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TU BERGAKADEMIE FREIBERG DRILLING EXCURSION

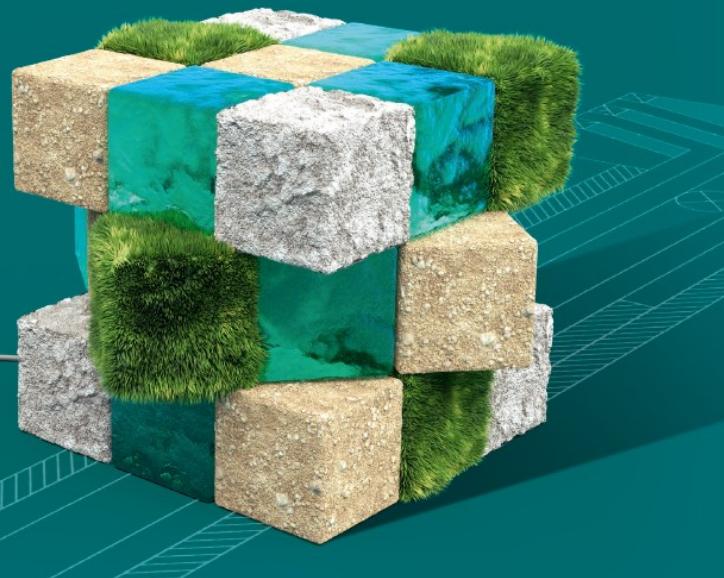


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# Content

## COVER



## IMPRESSUM

Group picture from TU Bergakademie Freiberg's excursion to OneSubsea, a SLB Company, in Celle

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# Event Calendar

For latest information and details on SPE Germany events visit our website.

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Date	Type	Event	Location
May 2023 08-11	DGMK Event	18th Pipeline Technology Conference	Berlin, Germany
May 2023 16-18	Non SPE Event	Energy Geoscience Conference 2023	Aberdeen, UK
May 2023 25	SPE Web Seminar	Geothermal Lithium	Virtual
May 2023 31	DGMK Event	DGMK/ÖGEW Spring Conference 2023 - Exploring the subsurface potential - make the energy transition happen	Celle, Germany
Jun 2023 01	DGMK Event	DGMK/ÖGEW Spring Conference 2023 - Exploring the subsurface potential - make the energy transition happen	Celle, Germany
Jun 2023 01	SPE Web Seminar	Natural Hydrogen - current developments and opportunities	Virtual
Jun 2023 05-08	SPE Conference	SPE EuropEC - Europe Energy Conference featured at the 84 <sup>th</sup> EAGE Annual Conference & Exhibition	Vienna, Austria
Jun 2023 06-09	EAGE Event	2023 EAGE Annual 84 <sup>th</sup> Conference & Exhibition	Vienna, Austria
Jun 2023 30	SPE Event	Annual General Meeting GSSPE	Celle, Germany
Sep 2023 05-08	SPE Conference	SPE Offshore Europe	Aberdeen, UK
Oct 2023 04-06	DGMK/KIT Short Course	Applied Clastic Diagenesis 2023	Karlsruhe, Germany
Oct 2023 10-12	Non SPE Event	LNG Global Congress	London, UK
Oct 2023 17-19	Non SPE Event	Der Geothermiekongress 2023	Essen, Germany
Nov 2023 09-10	SPE Congress	Student Technical Congress	Clausthal-Zellerfeld, Germany

# German Section SPE Chairman Letter

SVEN HABERER, GSSPE CHAIR & BAKER HUGHES



Dear colleagues and friends,

Welcome to the first edition of our German Section SPE Newsletter in 2023. In this editorial, I would like to take some time to reflect on a topic close to my heart and nowadays heavily discussed among the general public: Automation.

While some see our industry as antiquated, we have a long history of pushing technical boundaries - including successfully using innovative technologies from other industries to provide safe and reliable energy to the world. This includes using sensors originally developed for medical, telecommunication, and aero-space applications – as well as cutting-edge software to convert the measured raw-data to useful information.

Automation strives to take this to the next level, for example by using pattern recognition to detect well integrity issues, or by using ROP to estimate formation density at the bit. Both examples use data from standard sensors and process it using machine-learning algorithms to reduce risk and/or to increase efficiency. With software technology

constantly evolving, this will allow using data from diverse sources to ensure more consistent outcomes. Future usage of language models (like ChatGPT) would likely enable us to use information stored in previously hard-to-process sources like PDF reports together with real-time sensor data. By sharing this information, SPE will unlock the potential for our members to follow, understand, and lead these technological (r)evolutions. Specific examples of such opportunities include the multi-disciplinary Drillbotics competition for students and the SPE Geothermal Datathon.

From our local section, we are also working on an interesting event program, specially targeting our members to help them connect with experts from their respective fields. With Covid-19 restrictions being eased, we plan for several in-person events to meet our peers face-to-face and start in-person networking once again. From this corner, I can only encourage you, dear member, to engage, be present with us, and even volunteer in our section. Please use these opportunities for your personal and professional growth, you will not regret it!

One good example of these in-person events is our Annual General Meeting, scheduled for June 30<sup>th</sup> in Celle (more details to come soon). For those interested and making a bigger impact and expanding your network, you may apply to our different volunteering areas, even as board members, to help us shape our local group and make it worthy. New faces are always welcome!

I hope you enjoy reading this newsletter and am looking forward to your feedback and comments.

Kind regards,

**Sven Haberer, SPE German Section Chair**

*PS: To ease transition for students, SPE now offers a free 1-year membership for graduating SPE student members, allowing them to benefit from all the technical and leadership development options offered by SPE, as well as to build their professional network. See page 12 for more information.*

# Start of a modern and unique bachelor course in geo-energy systems

BY PROF. DR. PHILIP JAEGER, ERIK FELDMANN, TU CLAUSTHAL



The energy transmission comes along with a change in requirements regarding the knowledge and experience of engineers and therefore, a modernization of the respective study programs is overdue. In general, universities are facing a decreasing interest of young people in the classical engineering disciplines although a growing demand for experts exists that can handle the limited resources of this planet in a responsible way. All known energy perspective scenarios predict the global energy mix will still be formed by oil and gas to a considerable extent over the next 3 decades especially in view of lack of sustainable, affordable, and safe alternatives. Universities are obliged not only to lead the science and research in this field but also provide attractive courses and offer orientation and perspectives to those that will take part in creating the future on this planet.

The Institute of Subsurface Energy Systems at Clausthal University of Technology has picked up the challenge to develop a new future oriented bachelor course "Geo-Energy Systems", have it accredited in 2022 by the German Board of Accreditation and to get started in October 2022. Various boundary conditions had to be fulfilled while setting up this study program. Graduates from this new bachelor course still must be able to proceed with their studies in the Master course Petroleum Engineering at the same institute. This course is highly requested on a global scale. Still, all chances for creating new and up-to-date content and methods were to be implemented. Next to the classical courses on reservoir characterization, methods in drilling and in

production systems, contents are extended to topics like „deep geothermal systems“, hydrogen as well as carbon dioxide transport and storage (CCS). The combination of various energy sources and the respective energy transformation is addressed in a special lecture on sector coupling.

The bachelor program is bilingual, i.e. the fundamentals are mostly held in German language while the specialization is given in English with a special course dedicated to the active use of English in modern science and technology. Conventional as well as up-to-date topics are taught applying modern didactic concepts, combining virtual and real methods, e.g. for practical exercises in digital drilling technologies. Excursions as well as project related work are offered to those students that are interested in deepening their experience beyond the official curriculum. In this context, the so-called Drillbotics® project, initiated by students and young researchers and established at the institute, is an excellent chance to apply attained knowledge in a creative way, gather practical experience and get into touch with the industry. Once a year, a Drillbotics® competition takes place that is sponsored by the industry and by SPE.

A broad variety of career opportunities opens to the graduates of the bachelor course "Geo-Energy Systems", ranging from the international E&P industry, engineering companies, mining authorities, equipment and service providers to all companies involved in development of geothermal projects and subsurface gas storage.

# Development of an Artificial Intelligence-based Well Integrity Monitoring Solution

By PRIHANDONO ADITAMA, TINA KOZIOL, DR. MEINDERT DILLEN, WINTERSHALL DEA

*Editor's note: Summary from research paper prepared by the authors. Full version can be found in OnePetro  
<https://doi.org/10.2118/211093-MS>.*

The Deepwater Horizon incident in 2010 brought attention to the importance of well integrity in Exploration and Production (E&P) companies. Advanced data handling and analysis, as well as adequate communication results, are required for well integrity control. Artificial Intelligence (AI) is a novel technology that can improve well integrity, with use cases in evaluating the well barrier element condition and assessing well integrity risk. The paper focuses on the development of an AI-based digital product for detecting incident-relevant anomalies from time series sensor data, specifically for wellbore annulus leakage during well in operation.

The Proof of Concept (PoC) aims to validate the hypothesis that AI models can predict and monitor incident relevant anomalies from historical well sensor data. The success criteria were defined by a human-centric approach and a statistical approach, with the latter translated into two performance metrics: Detected Event Rate (DER) and False Alarm Rate (FAR). The AI models were optimized for recall instead of precision with consequence they may report some false alarms. The PoC's overall objective was to find satisfactory models that deliver Key Performance Indicators (KPIs) agreed upon through iteration and alignment with the users. The KPIs are a DER of at least 75% for real historical events and 50% for synthetic case, and a FAR of at most 1.0 per month per well.

A smaller number of sensors were selected for input variables in collaboration with domain experts. Historical time series for the last five years are available on average, but individual time periods vary. The data transformation step involves a harmonization process, where missing data points are replaced by interpolation or filing. Further time series manipulation strategies are applied to augment the data and reduce noise, known as feature engineering, which varies across models because sensor patterns are idiosyncratic across well types.

We use a combination of Machine Learning (ML) and rule-based models to detect annulus leakage in different well types. Deep learning algorithms, especially Long

Short-Term Memory (LSTM) classifier and autoencoder, are used to learn patterns and detect anomalous data indicative of well integrity problems. However, not all well types have enough data for ML models, so rule-based models are built which use predetermined rules to highlight leakages. Rule-based approach has the disadvantage of needing calibration to the data and proliferation of rules can lead to errors and go against the purpose of automation.

LSTM models are specialized Recurrent Neural Network (RNN) that can detect relationships between input variables in time series applications. LSTM classifier was used to predict leakage patterns by learning from labelled data, while LSTM autoencoder can detect anomalous pattern through dimensionality reduction in unsupervised ML. The latter is useful for modelling complex and nonlinear relationships between data. By reconstructing the most important sensor data for a particular well type, the LSTM autoencoder can predict incident-relevant anomalous pattern through calculating the reconstruction loss. This approach may detect patterns that cannot be detected by supervised or rule-based approach.

In addition to ML models, rules were implemented to detect simple anomalies in natural flow and water injector wells when data is limited. Post-processing rules were also implemented to filter out false positives by deleting sensor data spikes, filtering anomaly due to valve changes, and excluding anomaly when stabilization of annulus and wellhead pressure has been reached.

The Local Interpretable Model-agnostic Explanation (LIME) framework was used to identify the most important sensors that cause anomaly detection in the ML models. The LIME algorithm calculates the local importance of input variables at different time stamps when anomalies are detected. The user uses this information to critically validate the AI suggestion. Depending on whether the supervised or unsupervised model is used for prediction, we distinguish between a one-step and two-step LIME implementation as shown in Figure 1. The approach was evaluated using historical events and synthetic cases. The algorithm correctly indicated the most relevant sensors triggering the AI model prediction and corresponds quite well with the domain expert's logic.

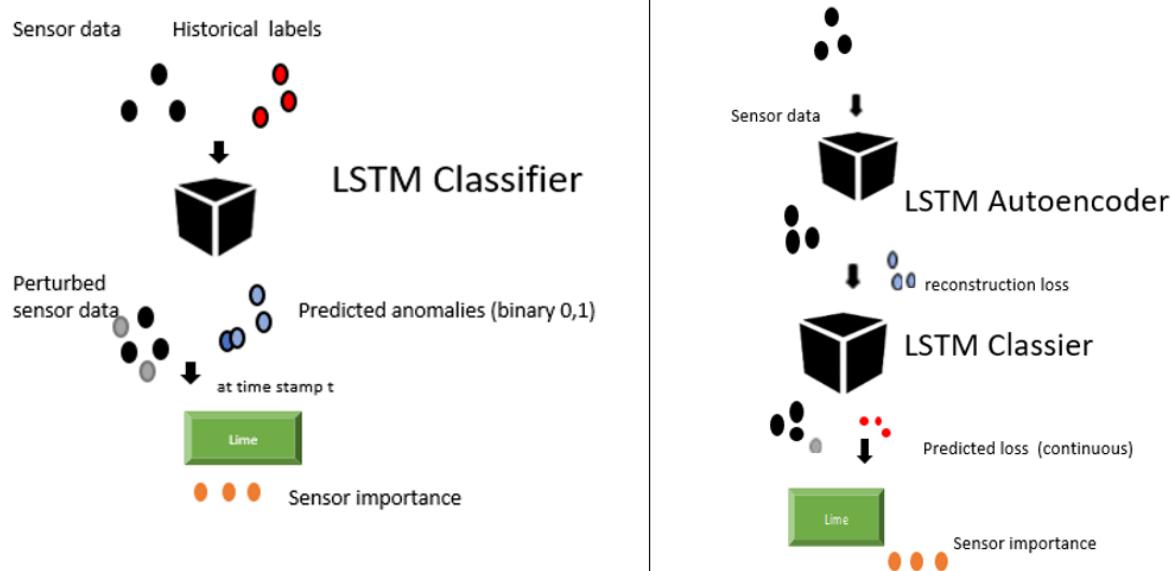


Figure 1 – Two LIME Application Approaches: One-Step (Left) and Two-Step (Right)

In gas lift and natural flow producer wells, the LSTM autoencoder, classifier, and rule-based models were built. The combined model of gas lift wells was evaluated for six gas lift producer wells. The models detected all historical events and 48% of synthetic cases with a FAR of 1.0 false positive per well per month. In natural flow wells, the combined model achieved a DER of 86% for real events and 67% for synthetic cases, with a FAR of 0.21 false positive. The prediction result of ML model in natural flow producer wells is illustrated in Figure 2.

For water injector wells, rule-based models were developed to detect the incident-related anomaly. At the time when this paper was written, the models achieved a DER of 91% for real events and 75% for synthetic events, but with a high FAR of 2.28 false positive per well per month. After a couple of iterations, the models reached a DER of 89% for historical events and 100% for synthetic cases, with a FAR of 0.15 false positive per well per month.

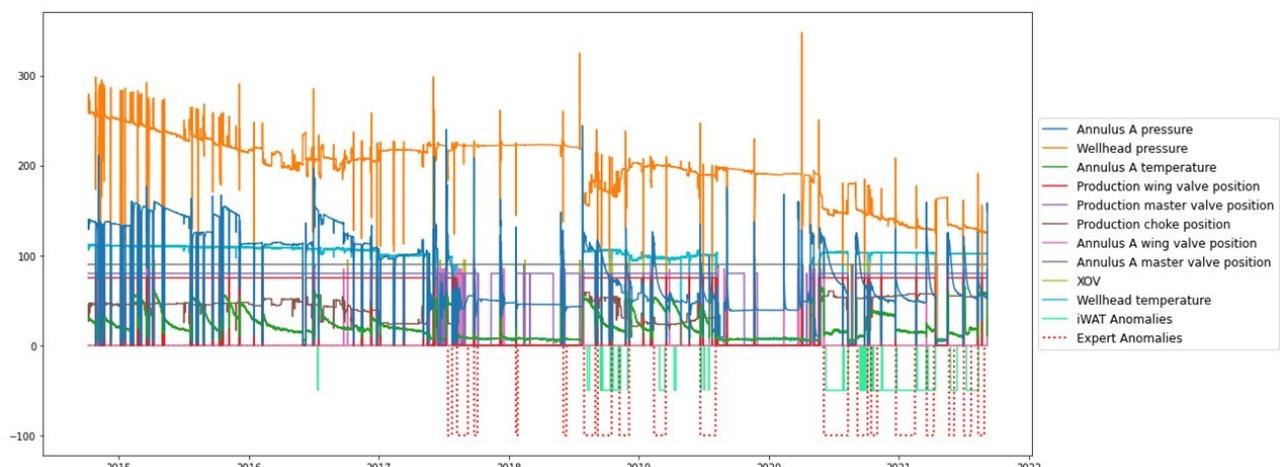


Figure 2 – ML Model Prediction on Historical Event (Natural Flow Producer Well)

In summary, the paper showcases how pattern recognition algorithms can identify and monitor well integrity issues related to annulus leakage. In the PoC, we successfully built AI models to detect annulus leakage in gas lift, natural flow producer, and water injector wells. Depending on data availability, either ML or rule-based models were developed, and an explainable anomaly detection system was built using

the LIME framework. Currently the models have been deployed in two subsea assets in Norwegian continental shelf. The digital product was developed to enable feedback loop from the users to continuously improve the model performance.

# The impact of ion type and salinity on the Interfacial Tension of CO<sub>2</sub>-Brine systems and Wettability of Shales

BY ERIC MABINDA, PHILIP JAEGER, HANIN SAMARA, CLAUSTHAL UNIVERSITY OF TECHNOLOGY

## Introduction

Carbon capture and storage (CCS) technology is employed globally to rapidly reduce greenhouse gas emissions by injecting huge volumes of CO<sub>2</sub> generated from fuel combustion and other human activities into geological formations. These formations include depleted oil reservoirs, saline aquifers, salt caverns and shales [1]. The success of a CCS project depends on the selected storage site and underground carbon storage mechanisms. To ensure the structural integrity of a storage site, which is the very first criterion for the success of the gas storage, it is necessary that a low permeability caprock overlays the formation where injection of CO<sub>2</sub> is intended. Shales are characterized by their low porosity and low permeability, thereby providing better sealing efficiency and structural integrity of the storage site. [1, 2]. Aside from structural trapping, other gas trapping mechanisms include residual and solubility trapping [2], that also depend on the interfacial behavior of the system in question. The capillary pressure which is the main parameter influencing fluid migration and fluid distribution in the formation depends next to the pore radius especially on the interfacial tension ( $\sigma$ ) and the contact angle ( $\theta$ ) according to Young-Laplace equation:

$$P_c = \frac{2 \cdot \sigma \cdot \cos \theta}{R} \quad (1)$$

The afore-mentioned interfacial properties vary with CO<sub>2</sub> injection pressure, formation temperature and composition of the brine. Therefore, it is imperative to investigate the influence of each parameter on the CO<sub>2</sub>-brine IFT and wettability of shale at conditions prevalent at reservoir conditions for the proper design of a carbon storage project. In this Master thesis work, investigation of the impact of pressure, temperature, ion type and salinity on the IFT of CO<sub>2</sub>-Brine systems and wettability alteration in systems comprising CO<sub>2</sub>-Brine-Shale was performed and the findings are discussed in a CCS context.

## Materials and Methods

For this work, the brine solutions used consist of 0.513 mol/kg and 1.711 mol/kg of CaCl<sub>2</sub> and MgCl<sub>2</sub> salts, representative of ions in the formation brine. Carbon dioxide of 99.99 mol % purity was supplied by Westfalen AG. Outcrop Shale rock samples were obtained from Lajjoun shale formation located southeast of Amman-Jordan. The Lajjoun shale is composed of almost 80% of Calcite and contains a total organic matter of approx. 17 wt% [1,3,4].

The measurement of the interfacial tension (IFT) is carried out using a high pressure drop shape analyzer (HP-DSA100, Krüss GmbH, Germany) (Fig.1) with a maximum allowable temperature of 200 °C and a maximum allowable pressure of 69 MPa [1]. The pendant drop method is applied to measure the IFT, where gas is used as the surrounding phase while the brine is injected through the capillary tube extending into the HP/HT view cell from the top to form a drop at the tip of the capillary tube. Contact angle measurements were carried out using the same set up using the sessile drop method (Fig. 1). The view cell is pressurized with CO<sub>2</sub> and a drop of liquid (brine) is deposited on the shale sample.

## Results and Discussion

IFT measurements of CO<sub>2</sub>-brine are shown in Fig. 2 left side as a function of pressure and salinity for 40 °C and 60 °C. From the graph it is observed that IFT strongly decreases with increasing pressure at low to moderate pressures. At higher pressures, the IFT levels out. The decrease of IFT with pressure is due to a surface excess concentration of CO<sub>2</sub>. At higher pressures and consequently a higher density in the bulk CO<sub>2</sub>-phase, the excess concentration decreases. At atmospheric pressure, lower surface tension is found at higher temperature. An inversion occurs regarding the temperature at increased pressure: at higher temperature, a higher IFT is observed. On the other hand, IFT is observed to increase with increasing salinity due to the desorption of cations from the interface - towards which they have no affinity- and into the bulk phase [5].

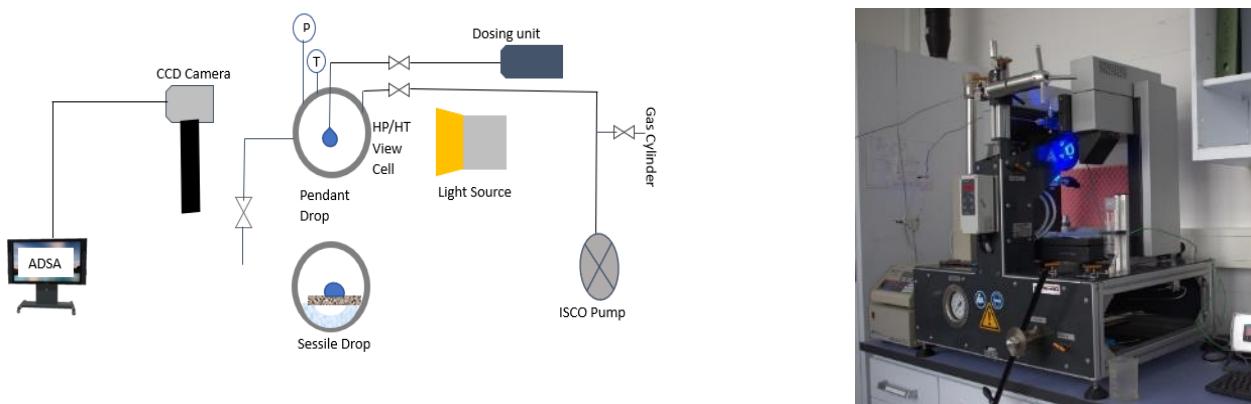


Fig. 1: Schematic diagram and image of the HP/HT drop shape analysis system.

Furthermore, it is seen that the IFT does not only depend on salt concentration but also the cation type. It has been stated in the literature that the influence of cation type on IFT follows the order of  $Mg^{2+} > Ca^{2+}$  [5].

In this work, wettability of shale was investigated in systems comprising  $CaCl_2$  brines in terms of the three-phase contact angle as a function of salt concentration, pressure and temperature as shown in Fig. 2 right side. Increasing the pressure increases the contact angle, i.e., higher gas wetting, owing to increased  $CO_2$  adsorption on the rock surface. The contact angle is found to monotonically increase until the pressure reaches about 200 bar, above which no significant change in contact angle is observed with increasing pressure. Increasing the temperature causes higher water wetting, i.e. lower contact angle due to reduced  $CO_2$  adsorption at higher temperatures. On the other hand, the contact angle is found to increase with salinity. The lower water wetting at high salt concentration may also be attributed to the higher  $CO_2$ -brine IFT, which ultimately results in the

corresponding changes according to young's equation which relates the contact angle to the interfacial energies between the phases involved.

### Conclusions

In this work, interfacial properties relevant to  $CO_2$  storage are systematically investigated as a function of pressure, temperature, and salinity. It is observed that IFT decreases with increasing pressure, increases with increasing salinity and is dependent on the ion type. The dependence of IFT on temperature exhibits a complex behavior. On the other hand, the contact angle increases with increasing pressures and increasing salinity (higher gas wettability) but decreases with increasing temperature (less gas wettability). A higher IFT promotes better structural trapping by means of higher capillary pressure, however, the efficiency of solubility trapping is reduced. Alternatively, higher contact angles reduce the efficiency of both structural and residual trapping. Therefore, high attention must be paid to these properties to guarantee safe storage conditions.

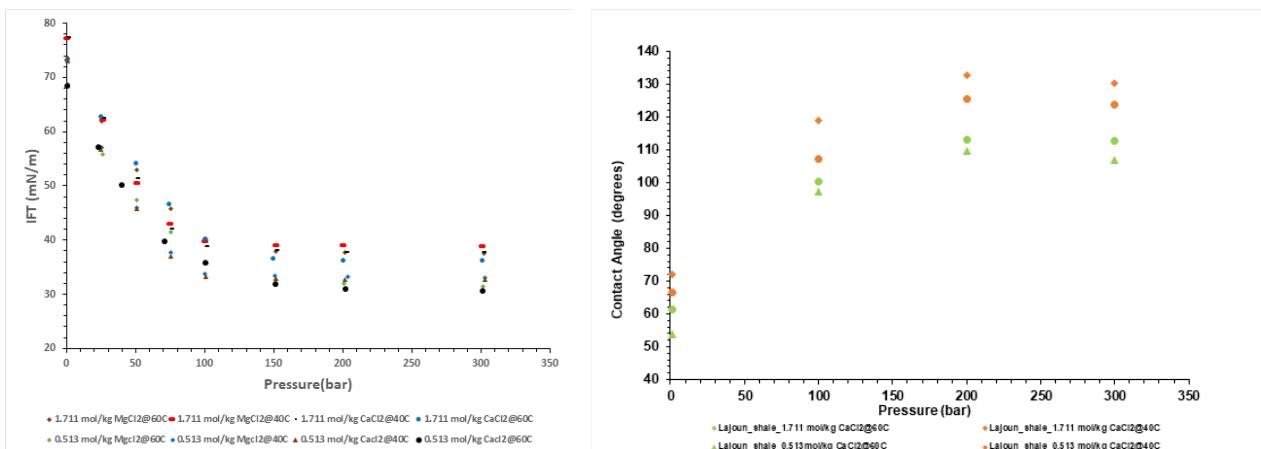


Fig. 2: IFT and CA of the  $CO_2$ -brine-rock system as a function of pressure, temperature, and ion type.

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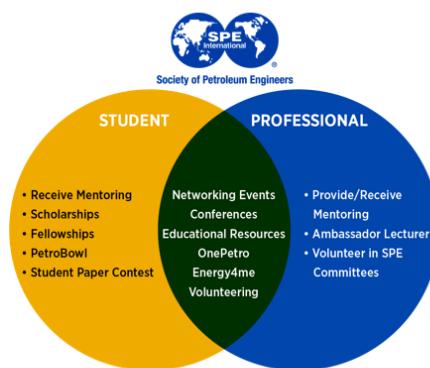
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# Bohrtechnik-Exkursion der TU Bergakademie Freiberg

BY TELMA DA SILVA, CHRISTIAN GLÄSER, LEONEL MACHAVA, TU BERGAKADEMIE FREIBERG



**Abbildung 1.** Gruppenbild vor einem Modell eines Unterwassersystems bei OneSubsea

Im Zuge der Studienrichtung „Tiefbohrtechnik, Erdgas und Erdölgewinnung“ bietet das Institut für Bohrtechnik und Fluidbergbau für die Studierenden zweijährlich in der letzten Woche des Wintersemesters eine fünftägige Exkursion an. Die Exkursion ermöglicht es den Studenten, einen praktischen Überblick über die Firmen in der Bohrindustrie zu erhalten und von aktuellen Projekten direkt vor Ort zu erfahren. Dieses Jahr nahmen sechs Studierende sowie zwei Betreuerinnen vom Institut teil.

## Tag 1 (27.03.2023): MB Well Services GmbH

Am ersten Tag sind wir direkt von Freiberg nach Salzwedel gefahren und pünktlich bei der Firma MB Well Services angekommen. Wir wurden zunächst herzlich begrüßt und von Michael Märtens, dem Arbeitsschutzbeauftragten, unterwiesen. Dann hat uns der Abteilungsleiter Daniel Hirschl mit einer Präsentation über die Firmengeschichte und Firmentätigkeit informiert. Nach dem Vortrag sind wir zum Lager gegangen, wo Elevatoren, Abfangkeile, Gestänge- und Tubingverbinder überprüft werden. Danach hat uns Herr Stammen mit auf das Außengelände genommen und die Werkstatt gezeigt, wo wir einige Anlagen, wie die Bohranlage T46, die in Reparatur stand, besichtigt haben. Auch eine längst

ausrangierte Bohranlage stand auf dem Hof (Abbildung 4).

Im Anschluss hörten wir von Herrn Hirschl eine Präsentation über Geothermieprojekte, wobei er uns insbesondere das Projekt Geothermal Super Single Ring (SSR) Concept nähergebracht hat. Für dieses Projekt arbeiten die Firmen MB Well Service und Herrenknecht zusammen. Das SSR ist eine kleine Bohranlage mit einer Hakenlast von 250 t, einem automatisierten Hands-off Pipehandling-System und einem elektrischen Top Drive.

## Tag 2 (28.03.2023): Baker Hughes und Drilling Simulator

Am zweiten Tag der Exkursion waren wir zu Besuch im Baker-Hughes-Technologiezentrum in Celle (Abbildung 2). Nach dem herzlichen Empfang durch den Funktionsmanager für Maschinenbau Alexander Otto haben wir drei interessante Präsentationen über die Firma, die technische Unterstützungsgruppe und das neue Lucida Advanced Rotary Steerable-System gehört. Der ausgezeichnete, moderne Campus wurde uns von Herrn Schramm gezeigt. Wir haben das elektrische Labor sowie die Fertigungsbereiche für Elektronik und Mechanik besichtigt. Nach der Campusbesichtigung gab es kleine Mittagspause mit leckerem Imbiss, kühlen Getränken und anregenden Gesprächen. Während der

Mittagspause haben wir von Elena Wujan einen kurzen Vortrag über Karrieremöglichkeiten gehört und zum Schluss gab es eine kleine Präsentation über Vielfalt und Integration von Informatikerin Tanita.



**Abbildung 2:** Besuchergruppe mit Herrn Otto (ganz rechts) bei Baker Hughes

Nach der Firmenbesichtigung fuhren wir zur  $\beta$ -Eta-Testbohranlage in Ahnsbeck (Abbildung 5). Das  $\beta$ -Eta-Rig ist eine Anlage, die verwendet wird, um Bohrwerkzeuge zu testen. Alle Bohrwerkzeuge von Baker Hughes werden auf dieser Anlage getestet bevor Sie zur Vermarktung kommen. Die  $\beta$ -Eta-Bohranlage hat eine Höhe von 60 m, ein Hakenlast von 400 t und darf laut Bergamt bis in eine Tiefe von 3000 m bohren.

Anschließend fuhren wir zurück nach Celle, um den Drilling Simulator zu besuchen, wo wir mit kleiner Verspätung ankamen. Der Drilling Simulator Celle ist ein Forschungszentrum der Technischen Universität Clausthal für die Simulation des Bohrprozesses. Wir wurden vom Teststandleiter Dr.-Ing. Michael Koppe

herzlich begrüßt und bekamen eine kurze Präsentation über den Simulator gezeigt. Vor Ort gibt es zwei verschiedene Drilling Simulatoren - Hardware und Software. Der Hardware-Simulator ist ein Bohrprüfstand für BHA-Tests unter Bedingungen wie im Bohrloch. Der Software-Simulator simuliert dabei den Bohrstrang oberhalb der BHA. Am virtuellen Simulator können auch Pipe Handling- und Bohrlochkontrollsituationen trainiert werden. Das durften auch wir Studenten ausprobieren (Abbildung 3).



**Abbildung 3:** Erläuterung des Softwaresimulators durch Erik Feldmann von der TU Clausthal

Am Abend wurden wir vom Freiberger Absolventen Lars Tannert in ein Restaurant in Celle eingeladen. In lockerer Runde konnten wir Lars und die anwesenden GSSPE-Vertreter über die Bohrindustrie in Deutschland ausfragen und uns Tipps für Bewerbungen und den Berufseinstieg holen.



**Abbildung 4:** Ausgemusterte Bohranlage auf dem Außengelände von MB Well Services

### Tag 3 (29.03.2023): OneSubsea und Sirius

An unserem dritten Tag besichtigten wir am Vormittag die OneSubsea GmbH, ein SLB Unternehmen in Celle. Wir wurden herzlich von Akber Jafri begrüßt und in HSE

unterwiesen. Außerdem gab er uns einen kurzen Überblick über das Unternehmen und dessen Umkreis Celle. Dann hat uns der Mitarbeiter Tim Diefenthal eine Präsentation über Unterwassersteuerungssysteme für

Öl- und Gasfelder vorgestellt. Er erklärte uns die Unterwasser-Komplettierungs-Technologie und danach die Werkzeuge, die dafür verwendet werden. Er hat uns außerdem über die Hauptkomponenten für Steuerungssysteme unterrichtet, also das Subsea Control Module (SCM). Danach gingen wir in den Fertigungs- und den Qualitätskontrollbereich für Unterwassersysteme (Abbildung 1). Das fertige Unterwasserprodukt wird dann im sogenannten „Hyperbaric Chamber“ unter hohem Druck getestet. Zum Abschluss des Firmenbesuches haben wir ein leckeres Mittagessen in der gemütlichen Kantine genossen.

Am Nachmittag des 29. März besuchten wir die Firma Sirius-ES, ein Unternehmen, welches Serviceleistungen rund um Bohrspülungen anbietet. Dazu gehören nicht nur die Planung und Bereitstellung, sondern auch die Überwachung und Feststoffkontrolle auf der Lokation sowie auch die fachgerechte Entsorgung. Wir lernten außerdem viel über die verschiedenen Spülungsarten, deren Vor- und Nachteile und die Einsatzbereiche. Leider konnten wir nicht länger bleiben, weil wir die nächste Unterkunft bei Bad Bentheim rechtzeitig erreichen mussten.



Abbildung 5: Exkursionsteilnehmer mit entsprechender Schutzausrüstung auf dem Gelände des β-Eta-Rig

#### Tag 4 (30.03.2023): Adorf Z18 und Bentec

Am folgenden Morgen besichtigten wir bei etwas durchwachsenem Wetter die Gasbohrung Adorf Z18 der Firma Neptune Energy in Georgsdorf (Abbildung 6). Es galt kein Sauergas-Status mehr, was im Vorfeld des Besuchs aber noch nicht präzise zugesagt werden konnte, weshalb sich alle männlichen Exkursionsteilnehmer rasieren mussten – im Notfall müssen Gasmasken dicht schließen. Zunächst wurden wir von den Bohringenieuren Christian Brünink und Lennard Schmidt über die Bohrung und deren Besonderheiten unterrichtet. Beispielsweise war es kompliziert einen Bohransatzpunkt zu finden, da ringsherum Naturschutzgebiete gelegen sind. Zusätzlich erschwerend kommt hinzu, dass parallel zum Bohrprozess nebenan die Produktionsanlagen errichtet werden und so quasi zwei Baustellen unmittelbar nebeneinander sind, was die Logistik erschwert. Beim anschließenden Rundgang über den Bohrplatz hatten wir die Möglichkeit mit den Richtbohrern von Baker Hughes, dem Driller von KCA Deutag und dem Spülungsingenieur der Firma Newpark zu reden und ihnen Fragen zu stellen. Dabei erfuhren wir viel über den generellen Ablauf sowie auch die eingesetzte Technik auf der Lokation. Abschließend stärkten wir uns mit belegten Brötchen, bevor wir zur nächsten Station aufbrachen.



Abbildung 6: Die Exkursionsgruppe auf der Gasbohrung Adorf Z18 mit den Bohringenieuren (5. und 6. von links) und Spülungsingenieur (ganz rechts)

Diese war am Nachmittag die Firma Bentec, welche Bohrequipment und -anlagen fertigt. Hier wurde uns zunächst erklärt, worauf es beim Bau von

Tiefbohranlagen ankommt. In Wüstenregionen ist es die Belastung durch die hohe Temperatur, im europäischen Raum liegt der Fokus auf der einfachen Transportierbarkeit und in arktischen Regionen ist es die Notwendigkeit alle Anlagen zum Schutz gegen den Frost einzuhäusen. Und auch hier macht man sich Gedanken um die Energiewende. Mit großen Batteriespeichern, welche Schwankungen im Dieselverbrauch dämpfen sollen, und Wasserstoff-Elektrolyseuren wird ein Beitrag dazu geleistet. Im Anschluss durften wir die Fertigungs- und Lagerhallen besichtigen. Hier wurden uns Top-Drives, Spülungspumpen, mechanische Catwalk-Maschinen, Iron Roughnecks und ein Bedienstand gezeigt. Einige der Bentec-Anlagen erkannten wir wieder, da sie auf der Adorf-Bohrung in Betrieb sind. Dann mussten wir uns wieder verabschieden, da unsere nächste Unterkunft im Sauerland lag und uns demzufolge die Fahrt dahin noch bevorstand.

#### Tag 5 (31.03.2023): Tracto-Technik

Am Freitag, unserem letzten Exkursionstag, besichtigten wir Tracto-Technik in Lennestadt, einen Hersteller für Flachbohrtechnik. Dabei leitet sich „Tracto“ nicht etwa von „Traktor“ ab, sondern von „trahere“ dem lateinischen Wort für „ziehen“. Uns wurden zahlreiche Lösungen für grabenlose Neuverlegung und Erneuerung von Rohrleitungen und Kabeln gezeigt. Dazu gehören

Erdraketen, Richtpressen und Spülbohrsysteme verschiedener Größe (Abbildung 7) sowie das nötige Zubehör wie Bohrmeißel und Räumer. Die HDD-Technik (Horizontal Directional Drilling) bietet dabei viele Vorteile bei Durchörterungen insbesondere in dicht bebauten Innenstädten oder Naturschutzgebieten. Deshalb sieht man im Alltag diese Anlagen im Gegensatz zu Tiefbohranlagen auch zunehmend häufiger im Einsatz. Abschließend konnten wir uns vor Ort noch stärken und traten dann die lange Rückfahrt nach Freiberg an wo wir gegen Abend mit allerhand neuem Wissen und vielen interessanten Eindrücken ankamen.

Wir möchten uns ganz herzlich bei den Firmen MB Well Services, Baker Hughes, OneSubsea, Sirius-ES, Neptune Energy, Bentec und Tracto-Technik sowie den Mitarbeitern vom Drilling Simulator Celle bedanken, dass sie uns viele interessante und spannende Einblicke gaben und geduldig unsere Fragen beantworteten. Weiterhin bedanken wir uns beim Verein der Freunde und Förderer der TU Bergakademie Freiberg e.V. für die finanzielle Unterstützung der Bohrtechnik-Exkursion.

**Text:** Telma da Silva und Christian Gläser, TU Bergakademie Freiberg

**Fotos:** Leonel Machava, TU Bergakademie Freiberg.



Abbildung 7: Gruppenbild vor einem in Bau befindlichen HDD-Bohrgerät bei Tracto-Technik

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# TU-Clausthal Drillbotics

BY CHARALAMPOS SOILEMZIDIS, WOLFGANG HOLLSTEIN, TU-CLAUSTHAL

Der Drillbotics Wettbewerb, organisiert von der Society of Petroleum Engineers (SPE und DSATS), ist ein jährlicher Wettbewerb, der Studentische Teams aus der ganzen Welt herausfordert, autonome Bohranlagen im kleinst-Maßstab zu entwickeln und zu bauen. Diese Anlagen sollen in der Lage sein, vollkommen autonom, eine Bohrung zu planen und abzuteufen.



**TU Clausthal Drillbotics Team**

Das TU-Clausthal Drillbotics-Team hat 2022 bereits zum siebten Mal an diesem Wettbewerb teilgenommen. Seit der ersten Teilnahme im Jahr 2016 hat das Studenten Team zwei autonome Bohrobooter gebaut. Die erste Anlage wurde unter der Voraussetzung entwickelt, möglichst schnell eine vertikale Bohrung in eine unbekannte, wechselnde Formation zu bohren. Die neue Anlage soll nun in der Lage sein, aus vorgegebenen Zielkoordinaten eine Trajektorie zu planen und anschließend eigenständig eine Lenkbohrungen durchzuführen.

Die Anlagen werden im DigitalDrillingLab des Institute of Subsurface Energy Systems an der TU Clausthal entwickelt und gebaut. Die Einrichtungen werden nicht nur für die Entwicklung der Anlagen genutzt, sondern auch für Lehrzwecke. Studierende haben die einzigartige Gelegenheit, sich mit Prozessen und Systemen der

Bohrtechnik im kleinen Maßstab vertraut zu machen und aktiv an deren Entwicklung teil zu haben.

Das Drillbotics-Projekt bietet den Teammitgliedern dank seiner Multidisziplinarität eine gute Möglichkeit, sich in fast allen Ingenieursdisziplinen zu beweisen und Grundkenntnisse von der Konstruktion bis hin zur Softwareentwicklung zu erwerben. Außerdem bietet der Wettbewerb eine ausgezeichnete Gelegenheit, mit der Industrie bei diversen Anlässen, wie etwa Firmenpräsentationen, Workshops und Führungen in Kontakt zu treten. An der Teilnahme hängt neben der technischen Entwicklung auch eine Menge logistischer Planung. Die Kosten der Anlagen werden hauptsächlich durch Spenden finanziert.



**Drillbotics Setup und Roboter**

In diesem Jahr findet der Wettbewerb in Belgien statt und das TUC-Drillbotics-Team steht bereits in den Startlöchern. Das TUC-Drillbotics-Team wird in diesem Jahr von Baker Hughes, Micon-Drilling, KCA-Deutag, Kraus Diamantwerkzeuge und der ITE-Engineering GmbH unterstützt.

# SPE TU Clausthal Student Chapter

By EDUARDA GOMES, SPE TU CLAUSTHAL STUDENT CHAPTER



From left to right: Martin Höcherl, Eduarda Gomes, Mats Wolter, and Mohamed Eita

Dear Readers: it is a pleasure to introduce you to our SPE Student Chapter in TU Clausthal. Our chapter is composed of bachelor's and master's degrees students from different countries in which our main goal is to introduce the students to the industry through different activities as well as provide social events and technical events. In addition, the chapter has a close collaboration with the German Section of SPE to enhance scientific research, training, and a lot more regarding the oil and gas industry as well as renewable energy.

One of our golden activities is participation in the ASEC (Annual Student Energy Congress) and the SPE Petro bowl European Regional Qualifier. This year, the event will be held between 20-22 of March in Zagreb, Croatia. The event brings students from all over Europe and professionals from all over the world to discuss the

latest in the energy industry. Additionally, during the event, we have the SPC (Student Paper Contest) and the Petro bowl. The Petro bowl is a quick quiz competition about the oil and gas industry in which different chapters from all over Europe compete against each other. The first 5 winners play at the ATCE against the best 5 chapters of all continents. We are glad that once more our students will have the opportunity to participate in the events.

Last year, our team was composed of four members, bachelor's, and master's degrees students.

It was an amazing experience that gave so much motivation to help our students participate once again in the competition and have the opportunity to go to the ATCE

# The role of Carbon Capture Storage (CCS) in Energy Transition

BY RYAN BOBBY ANDIKA, FIKRI ZAIN KARIM, SPE RWTH AACHEN STUDENT CHAPTER

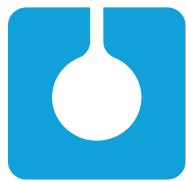


Yasir Thara presenting “The role of Carbon Capture Storage (CCS) in Energy Transition”.

*Editor's note: Summary prepared by the authors from the web seminar.*

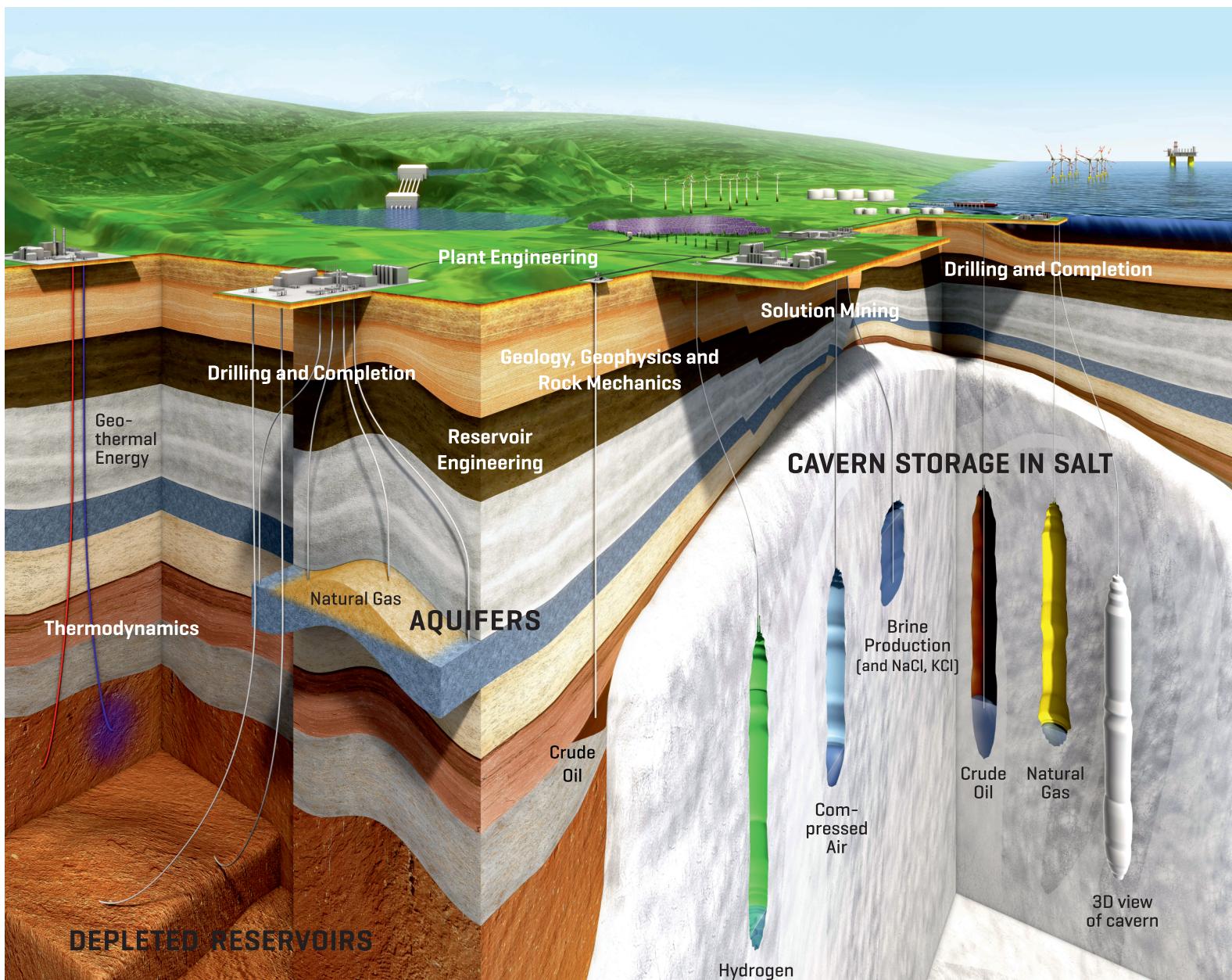
On Friday March 3<sup>rd</sup>, 2023, the SPE RWTH Aachen Student Chapter had the pleasure of welcoming Mr. Yasir Yousuf Thara, M.Sc., a Reservoir Engineer specializing in Carbon Management & Hydrogen from technical aspects of the CO<sub>2</sub> storage to hold a presentation about “The role of Carbon Capture Storage (CCS) in Energy Transition.” The session had participation from RWTH Aachen applied geoscience student students, and international participants either came from industry or academia. 45 people attended the web seminar. Mr. Yasir started his presentation by discussing the current annual CO<sub>2</sub> emissions on Earth and how the world needs to implement more actions to address that issue. The implication of climate change by such emissions has been a hot topic that made Europe (Specifically NW Europe) come up with the notion to deploy a more cutting-edge effort in the energy transition to achieve net zero emissions in 2050 based on the Paris Agreement, mentioning the utilization of CO<sub>2</sub> storage or Carbon Capture Storage (CCS).

Mr. Thara elaborated his presentation by explaining the general technical concept of CCS from the subsurface–surface aspect, how the ideal implementation of recent technology can support the Net Zero Emissions campaign in the future, and how is the current Global CCS Projects map. Moreover, Mr. Yasir continued his webinar by showcasing the ongoing regulation framework for CCS monetization (to stimulate the CCS campaign among many sectors) and how the company of Wintershall DEA takes part in global CCS projects as well. At the end of the presentation, a Q&A session was open where participants had the opportunity to ask questions either through the chat box or directly to Mr. Yasir. Many questions demonstrated a high level of interest in the topic, from technical to non-technical aspects of the current CCS project, and how this campaign can benefit the companies and the world to make a real action of Energy Transition. Mr. Yasir answered and discussed all the questions. On behalf of the SPE Student Chapter at RWTH Aachen University, we thank Mr. Yasir for sharing valuable insights about CCS for the energy transition. We wish him all the best in his career and hope to see him again in our SPE Student Chapter.



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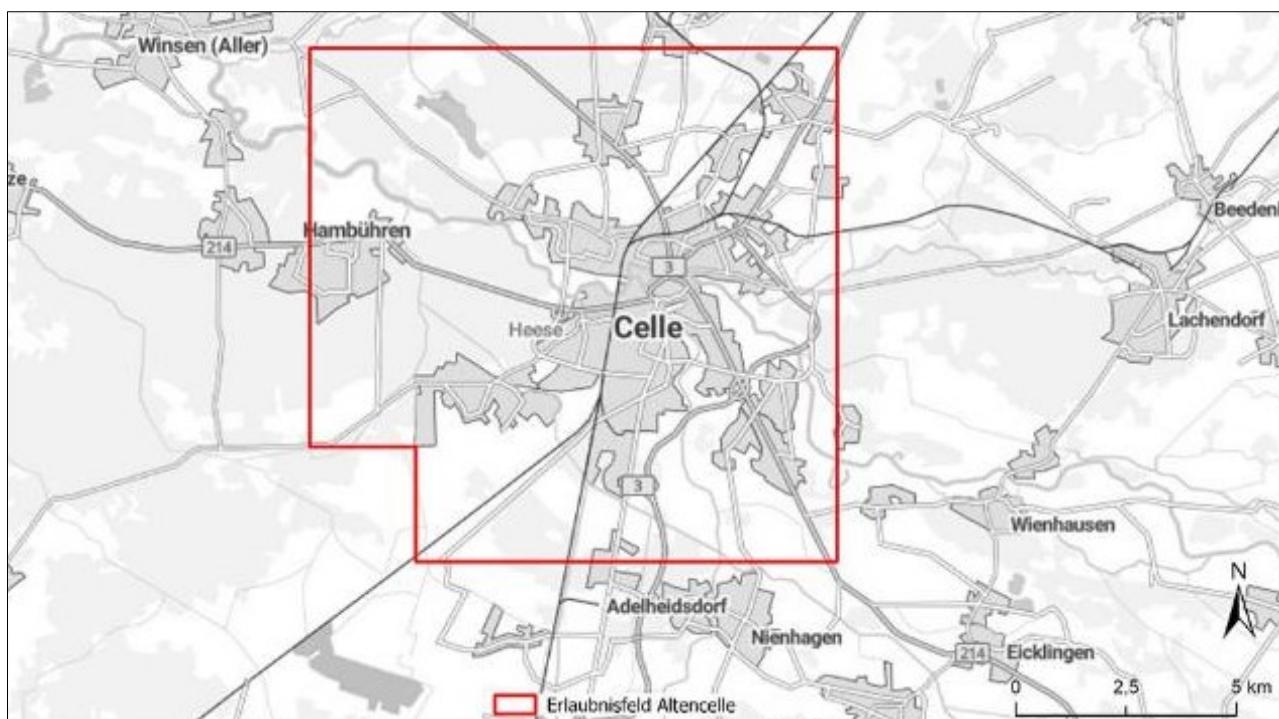
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# Geothermal News

BY RUBEN ENSALZADO, BAKER HUGHES



Baker Hughes to explore for geothermal energy in Celle. The Altencelle permit field covers an almost square, 133 square kilometer area around Celle.

**Lower Saxony Energy Minister Meyer expects geothermal energy to be used in the next few years.**

*Editor's note: Adapted from original text in German Language, 04.04.2023.*

Lower Saxony's Energy Minister Christian Meyer (Greens) considers "realistic" the use of geothermal energy in Munster (Heidekreis district) in the short term (2-3 years). Mr. Meyer told the local newspaper Kreiszeitung that due to the high level of acceptance among the population, it would be possible to implement geothermal power generation in this timespan, comparable to current LNG projects.

Meyer said he wants to initiate as many geothermal projects as possible. He mentioned that there are 13 so-called exploration areas in Lower Saxony so far, where geothermal technology could be applied. The project in Munster and another in Bad Bevensen (Uelzen district) are to be financially secured by the state.

The use of geothermal energy is considered climate friendly. Just a few days ago, it became known that CDU member of parliament Hüttemeyer (Visbek) had taken the lead in formulating a motion to the state government. The potential of deep geothermal energy is to be exploited.

## Sources

OM Online - [Energieminister Meyer rechnet mit Nutzung von Erdwärme in nächsten Jahren](#), dated 04.04.2023.

**District of Celle: Baker Hughes INTEQ GmbH is allocated Altencelle field - LBEG grants permission to explore for geothermal energy.**

*Editor's note: Adapted from original text in German Language, 26.04.2023.*

The State Office for Mining, Energy and Geology (LBEG) has awarded the Altencelle permit field to Baker Hughes INTEQ GmbH, based in Celle. The permit to explore for geothermal energy for commercial purposes is initially limited to five years until April 14, 2028. The Altencelle permit field covers a good 133 square kilometers and extends in an almost square shape around the district town of Celle.

The application for permission to explore for geothermal energy was submitted by Baker Hughes INTEQ GmbH at the end of November last year. After the LBEG examined the application and gave the district of Celle, which is affected by the area, the opportunity to comment, as well as informing the joint municipalities of Flotwedel

and Wathlingen, the communities of Adelheidsdorf, Hambühren, Nienhagen, Winsen (Aller) and the monastery community of Wienhausen, it has now granted permission. This gives Baker Hughes INTEQ GmbH only the basic right to carry out exploration. Baker Hughes INTEQ GmbH sees opportunities to implement deep geothermal projects for heat generation for commercial use.

#### Sources

LBEG Niedersachsen - [Landkreis Celle: Baker Hughes InteQ GmbH bekommt Feld Altencelle zugeteilt - LBEG erteilt Erlaubnis zur Aufsuchung von Erdwärme](#), dated 26.04.2023.

#### Lower Saxony funds first deep geothermal project in Munster with 7 million euros

*Editor's note: Adapted from original text in German Language, 02.05.2023.*

Lower Saxony's Energy Minister Christian Meyer handed over a grant of 7.1 million euros to the Managing Director of Stadtwerke Munster Jan Niemann in Hanover (today). The first deep geothermal project in Lower Saxony will supply parts of the city of Munster with heat in the future.

"The Munster site is particularly well suited for a deep geothermal pilot project and, if successful, could become a demonstration site for geothermal reuse of the numerous oil and gas wells that exist in Lower Saxony. The project shows that we want to establish a sustainable and broad-based heat supply in the municipalities," says Meyer.

As part of the permit for geothermal energy production, the goal is to use the former Munster-Südwest Z3 natural gas production well geothermally after and expand it into a geothermal doublet by drilling a second, new well. This will create a closed water cycle.

The project is being funded in the form of a contingently repayable grant which, if successful, will flow back to the state and minimize the exploration risk. Risk describes the danger that a geothermal reservoir will not have the necessary quantity or quality after development. However, since test drilling is very expensive, the state would like to hedge the production risk to a certain extent and has decided on a conditionally repayable grant. In addition to Munster, a geothermal project is also to be realized in Bad Bevensen.

#### Sources

Niedersächsisches Ministerium für Umwelt, Energie und Klimaschutz - [Niedersachsen fördert erstes Tiefengeothermie-Projekt in Munster mit 7 Millionen Euro](#), dated 02.05.2023.

#### Chancellor Scholz makes case for greater use of geothermal energy

*Editor's note: Adapted from original text in German Language, 06.05.2023.*

Africa's largest geothermal plant is the last stop on the chancellor's three-day visit to the continent. Olaf Scholz recommends that Germany should draw inspiration from the use of geothermal energy in Kenya.

At the end of his trip to Africa, German Chancellor Olaf Scholz spoke out in favor of much greater use of geothermal energy as an energy source in Germany. "Geothermal energy is possible in many more places in Germany than many people think today," he said during a visit to Africa's largest geothermal plant in Olkaria in Kenya.

Germany can learn from Kenya when it comes to using its natural conditions, Scholz said. "We don't have volcanic regions like this one in Germany, but we have many areas and landscapes where geothermal has good conditions." Scholz advocated re-evaluating the use of geothermal energy in Germany. "The potential is estimated to be very high. With modern technology, we also have the possibility that we can better determine whether drilling will be successful".

#### Source

Deutsche Welle - [Scholz macht sich für größere Nutzung von Geothermie stark](#), dated 06.05.2023

#### Geothermal energy: Schwerin now heats with geothermal energy.

*Editor's note: Adapted from original text in German Language, 28.04.2023.*

The Schwerin municipal utility opens a geothermal plant on 28.04.2023. The geothermal project in the Lankow district is to supply 2.000 households. The plant costs 20 million euros.

Among those attending the inauguration will be German Chancellor Olaf Scholz (SPD) and Mecklenburg-Western Pomerania's Minister President Manuela Schwesig (SPD). The heads of many other municipal energy suppliers from all over Germany also want to be there. They want to know how Schwerin manages to get so much heat energy from a comparatively shallow depth and with comparatively cold water.

#### Source

NDR - [Geothermie: Schwerin heizt jetzt mit Erdwärme](#), dated 28.04.2023

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