands.

Dr. Robert Hack (TU Twente) explaining the SSPC system to the participants in the Gildehaus quarry.

The 2019 Ingeokring autumn on Management of Post-Coal Mining in Limburg

Dr. ir. Dominique Ngan-Tillard *(Board member & representative ISRM, Delft, the Netherlands)*

Following the very successful 2018 symposium celebrating Peter Verhoef's contribution to the profession of engineering geology in the Netherlands, the 2019 Ingeokring autumn symposium scored yet another great reception. The symposium was dedicated to the management of post-coal mining in Limburg and it was the first ever symposium devoted to the topic in the Netherlands according to one expert in the field.

More than 50 participants, coming from different horizons (universities, consultancies, contractors, ministries) and with various backgrounds (engineering geology, but also mining engineering, petroleum engineering and remote sensing), attended. Four keynote speakers, Hans Roest (Staatstoezicht op de Mijnen), Johannes Klünker (Ingenieursbüro Heitfeld-Schetelig GmbH), Jaap Spaans (Informatiecentrum Nazorg Steenkoolwinning) and Frank Denys (Energie en Klimaat, Ministerie van Economische Zaken en Klimaat) delivered very well prepared, very informative talks.

Hans Roest explained the legacy of coal mining in Limburg and Johannes Klünker detailed how to deal with post-mining-hazards, from theoretical approach to practical remediation. Jaap Spaans introduced the newly formed Regional Information Centre and Frank Denys presented the administrative aspects of aftercare of coal mining in Limburg. The lectures were found to complement each other with the right amount of overlap for interesting interaction. Hans Roest, a man with a vision and a mission regarding managing post-mining risks, whether related to coal or salt mining, gas or water extraction, had personally orchestrated the technical content of the symposium. On behalf of the Ingeokring board, we want to express our warmthanks to Hans.

The symposium allowed a lively discussion on risk identification and prevention activities to ensure the safety of decommissioned coal mining sites in Limburg between the audience and the four experts. To widen the discussion and further engage the audience, the Ingeokring board innovated with a "Dino versus Greenie" debate between Karl-Heinz Wolf and Alex Daniilidis, both TU Delft, on the statement "We have learned from coal mining and gas extraction, we are ready for the decommissioning of geothermal installations" and proposed a fun interactive quiz. The event closed with the traditional after symposium drinks.

If you missed the symposium or want to (re-)visit its content, you can read the slides of the four speakers on the Ingeokring website or the summaries of the speeches in this Newsletter, prepared by Shlagha Thapa and Rinse Jan Jonker, two TU Delft students. Thank you to them and to the speakers for kindly reviewing the summaries. Thank you also to Andrey Rudanets and William Munsterman for the photos.

Hoping you will enjoy the reading and looking forward to the 2020 symposium!

Picture of the speakers presenting at the Ingeokring autumn symposium 2019.

The Legacy of coal mining in Limburg

Ir. J.P.A. (Hans) Roest *(Staatstoezicht op de Mijnen/State Supervision of Mines, The Netherlands)*

In his talk, Mr. Hans Roest has shared valuable lessons with the audience about the mining cycle in the Netherlands, from pre- to post-mining.

In the cross-border area (the Netherlands & Germany), Carboniferous coal can be found at reasonable depths and even at the surface. It is here that since 1113 AD, the coal mining started in the Netherlands. At first, the mines were nothing more than 'simple' adits (ditches), straight horizontal shafts into the hillside of the river Wurm valley. However, it did not take long before around this valley vertical mine shafts were excavated and problems with inflowing water did arise. The 'Pumpenkunst' (an ingenious mine dewatering machine) was invented to help solving this problem.
A booming industry sprung forth around the wealth of the coal mines with large industrial complexes and new problems started to arise. The excavation of huge volumes of coal caused deformations of overlying strata and subsidence at the surface. Mining of several layers of coal took place "like taking out the layers of cream from a cake". Large deformations started to become visible at the surface, as so-called 'surface steps' due to the cumulative effects. Sinkholes did sometimes occur as voids migrated to the surface (often aided by the presence of water). However, damage to buildings was often quickly repaired and not much of this history is still visible.
The last coal mine in the Netherlands closed in 1974 and the official period of aftercare in the Netherlands began. Slowly it became clear that this aftercare would not be such an easy task. A major example was the formation of a sinkhole at 't Loon, a shopping centre in Heerlen, in December 2011. For many years, signs of an ongoing phenomena were already visible a.o. at 't Loon's outer façade, and they just needed to be interpreted properly.
In Limburg, especially around Kerkrade, there are still large areas with increased risk. In some areas in Limburg, old 'surface steps' (zones of extension caused by differential subsidence) seem to cause some building damage. Furthermore, there are still some (very) old mine shafts, abandoned in an unsatisfactory way, from which the locations are not (yet) exactly known. To localize these, much effort was spent on combining old mining maps and integrating them into one georeferenced system (GIS). The 'GS-ZL study', a huge research project, was carried out in 2017 (more about that in another talk) and other investigations are still ongoing.
In general, most of SodM's (State Supervision of Mines) research focuses on risk management. Management of different types of risks requires an approach with defined risk levels, different types of monitoring systems and appropriate response actions. The central question is: Who does what and when? (at which risk level).

Mr. Roest concluded his talk by emphasizing that mining is a cycle in which the post-mining stage is expected to be the longest stage. It is important to realize that mining aftercare might never stop! A systematic approach should be implemented to organize appropriate actions in order to deal with our mining legacy in a proper way. More attention should be paid to early signals of settlement. Moreover, we need to make our current activities future-proof. "Safety by design!"

Ir. J.P.A. (Hans) Roest

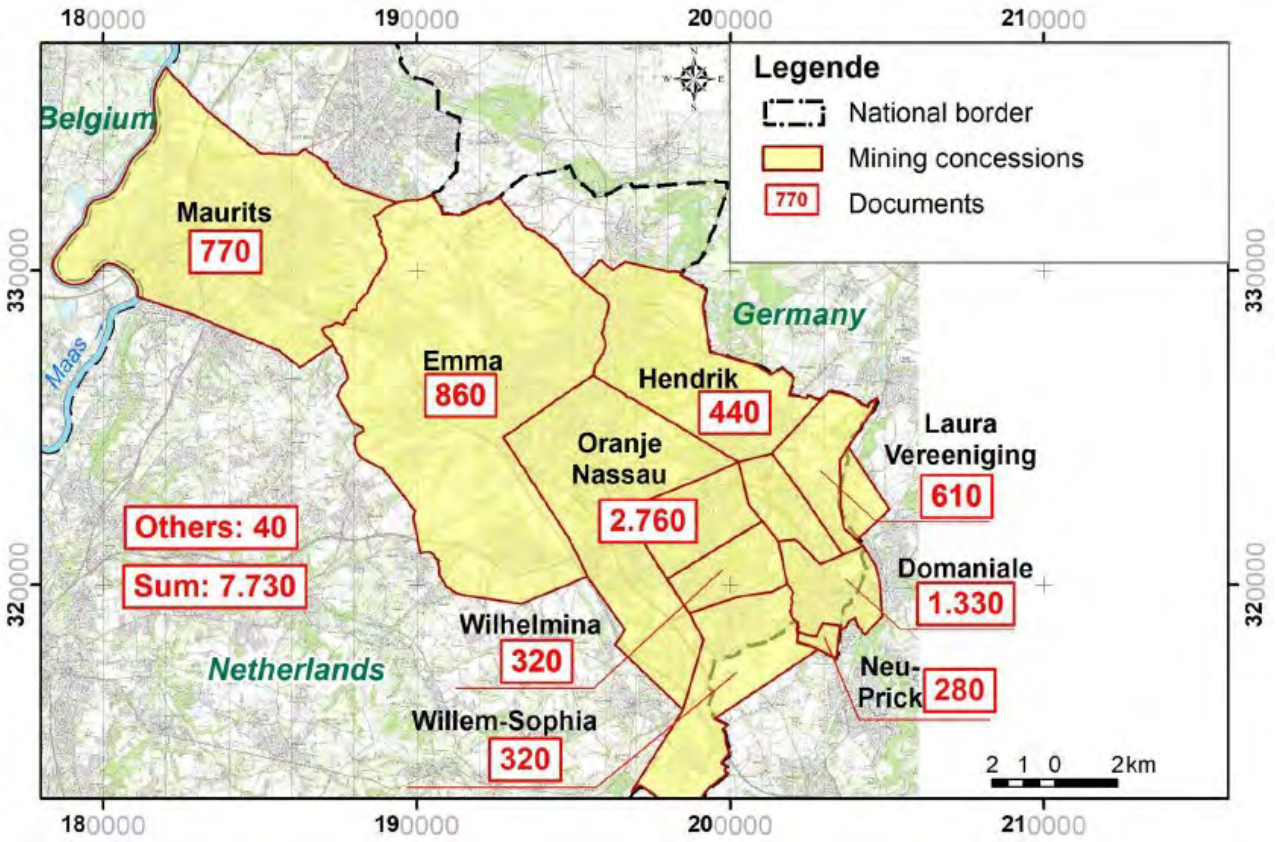
Dealing with post-mining hazards - from theoretical approach to practical remediation

Dr. Johannes Klünker *(Ingenieursbro Heit feld-Schetelig (HIS) GmbH, Achen, Germany)*

Dr. Klünker began his talk on post-mining hazards by dividing the hazards: First there are two large groups of hazards: those who are dependent on the mine water rise and those who are not dependent like mine shafts and mine voids, as had been done in the GS-ZL study. Mine shafts were further categorised as historical or industrial shafts.

The South Limburg mining areas could be divided into 3 categories; historical, industrial shallow and industrial deep mining areas. The historical mining area is characterized by the absence of accurate documents such that nearly no documents exist for the shafts in this area. There are a few maps that show a rough position of the shafts but mostly without any information about dimension or depth. Across the German border some of these old shafts were found in dangerous conditions. To reduce the post-mining hazard in Limburg, all the mining maps available were used to locate old shafts and then place them in hazard maps where the red dot shows the most probable position of the shaft and the black circle around it shows the accuracy of the position (area of about 20m radius). Light red area marks the shaft protection zone at ground surface which might be affected if the shaft was to collapse. 59 shafts were identified and mapped. For historical near surface mining, the excavations reached very close to the top of the Carboniferous. A geologic tectonic approach was taken for these excavations to compensate for the lack of available maps. For each coal seam the outcrop line at the top of the Carboniferous was constructed, mapped and then classified into impact categories: low, medium and high potential for impact. With respect to historical mines, Dr. Klünker mentioned that awareness needs to be raised especially amongst people working in the field and that there should be a management structure that is working with the current risks and aims at the prevention of new risks. For the shafts, active remediation was proposed whereas for near-surface mining, it was discussed that pre-active measures were not really effective. This is because the outcrop lines range over many miles and the proportion of an area where a failure might occur is very small in comparison.

For industrial mine shafts, these shafts were sunken to large depths (several 100 meters) using modern tech-



Collected documents after dire consequences of coal mining South Limburg

niques and when the shafts were closed, a safety system was installed to enable the conditions of the shaft. These shafts are deep so only a few shafts were constructed to get access to the whole area as opposed to the less deep historical shafts. All 39 of these industrial shafts were checked and compared to the safety regulations that are applied actually in the NRW mining areas of today. These shafts were also classified into impact categories: medium and low impact category. Most industrial shafts were in the low impact category and six in the medium category. A map of position and impact categories was made. Next, the shafts in the medium impact category needed further investigation while for the remaining constant monitoring was sufficient. To make a hazard map for post-mining hazards of industrial mines, all the available documents were checked for situations where the mining came between 20 or less meter to the top of the Carboniferous. Then, each of these risky areas were mapped with a safety margin of 10m on both sides and then a 45 degrees angle was drawn through the overburden to create the area with potential for impact on ground surface. A special case was taken into account after the sinkhole at Het Loon. The case at Het Loon was studied and was found out to have a triangle-shaped mining area below which is suspected to be one of the causes of the sinkhole. Thus all the mining documents were checked for a similar mining pattern and 26 such situations were located. These situations were labelled into higher impact categories: high and medium including a safety margin of 10m on both sides. Dr. Klünker also showed a map of the South Limburg mining area and noted that most of the area was in white colour with no impact category with a few low impact areas (blue) and hardly any high impact or medium impact areas (red or yellow).

Another feature of mines which were mapped out was the upward drillings which were made for the safety of the mine workers. These drills were quite small; about 4 cm in diameter and were closed with wooden plugs. However, it was suspected that there might be a problem with inflowing water somewhere. 7250 of these upward drillings were mapped in GIS.

When dealing with old shafts, it is important to start with a detailed georeferencing system with old maps with respect to the topography. Next, is to be able to work with cheap investigation methods such as small hammer driving and inclined hammer driving to find the shafts. Once shafts are found, then larger scale methods such as inclined core drilling can be used to study the shafts. From studies it can be decided if something needs to be done in the shafts such as partially refilling the shaft with cohesive materials. This can be done by creating a shear plug as there is in the industrial shafts or putting a reinforced concrete slab on the top of the Carboniferous, then putting a clay sealing against degassing and finally refilling the excavation. Another remediation method is to stabilise the filling of the shaft by injecting a water/cement-suspension.

Next, Dr. Klünker went over to a few case studies; the remediation of the DOM-27 and 28 shafts. One of the obstacles was that it was difficult to reach the shafts as they were really close to existing buildings. The DOM-28 shaft was remediated by injecting a water/cement suspension step-by-step each half meter into the shaft. Altogether nearly 80 tons of cement were injected into the poorly backfilled shaft. The effect of this is that the bulk density of the material increases and creates a 3D network of cement veins in the shaft. Both these effects stabilise the shaft. For safety, the area near the building was monitored all throughout the work.

Shaft remediation by refilling with cohesive material (including clay).

The last subject Dr. Klünker went over was the results of investigations at a sinkhole that appeared in spring 2019 in Kerkrade. This sinkhole appeared in a location where a lot of electricity, gas and water cables were passing through and could potentially affect the supply of these amenities for consumers. Therefore, immediate action was taken to refill the sinkhole and investigation ensued a few months later. Due to all the cables running through, the investigation had to be carried out from a distance. From the desk study it was seen that below the sinkhole area there was a crossing of two mining galleries, one of them was dipping at 26 degrees. After georeferencing the map of galleries, it was determined that the sinkhole had formed right at the crossing of the galleries and also an upward drilling was made at the corner of the crossing. This led the team to believe that the sinkhole might be a mining related damage. Further studies were carried out and by core drilling tertiary sand was found inside the gallery. The interpretation was made that at some point in time the gallery must have collapsed, thus making way for the tertiary sand to enter the gallery. A scientific proof for this interpretation was found by doing a sieve analysis to verify that it was the same sand as the one from the layer above the Carboniferous.

Dr. Klünker ended his speech by telling the audience that the study on the sinkhole is ongoing and requires further investigations.

The regional information centre

Ir. Jaap Spaans *(Kragten, Informatie centrum nazorg steenkoolwinning, The Netherlands)*

The third talk of the symposium was by Mr. Jaap Spaans from Kragten. His talk was a scoop about the regional information centre (only 2 months old on 15 November 2019). In his talk Mr. Spaans talked about the reason for the centre's existence, what the centre does, and for whom.

The beautiful landscape of Limburg hides its mining history well. Arguably too well. It is difficult to raise awareness for mining related problems when it's hardly visible. Take the problem of subsidence for example, only when you know where to look you can recognize how just one story of a once tall three story home looks over a channel next to the house, the rest sunken beneath it since 1932. In fact, much of the history has already been removed from the landscape entirely.

In the Netherlands, unlike e.g. France or Great Britain, the responsibility for enduring post-mining related problems like ground subsidence are not very well regulated. All old mining companies are long gone and their successors (if any) don't recognize liability. Furthermore, with more than 30 years of time between the closure of the last mine in the Netherlands and the present the legal limitation of all damage claims has also already expired. Only for severe damage is there a calamity fund available. The advice from abroad is as follows: Establish a centre of expertise!

And so after 50 years there is finally an urgency to start with an information centre. Possibly 50, 100 or even 150 years of aftercare are still in our future. The centre has already achieved a lot in the past two months: A new Monitoring Risk Warning System (MRSS) pilot is being put into place right now and will be evaluated in 2020 for the first time. Ground subsidence is now being monitored on three different levels (regional, local and strain on infrastructure and buildings). Additionally, there has also been a concern of groundwater contamination for a while in which mine water from Carboniferous layers will possibly intermingle with groundwater from Cretaceous formations (which are used for drinking water extraction). The industry may only extract natural groundwater, but when is groundwater not natural anymore? (New answer: when chloride and sulphate are added). There were no places left to measure the old water levels as all old mine shafts had been previously backfilled. So, last year 7 new drillings were made to measure the rising water levels in old mines. However, new protocols and warning systems still need to be designed.

The goal of the regional centre as it currently stands is to support the responsible authorities (province, municipalities) with their risk management. It is important to note that the centre is not as of yet open to the public. The politics are very concerned with all outgoing communication and want to avoid any panic. A small expert team is responsible for new data collection, management, monitoring and safeguarding.

Jaap Spaans finished his talk with a small summary about the future of the information centre and the long road yet to travel. Lastly, he emphasised that "The future of mining is aftercare."

Jaap Spaans answering questions at the 2019 Ingeokring symposium

Administrative aspects of aftercare of coal mining in Limburg

Ir. Frank Denys *(Ministerie van Economische Zaken en Klimaat, the Netherlands)*

Mr. Frank Denys begins his speech by talking about the history of coal mining in Limburg and then continues by describing the involvement of the state in mining. This involvement can be tracked all the way back to the French mining law (1810) which was also used by the Dutch and only replaced on the 1st of January 2003. This law gave the state the ownership of the mines discovered within the state. With this law, King Willem 1 started state involvement in the mines.

Over time, more foreign investors who were interested in investing in the mining business started to buy licenses from the state. The state then sold the concessions and thus, started to lose control over the mining industry. That is why the state decided to get involved and found the state company Staatsmijnen. The cooperation with the catholic church created a so called "one-package deal" which made it possible to organize the society in Limburg and focus on the coalmining.

Ir. Frank Denys during his lecture at the 2019 Ingeokring symposium.

In the 1920's, news articles about mining damage started appearing. For example in 1922, the Delftse Courant made an article about a lot of mining-related damage and the repairs that Staatsmijnen was doing. For example, there was a lot of subsidence in the middle of roads. An article also mentioned how the owners of houses were powerless to do anything because in the Netherlands there were no rules for refunds of mining damage. The minister of infrastructure and public management at that time was worried about the condition of bridges, railway tracks and pollution. With all this awareness building up, in 1932, measures were taken in order to resolve the mining related claims faster.

After the second world war, the Netherlands needed a lot of energy for their reconstruction works, putting coal in high demand. This triggered a lot of near surface mining in Limburg, which in turn led to 42000 cases of damages within a five year period according to a newspaper at that time. One of the solutions suggested was to fill up the mines with stones, however, this method would have been too expensive. An important Dutch phrase from that time was "De Limburger klaagt niet" which means the Limburger does not complain. This phrase relates to the "one-package deal" between church and state providing jobs for the Limburgers within the designed society.

In 1965 it was discovered that coal mining was no longer profitable because imported coal from open pit mines was much cheaper. As a result the socialist party announced the closure of the coal mines which were then phased out between 1966 and 1974. The actual coal mining stopped 1974. Some of the German mines near Kerkrade were kept dry by continuing the pumping of the minewater using a Dutch shaft. This has led to discussion on the 30 years limitation period for mining damages. For example: 'When exactly does the 30 years start?', 'Who should be responsible?'. These questions are difficult to answer and have been researched and documented in reports.

The state retreated from Limburg. A large restructure program was set up. Many miners were left jobless despite the promise of new jobs. The new jobs were mainly office jobs which were not suitable for miners. By 1990, the big restructure program had ended. The state had sold its shares and stopped its involvement with the mining at South Limburg.

Today damages related to the coalmining are still occurring. Since 2009 about 80 cases were reported. The post mining damage is far less than the damages that occurred during the mining period. Never the less authorities should be aware of the risks that exist and should have proper mitigating and response systems in place. The ministry of Economic Affairs and Climate and the local authorities are working together to provide information and set up a system that takes care of future damages.

Debate - “Dino” versus “Greenie”

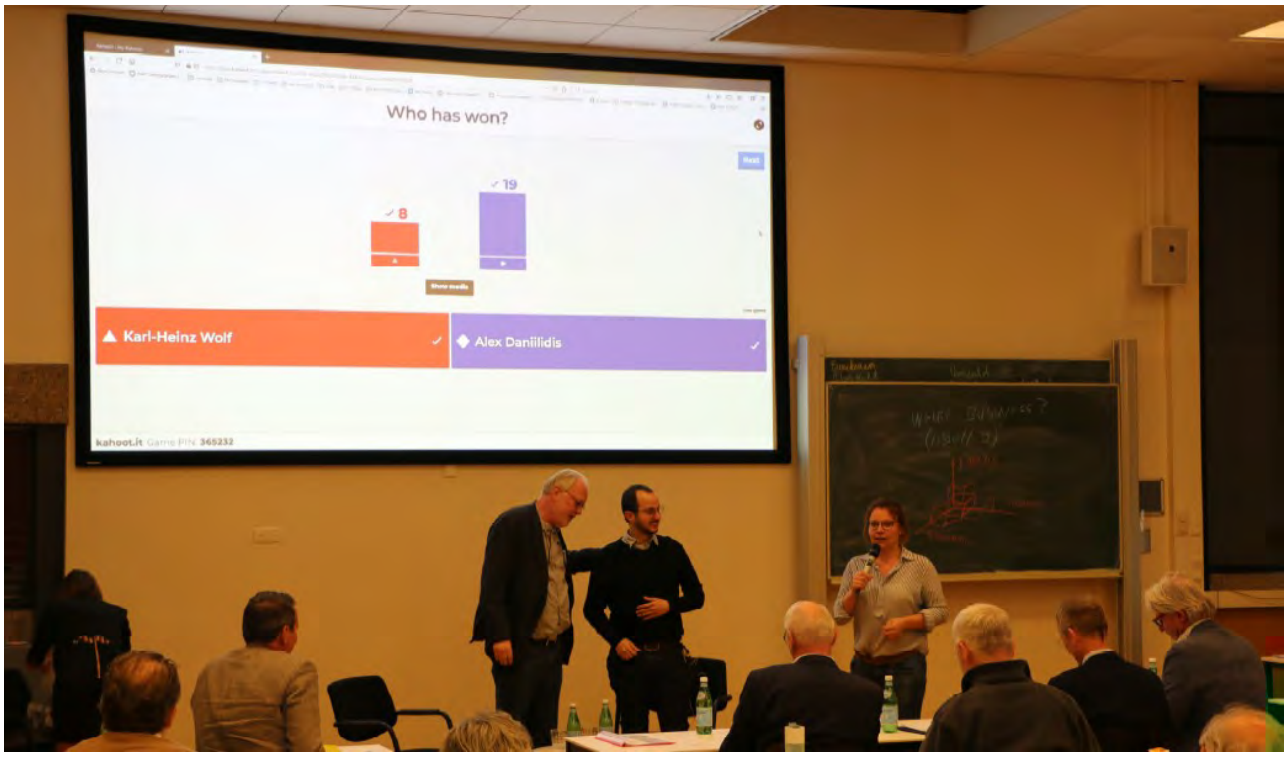
Proposition: We have learned from coal mining and gas extraction. We are ready for decommissioning of geothermal installations.

As affirmative debater we had Dr. Karl Heinz Wolf, who is an associate professor of geophysics in the department of Geosciences in TU Delft and will be known as ‘Dino’ in this debate. Meanwhile, as negative debater we had Alex Daniilidis who is a post-doc researcher in the field of geothermal energy and will be known as Greenie in this debate.

Dino: We have a lot of experience and information about decommissioning. We know of the troubles related to decommissioning, such as those in Limburg and also those in Groningen. However, we also have the mining law which lasts for 30 years. Within the 30 years, you should be able to clean up. Normally, there are one or more partner companies who put effort to clean it up. A lot of money has already gone to the decommissioning process, so after 30 years, society should take over the responsibility. Even more, within 30 years there is a public loss of history so it will be difficult from a technical point of view and public perception to keep the responsibility purely up to the government.

Greenie: I think that today we’ve heard a lot of examples of information that we can use from previous experiences but we cannot really say that we will be problem free. We still have problems that persist in coal mining, gas extraction and even salt mining. So even though a lot of knowledge is there, we are not ready for geothermal. This has to do with the fact that geothermal processes are very new and we don’t have so much experience to be able to identify all the problems relating to geothermal. Especially regarding the temperature difference. With regards to the legislation, problems might occur before the 30 year period but there is a grey zone as to who should pick up the liability if a problem was to occur after the 30 year period. Lastly, currently it is the interest of the Dutch geothermal association to come up with an abandonment plan for geothermal so this highlights the fact that not everything is in place yet. Also sufficient funding is needed to allow research to be done in the field.

Dino: Geothermal has relation to drillings that have been done a lot in the Netherlands and it is not a very difficult thing to do. It is similar to deep exploration of oil and gas; high pressures, high temperatures,



Final result of the debate according to the public attending the 2019 Ingeokring Sympusium.

toxic material and water. With respect to funding, the same situation is also there in exploration and they are able to generate funds for the whole process from the beginning of exploration to decommissioning so why should it be different for geothermal? Another thing to take into account is when do you expect a geothermal installation to stop working? That also gives us a lot of time to work it out. There might be alternative ways to reuse the wells or to prevent any disaster. The liability in 30 years will be much lower than is expected now. Lastly, for geothermal as with all other mining activities, you are responsible to have an aftercare of 30 years which is quite a long time and should be enough. Things can always go wrong and sometimes there are people who do things they should not… (discussion leader: time is up!)

Greenie: Indeed geothermal is different from gas extraction as we are introducing different temperatures in the subsurface. Recently it has been shown that the temperature effects on geochemical properties of rocks are more significant than we originally thought. This could be something that is not clear in the early stages of exploration but it might be a topic that comes back in the future that might not yet be recognised. This is similar to what happened with previous subsurface resource projects that were abandoned after the project period. After they were abandoned, they were found out to be valuable resources for alternative uses or for collaborating existing understanding of the subsurface. This is due to our changing of perception and advancement of our understanding over time. Prematurely abandoning a well might cause us to be unable to use the well to its maximum potential. This is something that should first be studied under the national umbrella to add to how this should be handled and for future uses.

That was the points discussed in the debate, it was followed by a few rounds of questions from the audience after.

Q1: For Dino. Is it a good idea to have a good look at the problems we have with gas leaks. As geothermal will also face the same problems for example due to corrosion. Should we not first solve the mistakes we have with gas before we are ready with geothermal?
A: Its always good to do research. But it also has to do with who is making these claims and who has control over the situation. For example, not doing the research or aftercare for the activities carried out. So it is no problem to do extra work but keep in mind that there is a lot of work already done so use that information well.

Q2: Question about shallow geothermal energy. It is important to save the rooftop between chalk and Carboniferous but there is no legislation and control on this. So this is what I see as a problem in the practice of shallow geothermal energy and I would like both of you to comment on it.
Greenie: For shallow geothermal, the way to counter this would be to be proactive to disallow such things to happen by adjusting the legislation for licensing. Then closer monitoring.

The audience voted for Greenie as the winner of the debate.

Abstracts from Geo-Engineering MSc thesis candidates for the best thesis award 2019

Liquefaction-induced slope instability in relation to pile installation

MSc Pascale Lamens

In 2017 I graduated from TU Delft on the topic of liquefaction-induced slope instability in relation to pile installation. This was very much a sand-focused study. These days, I am dealing mostly with clay! Since graduating I have worked on the construction of the first polder of South-East Asia in Singapore, as part of the design and engineering team of a joint venture between Boskalis and a Japanese marine and civil engineering company. Important geotechnical engineering tasks lie in the design of the build-up of the reclamation fill, and that of the subsequent soil improvement. Marine clay dominates the region's Quaternary deposits, and although it has found previous application as reclamation fill material, its high water content and low shear strength pose a unique set of challenges. Another key aspect of the polder project is the construction of a dike surrounding the fill area and a drainage system to keep the polder dry. The overarching goal of finding a way to tackle land scarcity and rising sea levels, together with the dynamic international setting, give extra value to the engineering work.

Working abroad: “Desert drilling”

Ir. Robert Vuurens *- Deputy General Manager Gulf Laboratories*

Dear fellow engineering geologists. I recently returned to the desert country of Qatar. After many years in project management roles for large projects in infrastructure, marine and mining industries I never thought I would go back to managing site investigations. Gulf Laboratories is the leading geotechnical drilling and laboratory services provider in Qatar. We primarily conduct site investigations for construction projects, but also do geophysics for archeological sites, geological mapping and mineral exploration. The laboratory business expanded from geotechnical and construction material testing to include chemical, water, oil, and even food analyses.

Although managing the business is my main responsibility, I fortunately do get opportunities to go out to and look at some rocks! So last week I found myself driving through the southeastern part of Qatar. This area, known as Khor Al Udaid, is a relatively unspoiled sandy desert. It consists of typical barchan dunes with low lying sabkha areas in between. These areas can get flooded at high tides or after heavy rains. The dune sand (mainly quartz) has been carried here from its source in Saudi Arabia by the predominantly northwestern winds. It is now one of the few places on earth where dunes are migrating into the sea. Since sea levels started rising about 8.000 years ago and Qatar became a peninsula, the dunes do not get replenished and it has been calculated they may disappear entirely in a few hundred years.

Anyway, the reason for driving down here is not to drill in dunes. We have been tasked by our client, a major O&G operator, to core the upper sections of the Eocene Rus formation, up to a depth of 150m. Although Qatar’s oil and gas reservoir are around 3.000 m deep, petroleum geologists here are also interested in shallower formations. The characteristics of these relatively recent layers have many similarities to the deposits of the reservoir rock. Even today’s depositional environments such as the sabkha, salt-rich and known for its gypsum minerals growing in it (desert roses), are studied for their oxygen-producing microbes similar to stromatolites.

Drilling machine for rock cores in the upper sections of the Eocene Rus formation, up to a depth of 150m .

Khor Al Udaid, relatively unspoiled sandy desert in Qatar.

Remote site work has its usual challenges. Driving the rig up here on a trailer was fortunately uneventful. The sabkha has a way of sucking in vehicles up to their axles, a situation to be avoided. First thing to do is drill a 20m hole to create a source for drilling water (so no need to drive water trucks to this site). Then we core the main hole. Cores are being sent to the lab on a daily basis for logging, splitting and sampling. What else? Ah, toilet would be nice…where do we order a toilet around here? Let’s ask the Qatari guy in his tent over there.

Even though the country generally looks like a flat barren desert, there is more than the eye can see underneath. You are welcome for a visit.

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  - Figures, drawings, and pictures should be produced in one of the common image formats: GIF, TIFF, JPEG.
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