

Information on Abstracts (in alphabetical order of company)

Topic: Mine Development

Author / Autor: **Lars Bergkvist,**
Atlas Copco Rock Drills AB, S

Title of Paper: **CARE for mining simulations for LHD**

Vortragstitel: **Der Einsatz von CARE in der Bergbausimulation für LHD's**

Very often purchase price is only a small part of the total cost but sets the limit of what type of equipment the operations choose. High purchase price is very often related to higher quality and in the end it gives less maintenance, minimizes break downs and creates better productivity. Cheaper machines tend to have a higher operating cost if all parameters are included in the machines total life.

CARE for Mining simulation tool gives the opportunity to simulate operations to compare different scenarios and see the total running cost including operator cost and maintenance.

In tunnels and mines with limited space it is even more important to have vehicles running and not standing in the way creating traffic problems, and stop production.

CARE = Computerized Analysis of Rock Excavation.

CARE can also analyze different shift forms and estimated utilizations and availability.

CARE simulations and analysis of Boliden owned Garpenberg mine in Sweden will be the base of the presentation to compare the existing fleet of surface trucks to a fictitious fleet of MineTrucks.

This will show all parameters included in the total life of the machines.

Topic: Mine Development

Author / Autor: **Mick Cairney,**
Centennial Coal Company Limited, Australia

Title of Paper: **Evolution of rock bolting systems in a multi seam Australian coal mine**

Vortragstitel: **Entwicklung von Ankersystemen in mehrschichtigen Flözen in einem australischen Bergwerk**

Topic: Mine Development

Author / Autor: **Michael Maas,**
deilmann-haniel mining systems gmbh, GER

Title of Paper: **New low-height roadheaders for coal mine development**

Vortragstitel:

dh specializes in equipment, service and technical solutions used in underground coal mining worldwide. To offer its customers the most productive and technologically advanced products available dh invests a percentage of its total sales revenue in R&D signification each year. For completion of product portfolio drilling, loading and dinting machines and in order to become a system supplier for all issues of roadway driving a new series of lowest height roadheaders was introduced to the market in November 2009. The new designed RH 50 and RH75 roadheaders fits the bill when high efficient roadheaders are requested for achieving good daily advance rates together with high support quality and less manpower requests. Heavy weight, high cutting power and unique integrated design makes dh roadheaders a perfect tool for coal mine development jobs even in smallest cross sections.

Equipped with onboard bolting devices, working platforms and steel arch manipulators the integrated design results in a total machine height of less than 2.5 m for the RH75 roadheader and less than 2 m for RH50 roadheader.

A unique patented water mist spray system which is designed exclusively as an external spraying arrangement ensures an effective preventive explosion protection and dust suppression. The spraying water consumption is significantly lower than conventional systems which improve loading and conveying of coal and muck. In addition to the technical advantages, the water mist spraying system brings a number of economic benefits as less investment expenditure for cutter gearboxes, cutter heads and less cost for service and maintenance activities.

The side-mounted drilling and bolting device uses the proven BTL drill boom with double rotation unit and guarantees fast and accurate positioning of the drill feed to all drilling patterns. For achieving short bolting cycle times a powerful DH DP15 drifter with 15 kW percussive power is used. Designed as one of the shortest rock drills in its class the DH DP15 stands for best utilization of feed length. Alternatively the high performance rotary drill DH DR250 can be mounted to the drill feed. Both rock drills guarantee for short bolting cycles independently which bolt types are used.

The new roadheaders are available with remote controls for all functions and with cutting control systems and built to withstand the rigors of harsh mining conditions.

Even more the overall design of the machines guarantees best organisation of workforce during the cycle times.

Every working process is addressed to a specific area on the machine so therefore no idle work flows.

Topic: Mine Development

Author / Autor: **Gregor Hannsmann,**
DMT GmbH & Co. KG, GER
Franz Hebinck,
RAG Aktiengesellschaft, GER
Wolfgang Schnitzler,
RAG Aktiengesellschaft, GER

Title of Paper: **Successful long wall mining under difficult conditions by using advanced visualization and training methods created by DMT GmbH & Co. KG**

Vortragstitel: **Schulung von Mitarbeitern des BW West mittels 3D Applikationen**

The mine Bergwerk West assigned DMT GmbH & Co. KG to support the training of the mines employees concerning the expected difficult conditions by developing 3D applications. The Goal was to create a visual impression of the expected 30 Gon pitch of the field and of the tasks needed to be established, e.g. special roof support. In order to fulfill these requirements in close cooperation with the mines responsible persons several 3D animations and an interactive 3D simulation have been developed.

Beside the pure visualization the employees awareness for risks and threads had been raised. Thus the Bergwerk West expected a better and safer performance of the employees, a more productive mining process, an easier handling of the difficult conditions and as a result a significant cut of costs

Zur Steigerung der Produktivität im deutschen Steinkohlenbergbau werden neben der Optimierung der originären Bergbautechnik zunehmend Anstrengungen auf die Verbesserung der Interaktionen der gesamten Produktions- und Logistiksysteme gelegt. Hier wird die Informations- und Kommunikationstechnik zunehmend wichtiger; sie wird mit zum Schlüsselfaktor für mehr Produktivität. Aktuelle Entwicklungen zielen derzeit auf eine generelle Vereinheitlichung der gesamten untertägigen und übertägigen IT-Infrastruktur. Die extremen Bedingungen einer explosionsgefährlichen Umgebung erforderten daher Investitionsanstrengungen in sichere IT-Komponenten, wie Glasfasertechnologie für die untertägige Anbindung des Netzwerkes sowie Access Points für die untertägige WLAN-Verfügbarkeit unter ATEX-Bedingungen. Diese neuen Komponenten beschleunigen Verbesserungen in den Management- und Prozessüberwachungssystemen und bieten die Möglichkeiten zu innovativeren Kommunikationsprozessen. Die vielfältigen Anforderungen an den Kommunikationsbedarf in einem Steinkohlebergwerk können nur durch ein breites Portfolio passender technischer Komponenten realisiert werden. Hierzu gehören - um nur einige zu nennen - Techniken wie VoIP, digitale Kommunikation, Handies, Video-Kommunikation und Wandler, die bei RAG bereits zur Betriebsreife gebracht wurden.

Innovationen im deutschen Steinkohlenbergbau werden heute häufig durch die Adaption bereits erprobter Technologien anderer Industriezweige erreicht. So wurde mit der Einführung von Virtual Reality (VR) Lehr- und Trainingssystemen bereits vor 10 Jahren begonnen. Beides, Software und Hardware, wurden für die speziellen Anforderungen des Bergbaus entwickelt und angepasst. Sowohl eine umfangreiche Vielfalt von erprobten Applikationen als auch ermutigende Forschungsergebnisse zeigen die wirtschaftlichen Vorteile der Investitionen in VR-Technologien nicht nur in den Bereichen Lehre und Training, sondern auch im Bereich des Wissensmanagements.

Mit der Einführung der schlagwettergeschützten PCs u. T. mittels derer alle RAG-Anwendungen verfügbar gemacht wurden und der Einführung der Pocket-PCs ist auch untertägig die Informationstechnologie in die Produktionsnähe gerückt. Dies lässt sich auch daran ablesen, dass sich der IT-Durchdringungsgrad, d.h. das Verhältnis von IT-Anwender zu der Gesamtbelegschaft in den letzten fünf Jahren verdoppelt hat. Er liegt aktuell bei rd. 55 %. Mit der Entscheidung, die Automatisierung der Leitwarten voranzutreiben, gewinnt die Wertschöpfung der Informations-, Kommunikationstechnik nochmals an Bedeutung. Hier werden die Bestrebungen auf eine höhere Integration der unterschiedlichen Systeme wie Dude, ETAP, MTAP, WTAP, GDWR, TS/4, SAP (MM, PM), etc. forciert werden müssen. Das Schnittstellenmanagement wird dabei insbesondere darauf hinzielen, Mehrfacheingaben zu vermeiden, Datenkonsistenzen zu schaffen sowie die Prozessleittechnik- und die klassische Datenverarbeitungs-Welten näher zusammenzuführen. Auf Basis dieser qualitativ hochwertigen Daten ist eine weitreichende Automatisierung von Prozessen möglich. In diesem Zusammenhang ergibt sich die Forderung einer Verfügbarkeit von annähernd 100 % sowohl des untertägigen als auch übertägigen Netzwerkes. Was bedeutet, dass zusätzlich Anforderungen an das heutige Netzwerkmanagement gestellt werden.

Topic: Mine Development

Author / Autor: **Serguei Kenzap,**
Hatch Limited, Canada
Vassilios N Kazakidis,
Laurentian University, Canada

Title of Paper: **Evaluation of Vertical Shafts Excavation Alternatives using the Analytical Hierarchy Process**

Vortragstitel:

This paper presents a case study for the evaluation of excavation alternatives of ventilation shafts through the application of the Analytic Hierarchy Process (AHP). The Alimak raising, Raiseboring, Shaft sinking, and full face Mechanical excavation were compared. First, the alternatives were evaluated using a quantitative efficiency analysis, engaging only cost and time parameters. This analysis was unable to finalize the selection of the best excavation technique. Second, the AHP analysis that takes into consideration both quantitative and qualitative shaft excavation evaluation parameters was applied. These parameters included financial parameters, excavation efficiency, reliability, flexibility, energy consumption, risks, and constructability. The AHP evaluation enabled the prioritization of the excavation techniques and proved to be an effective tool in modelling and assessment of mining excavation alternatives.

Topic: Mine Development

Author / Autor: Christian Kloibhofer,
KLOIBHOFER Bergbausicherheit GmbH, A

Title of Paper: **Integrated Raw Materials Management Information System - a Computer-Assisted Model for Mining Enterprises**

Vortragstitel: **Integriertes Rohstoff Management Informations Systems - ein EDV-gestütztes Betriebsführungsmodell für Bergbauunternehmen**

Reasons for IRMIS

Mining enterprises are constantly confronted with a large number of laws, official regulations, permanent procedures for public authorities and, because of the mining activities themselves, continuously changing specialized problems.

Core Idea – Availability

The special technical parameters in mining, the comprehensive documentation and business processes must be properly handled and, nowadays, also inter-linked.

Clear, quick and constantly available access to current processes is important to every manager.

For this reason a reliable and, most importantly, a simple means of processing data is highly valued by those responsible.

Application of IRMIS – a Model for the Industry

IRMIS was created especially for mining companies as a digital, forward-looking and innovative office administration to support the daily business processes.

The electronic Log-book system IRMIS is oriented on the principles and current needs of mining, also for plant locations away from the Central Office, (based on the web).

Program description

IRMIS – an Integrated Raw Materials Information Management System provides a jointly usable information application. The application offers a highly integrated approach to link documents and other material for businesses, authorities, and the public in a logical, thematic and graphic manner. In addition, support is provided for the fulfilment of the prescribed norms.

The application contains a Log-book system, maps, a graphic information system, a picture gallery, emergency plans and a crisis module, a legal compliance and norms-conformity module, a module for public authorities and for the public as well as user and document administration.

Technical Description

The software uses JAVA technology. As the basis of the application there is the so-called Log-book system into which all the documents concerning the company are entered and which, in addition, contains an extensive set of maps. This is linked to the system and allows access via many coherent routes. Specially generated reports and summaries in different specialist fields can thus be effectively and economically made available. This makes possible a forward-looking digital invigoration of companies and raises considerably their technical capacity.

Data Security

An MOA-ID is used for the secure identification and authentication of users through a special ID-card. The data base is, in addition, completely separated from the internet by a proxy solution.

The decisive steps for the implementation for data security have been designed by the Institute for Applied Information Processing and Communication Technology of the Technical University of Graz.

Trademark Protection and Support

IRMIS is trademark protected under the Austrian Patent Office, Number 242748.

IRMIS was also the subject of a research project in 2007 – 2008 and received the (financial) support of the Austrian Research Promotion Agency and the Styrian Business Promotion Agency.

GOALS of the Log-Book system:

- Expandable system
- Independent of a specific program
- Clear overview
- Easy handling after training

- Continuous system maintenance and support with data management
- Enhancement of productivity, tailored to individual company needs and timeliness for the company
- Quick overview of legal requirements

IRMIS offers several advantages

- enhances flexibility and stimulation in the company,
- problems are more easily identified thanks to linking possibilities,
- better control of mining resources,
- service point with great convenience and use of new technologies
- shorter paths, with central management: good for environmental protection
- electronic administration – chance for growth and stimulation to innovation
- new technology with better support for customers
- central management and de-central implementation, quality remains high
- simpler access to information for management and staff
- makes the work easier and raises motivation
- encourages new and improved communication
- provision for raised legal security
- quick handling of documents
- reminders of dates, deadlines and requirements
- easy access to information in emergency and crisis situations
- evaluation of company results

The KLOIBHOFER Bergbausicherheit GmbH is a small engineering company that is mainly concerned with the planning and monitoring functions for mining companies and thus knows very well the particular and far-reaching requirements made on mining enterprises.

In doing our job, having permanent contact with government authorities, preparing and coordinating expert opinions (from university institutes, authorized experts, and specialist companies), creating materials and advising on the implementation of measures to comply with mining regulations and meet technical necessities, we have become aware of the enormous number of bureaucratic procedures which have to be followed daily both by small and large mining companies. IRMIS supports mining companies with their operations in an up-to-date and forward looking, but most importantly, practical way. IRMIS offers a relevant approach to resource management and to the provision of raw materials security.

Since it is computer-supported, IRMIS can be presented to the participants very clearly and understandably.

Perhaps there will be a possibility to exhibit our “IRMIS – Integrated Raw Materials Management Information System” in the framework of your symposium. We would be delighted if this idea met with your approval.

Anlass und Gründe für IRMIS

Bergbaubetriebe haben ständig eine Vielzahl von gesetzlichen Bestimmungen, behördlichen Auflagen, permanente Behördenverfahren und abbaubedingt sich fortwährend ändernde spezialisierte Aufgabenstellungen wahrzunehmen.

Herz und Kernstück – Verfügbarkeit

Der besondere technische Gestaltungsrahmen im Bergbau, die umfangreichen Akten und Geschäftsvorgänge müssen solide und geordnet aufbereitet, neuerdings auch vernetzt sein.

Ein übersichtlicher, schneller und stetiger Zugang zu aktuellen Vorgängen ist ein immanentes Anliegen aller Geschäftsführungen.

Deshalb weiß der Sachkundige Vorsorgen für eine verlässliche und vor allem einfache Aktenbearbeitung sehr zu schätzen.

Einsatz von IRMIS – ein Modell für die Praxis

Mit IRMIS wurde eine digitale, somit zukunftsorientierte und innovative Büroadministration speziell für Bergbaubetriebe zur Unterstützung von allen täglichen Geschäftsprozessen geschaffen.

Das elektronische Fahrbuchsystem IRMIS orientiert sich an den Grundsätzen und zeitgemäßen Bedürfnissen des Bergbaues, auch für dislozierte Betriebsstätten (webbasierend).

Programmbeschreibung

IRMIS – ein Integriertes Rohstoff Management Informations System stellt eine gemeinsam genützte Informationsapplikation dar. Die Applikation bietet einen hochintegrativen Ansatz, um Unterlagen für Unternehmen, Behörden u. die Öffentlichkeit logisch, thematisch sowie grafisch zu verknüpfen. Zusätzlich wird damit eine Unterstützung zur Erfüllung von vorgeschriebenen Normen gegeben.

Die Applikation beinhaltet ein Fahrbuchsystem, Kartenwerk, grafisches Informationssystem, Bildergalerie, Notfallplan und Krisenmodul, Legal Compliance und Normkonformitätsmodul, Behörden- u. Öffentlichkeitsmodul sowie eine Benutzer- u. Dokumentenverwaltung.

Technische Beschreibung

Die Umsetzung der Software erfolgt mittels JAVA Technologie. Als Basis der Applikation dient ein so genanntes Fahrbuchsystem, in dem alle den Betrieb betreffenden Dokumente eingegeben, dazu die umfangreichen Kartenwerke erfasst, im System vernetzt und ein Zugriff über mehrere schlüssige Wege ermöglicht wird. Speziell generierte Berichte und Zusammenfassungen in unterschiedlichen Sach- und Fachbereichen können so effektiv u. ökonomisch bereitgestellt werden. Damit wird eine zukunftsorientierte digitale Neubelebung von Betrieben u. eine wesentliche Anhebung der technischen Innovation besonders aufbereitet.

Datensicherheit

Für eine sichere Identifikation und Authentifikation von Benutzern mittels Bürgerkarte wird MOA-ID verwendet. Die Datenbank ist zusätzlich durch eine Proxylösung völlig getrennt vom Internet.

Die maßgeblichen Umsetzungsschritte zur Datensicherheit sind vom Institut für Angewandte Informationsverarbeitung und Kommunikationstechnologie der Technischen Universität Graz getroffen worden.

Markenschutz und Förderung

IRMIS weist einen markenrechtlichen Schutz – Registrierungsbestätigung des Österreichischen Patenamtes, Nummer 242748 – auf.

IRMIS war auch Gegenstand eines Forschungsprojektes der Jahre 2007 – 2008 und fand die (finanzielle) Unterstützung der Österreichischen

Forschungsförderungsgesellschaft mbH und der Steirischen Wirtschaftsförderungsgesellschaft mbH

ZIELE des Fahrbuchsystems:

- Erweiterungsgerechtes System
- Plattformunabhängig
- Leichter Überblick
- Nach Einschulung mühelose Handhabung
- Ständige Systembetreuung und Unterstützung bei der Datenpflege
- Förderung der Produktivität, Individualität und Aktualität im Unternehmen
- Schnelle Übersicht von gesetzlichen Vorgaben

IRMIS bietet mehrwertige Nutzen

- Fördert Beweglichkeit und Belegung im Betrieb
- leichtere Erkennbarkeit von Problemstellungen durch Vernetzungsmöglichkeiten
- bessere Steuerung bergbautechnischer Ressourcen,
- Serviceeinrichtungen mit hohem Komfort und Einsatz neuer Technologien
- kurze Wege mit zentral geführten Organisationsmodellen –

Rücksichtnahme auf umweltrelevante Anliegen

- elektronische Verwaltung – Chance für Wachstum und Stimulierung zur Innovation
- neue Arbeitstechnik mit besserer Kundenbetreuung
- zentrale Leitung u. dezentraler Vollzug mit gleichbleibender Qualität
- erleichteter Zugang zu Informationen für Führungsorgane und Mitarbeiter
- Arbeitserleichterung u. Hebung der Motivation
- fördert neue und verbesserte Kommunikation
- Vorsorge für erhöhte Rechtssicherheit
- rasche Handhabung von Dokumenten

- Erinnerung an Termine, Fristen und Auflagen
- leichtere Verfügbarkeit von Informationen im Not- und Krisenfall
- Evaluierungen von Betriebsergebnissen

Die KLOIBHOFER Bergbausicherheit GmbH ist ein kleinstrukturiertes Ingenieurbüro, das in der Hauptsache für Bergbauunternehmen Planungs- und Aufsichtsfunktionen wahrnimmt und so die bestimmten und weitreichenden Anforderungen im Bergbau bestens kennt.

Im Zuge dieser Aufgabenstellung mit permanenten Behördenkontakten, der Aufbereitung und Koordinierung von Gutachten (von Universitätsinstituten, autorisierten Fachbüros und Sachverständigen), Erstellung von Unterlagen und der Umsetzung von bergrechtlichen und – technischen Vollzugsmaßnahmen zeigte sich die enorme Fülle der sowohl von kleinen als auch von großen Bergbauunternehmen täglich zu besorgenden bürokratischen Arbeitsvorgängen.

Mit dem spezifischen EDV-Programm IRMIS werden Bergbauunternehmen in ihrer Betriebsführung zeitgemäß und zukunftsorientiert, vor allem praktisch unterstützt.

IRMIS findet zum Ressourcenmanagement und zur Aufbereitung der Rohstoffsicherung einen treffenden Zugang. Es kann, da EDV-gestützt, sehr einfach und bedarfsgerecht bei Vortragstätigkeiten anschaulich und nachvollziehbar dargeboten werden. Vielleicht bietet sich im Rahmen Ihres Symposiums eine Möglichkeit, unser „Integriertes Rohstoff Management Informations System“ einzubringen. Ihre Wertschätzung würde uns sehr freuen.

Topic: Mine Development

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Title of Paper: **Internet Tools supporting planning of underground mining transportation**

Vortragstitel: **Internetbasierte Instrumente zur Planung der Förderung im Untertagebau**

Internet tools, supporting the planning of underground transportation in collieries, that were developed during realization of MINTOS project financed by Research Found for Coal and Steel, will be presented. Knowledge repository that includes computer applications is accessible to the designers of underground transportation on the Internet platform. Selection of diesel suspended monorails, carrying beams and brake cars are aided. Maximal required pulling force of diesel suspended monorail for the given roadway upward inclination and maximal required braking force for the given downward inclination are calculated. Possibility of collision between a load and a floor as well as between a load and a roadway during railway turns is tested. Participatory mode of formulation of criteria for assessment of transportation system design is discussed; for example verification of suspended monorail track due to dynamic forces that occur during braking on downward inclinations.

Topic: Mine Development

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Hirofumi Furukawa,
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Title of Paper: **Some considerations in underground mining systems for ultra thick coal**

Vortragstitel: **Verschiedene Betrachtungsweisen von Abbausystemen in besonders mächtigen Flözen**

The research activities for developing an innovative method for the extraction of ultra thick seams (over 10 m thick) must be started and accelerated with the close tie-up between the research institutions, academic institutions, manufacturers of mining machines and coal companies. It is possible to develop a highly mechanized innovative method to overcome the hurdle of the extraction of ultra thick coal seams with high productivity, safety and coal recovery. The developed system must also be cost effective and cost competitive along with keeping the employment in the mine. There are many mines where this mining system is applicable in China, India, Indonesia as well as Thailand. This paper describes underground mining systems for ultra thick coal seams and discusses applicable mining systems, taking into consideration the geological and geotechnical conditions.

Topic: Mine Development

Author / Autor: **Thorsten Brandt,**
mercatronics GmbH, GER

Title of Paper: **Virtual Prototypes for Mining**

Vortragstitel: **Virtuelle Prototypen im Bergbau**

The development of mining equipment is becoming more and more complex. Besides the mechanical construction, the added value is primarily generated in the domain of electrical and electronically components. This mechatronic development process requires close interaction of all developers and experts involved.

The cost-efficient development of these systems requires both, an appropriate project management as well as the identification and elimination of possibly misleading engineering concepts at the earliest possible development stage. Traditionally, the prototype testing is one of the most expensive development stages. Therefore, it is recommended to perform this testing with prototypes as late as possible in order to limit the number of real prototypes.

One possibility to establish system knowledge and to predict relevant technical product properties is the development and usage of simulation models. These models are developed and analyzed in an interdisciplinary manner by all involved experts. This discussion can be supported well by appropriate visualization of the simulation results, based on the developed models. In the past, this required a large effort in terms of soft- and hardware, which appeared to be unjustifiable. Today, this can be done using powerful visualization tools, which perform well already on mass-market PCC hardware and produce realistic impressions. This allows also involving the customer – e.g. mining companies – into the design phase at a very early stage. First milestones like control strategies or assistance systems can be assessed using these virtual prototypes.

Especially for the development of assistance systems (control assistance, collision avoiding etc.) it is necessary to take the user into account as early as possible. This includes the human-machine interface (HMI) as well as a close analysis of the process, which should be supported for the user by the assistance system. Thinking of other branches like the automotive industry, it makes a huge difference if an assistance system influences directly the steering angle or the perceived torque on the steering wheel. The evaluation of both strategies can only be efficiently done using human subject studies in a simulator and later on in prototype vehicles. This procedure is established well as simulator-based development in the automotive or the aerospace industry. Presently, this concept is transferred into other branches like construction or mining machines.

The performance of the simulator is coupled closely to the power of the visualization tools. These flexible tools can be adapted to many environments. This allows to visualize simulations, but also process data of running machines using the same software.

Die Entwicklung von Bergbaumaschinen wird zunehmend komplexer. Neben der mechanischen Konstruktion findet die Wertschöpfung inzwischen vor allem im Bereich elektrischer und elektronischer Komponenten statt. Diese mechatronische Entwicklung erfordert eine enge Zusammenarbeit aller beteiligten Fachleute.

Die kostengünstige Entwicklung dieser Systeme erfordert außer dem entsprechenden Projektmanagement vor allem die frühzeitige Erkennung und Vermeidung möglicher Fehlentwicklungen. Traditionell stellt die Testphase am Prototypen untertage einen der größten Kostenanteile dar. Darum gilt es, in diese Entwicklungsphase erst mit möglichst reifen Produkten einzutreten, um so kostenintensive Umkonstruktionen zu vermeiden.

Eine Möglichkeit, bereits frühzeitig Systemverständnis aufzubauen und signifikante Eigenschaften des zu entwickelnden Produktes vorherzusagen, sind Simulationen. Diese werden von den beteiligten Entwicklern interdisziplinär durchgeführt und analysiert. Die Diskussion zwischen den beteiligten Fachleuten unterschiedlicher Disziplinen wird hierbei am besten durch frühzeitige Visualisierung auf Basis der Simulationsmodelle des geplanten Produktes unterstützt. Bisher erforderte dies häufig einen hohen Soft- und Hardwareaufwand, der meist nicht gerechtfertigt erschien. Heutzutage existieren jedoch leistungsfähige Visualisierungswerkzeuge, die bereits auf Standard-PCs in der Lage sind, sehr realistische 3D-Visualisierungen zu erzeugen. Dies erlaubt es auch den Kunden --etwa die Betreibergesellschaft - mit in die Konzeptionsphase einzubeziehen und erste Meilensteine, z.BB. hinsichtlich der Steueralgorithmien, am virtuellen Prototyp abzunehmen.

Insbesondere in der Entwicklung von Assistenzsystemen (Steuerungsassistent, Kollisionsvermeidung etc.) ist es notwendig, den späteren Bediener möglichst früh zu berücksichtigen. Dies schließt sowohl die Mensch-Maschine-Schnittstelle selbst als auch die genaue Analyse des Prozesses, bei dem der Bediener unterstützt werden soll, mit ein. Denkt man an Branchen wie die Automobilindustrie, so ist der Unterschied, ob ein Assistenzsystem zur Spurhaltung direkt den Lenkwinkel an den Rädern oder aber das empfundene Moment am Lenkrad beeinflusst, immens. Dies kann vom Entwickler jedoch nur in Form von Probandenstudien am Simulator und später im Testfahrzeug beurteilt werden. Dieses Vorgehen ist im Automobil- oder im Luft- und Raumfahrtsektor als simulatorbasierte Entwicklung heute etabliert. Aktueller Trend ist die Übertragung dieses Konzepts auf andere Branchen, so z.B. die Baumaschinen- oder Bergbaumaschinenbranche.

Hierbei ist die Leistungsfähigkeit des Simulators eng an die Performanz der Visualisierungsumgebung gekoppelt. Als flexible Entwicklungswerkzeuge sind Visualisierungsumgebungen heute an verschiedene Umgebungen adaptierbar. So kann nicht nur eine Simulation durchlaufen und visualisiert werden, sondern dieselbe virtuelle Umgebung auch zur Überwachung realer Prozessdaten laufender Maschinen eingesetzt werden.

Topic: Mine Development

Author / Autor: Frank Leschhorn,
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Title of Paper: Gold Mining in Australia - Development of the first German owned gold mining project

Vortragstitel: Goldbergbau in Australien - Entwicklung

Author / Autor: **Sair Kahramann,**
Nigde University, TR
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Nigde University, TR
Cemal Balci,
Istanbul Technical University, TR

Title of Paper: **Predicting the Capacity of Roadheaders in Chromite Ore Excavation**

Vortragstitel: **Untersuchungen zur Vorhersage der Leistungsstärke von Teilschnittmaschinen im Chromeisenerzgewinnung**

The metal prices in the world have been decreased considerably. Using the mechanical miners will increase the production rate and decrease the costs. There are numerous underground chromite mines in Turkey. These mines are small-scale and the excavation method in these mines is the drilling and blasting. Changing market conditions and general global trends cause ups and downs in the commodity prices, which affect especially these small-scale mines. Therefore, these mines need to more efficient mining operations to increase the competitiveness.

In this study, the usability and the excavation capacity of roadheaders in Cevikler Mermer chromite mine was investigated. Chromite samples were collected from the two different mines in the area. Core samples were prepared from the block samples in the laboratory. Physical and mechanical test were carried out on the samples. Small-scale linear cutting tests using drag cutter were also performed on the 70 mm-core samples. Specific energy values were calculated using the mean cutting force and the yield (volume of the cut material) obtained from the results of linear cutting tests. The instantaneous cutting rate (m³/h) for a roadheader was calculated from the equation suggested by Rostami et al. (1994). Yearly production rates of the considered roadheader were calculated and compared to the annually output of the conventional drilling and blasting method. It was shown that the chromite production of the considered roadheader was much more than the existing mining methods.

Topic: Mine Development

Author / Autor: **Marc Kirsten,**
Northern Underground, Australia

Title of Paper: **Improving development rates through the use of the Hilti OneStep Bolt**

Vortragstitel: **Verbesserung der Förderungsraten durch den Einsatz des Hilti OneStep Ankers**

Topic: Mine Development

Author / Autor: **Richard Pavlik,**
OKD, a.s., CZ

Title of Paper: **Technological change in Czech Republic Coal Mining - Experiences with Hilti OneStep Rock Anchor in OKD (and next steps...)**

Vortragstitel: **Technischer Wandel im tschechischen Bergbau - Einsatzerfahrungen mit dem Hilti OneStep Anker bei der OKD, a.s.**

Topic: Mine Development

Author / Autor: **Jürgen Eikhoff,**
RAG Aktiengesellschaft, GER

Title of Paper: **Roadheading in German hard coal mining**

Vortragstitel: **Streckenvortrieb im Deutschen Steinkohlenbergbau**

Topic: Mine Development

Author / Autor: **Bernd Langhanki,**
RAG Aktiengesellschaft, GER
Walter König,
RAG Aktiengesellschaft, GER

Title of Paper: **Lean processing as driving force behind efficiency increase and comprehensive optimization of heading operations**

Vortragstitel: **Lean Processing als Motor zur Effizienzsteigerung und ganzheitlichen Optimierung in der Streckenauffahrung**

Die Streckenauffahrung bildet mit einer Gesamtlänge von fast 50 km im Jahre 2009 neben der Produktion den zweiten wichtigen Kernprozess auf den Bergwerken im deutschen Steinkohlenbergbau. Dabei sind die Anforderungen an die Ausstattung in den Strecken, an den Streckenquerschnitt und an die Qualität des Streckenausbaus in den letzten Jahren ständig gewachsen. Damit hat die Komplexität des Herstellungsprozesses deutlich zugenommen. Natürlich zieht diese Entwicklung auch eine notwendige Anpassung in den Methoden zur Effizienzsteigerung nach sich, denn die Zielrichtungen in der Prozessoptimierung gelten weiter: Erhöhen der Qualität, Einhaltung der Fertigstellungstermine und Reduzierung der Herstellungskosten. Lean Processing ist das Verbesserungsprogramm der RAG um diese Forderungen zu erreichen. In der ganzheitlichen Betrachtung geht es um die Verbesserung aller Teilprozesse vor Ort und im nachlaufenden Bereich genauso wie um die unterstützenden Instandhaltungs- und Logistikprozesse. Transparenz durch Kennzahlen, systematisches und methodisches Vorgehen unter Einbeziehung der Mitarbeiter bilden die Grundbausteine um Verschwendung aus den Prozessen zu eliminieren, die Arbeitssicherheit weiter zu verbessern und die Anforderungen der Kunden für die spätere Nutzung zu erfüllen.

Topic: Mine Development

Author / Autor: **Uwe Pesch,**
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Title of Paper: **Practical experience with a partly automated drilling jumbo on RAG
Auguste Victoria Colliery**

Vortragstitel: **Betriebliche Einsatzerfahrung mit einem teilautomatisierten
Bohrwagenauf dem Bergwerk Auguste Victoria**

Auf den Bergwerken der RAG Deutsche Steinkohle wird bei Bohr- und Sprengarbeiten im Streckenvortrieb der zweiarmige Sprengloch- und Ankerbohrwagen BTRK-2 eingesetzt. Dieser Maschinentyp wurde in einem ersten Schritt mit einer elektrohydraulischen Steuerung und Industrie-PC ausgestattet, mit deren Hilfe wesentliche Funktionen der Bohrarbeit in der Bedienung einfacher und in der Ausführung exakter wurden.

Auf dieser Grundlage wurde die Teilautomatisierung des Bohrwagens betrieben.

Der Teilautomatisierte Bohrwagen kann sich durch eine einfache Orientierung am Richtlaser virtuell zur Streckenachse ausrichten und für die Bohrarbeit eine virtuelle Ortsbrust annehmen und diese dann abbohren.

Der Vortrag soll an Hand des Ersteinsatzes auf dem Bergwerk Auguste Victoria die Vorgehensweise bei der Einführung und die betriebliche Einsatzerfahrung aus Sicht des vorleistenden Betriebes aufzeigen.

Topic: Mine Development

Author / Autor: **Klaus-Jürgen Reinewardt,**
RAG Aktiengesellschaft, GER
Peter Achilles,
RAG Aktiengesellschaft, GER

Title of Paper: **First application of a partially automated AM 105 for driving 2530 loader
gateroad, H seam, RAG Prosper-Haniel Colliery**

Vortragstitel: **Ersteinsatz einer teilautomatisierten AM 105 in der Auffahrung
Kohlenabfuhrstrecke 2530 in Flöz H auf dem Bergwerk Prosper-Haniel**

Auf den Bergwerken der RAG Deutsche Steinkohle werden im maschinellen Streckenvortrieb Teilschnittmaschinen vom Typ AM 105 eingesetzt.

Im Rahmen eines EU geförderten FE-Vorhabens sind Steuerungsfunktionen der Maschine automatisiert worden sowie Sensoren zur Flözlagererkennung und zur Navigation integriert worden.

Die Schwerpunkte der Automatisierung sind

- Das Abfahren automatisierter Schneidvorgänge
- Das Einhalten einer definierten Ladehöhe durch eine Flözlagererkennung
- Das Einfügen erster Hilfsfunktionen zur Navigation (Positionserkennung)

Darüber hinaus soll die Maschine ihren jeweiligen Funktionszustand und mögliche Funktionsfehler selbst erkennen sowie in Abhängigkeit von ihrem Belastungszustand die Grundlage für eine zustandsorientierte Instandhaltung liefern.

Der Vortrag beschreibt die aufgezeigten Entwicklungsschritte und berichtet über die Einsatzerfahrungen unter Tage auf dem BW Prosper- Haniel.

Topic: Mine Development

Author / Autor: **Hartmut Schlüter,**
RAG Aktiengesellschaft, GER
Frank Lüttig,
RAG Aktiengesellschaft, GER
Ulrich Barth,
Thyssen Schachtbau GmbH, GER

Title of Paper: **Extension of the 7th level south shaft-landing, 10 shaft, RAG Prosper-Haniel Colliery**

Vortragstitel: **Weiterauffahrung des südlichen Füllortes Schacht 10, 7. Sohle auf dem Bergwerk Prosper-Haniel**

Während des Tieferteufens des Schacht 10 wurde das Füllort auf der 7. Sohle (-1159 m NN) beidseitig ca. 10 m ausgesetzt. Mit der Auffahrung der Richtstrecke C 467 erfolgte im September 2008 der Durchschlag am nördlichen Füllort. Für den Durchschlag wurde im Vorfeld ein numerisches Modell erarbeitet, um den Einfluss der Auffahrung auf die sehr steife Ausbausohle des Füllortes zu beurteilen (stahlfaserarmierter Spritzbeton mit Gittergurt-trägern und Ankerung). Auf Basis der Rechenergebnisse und der angetroffenen geologisch / geotechnischen Situation erfolgte eine detaillierte Planung der einzelnen Ausbauschritte, die nachfolgend untertägig erfolgreich umgesetzt wurde.

Aufgrund einer weiteren gebirgsmechanischen Detailuntersuchung und den Erfahrungen beim Erstellen des nördlichen Anschlusses wurde für den südlichen Anschluss empfohlen, die Weiterauffahrung vom Schacht 10 aus durchzuführen und nicht nochmals auf den Schacht zuzufahren. Bedingt durch den großen Querschnitt der südlichen Ortsscheibe waren für die Planung der anstehenden Auffahrung Lösungen gefragt, die ansonsten im täglichen Vorleistungsgeschäft nicht anzutreffen sind. Hier sind zu nennen:

- Einsatz einer im Stoß verlagerten starren Bühne in ca. 4,5 m Höhe über der Sohlenbühne des südlichen Füllortes
- Einsatz eines Bohrwagens auf der Auffahrbühne
- Einsatz eines Bobcats als Ladegerät auf der Auffahrbühne
- Konzeption einer Auffahr- und Ausbautechnik, die den zu erwartenden Belastungen gewachsen sein muss

Über die Planungen und die Erfahrungen mit diesem Vortrieb soll berichtet werden.

Topic: Mine Development

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Title of Paper: **Development of an automatic cutting cycle for part face mining machines**

Vortragstitel: **Entwicklung eines automatischen Schneidverfahrens für
Teilschnittmaschinen**

Especially during the last years a global trend to introduce automation even in mining can be observed. Its general aim is to improve human safety and to ensure continuous productivity at the running machines. Ruhrkohle AG puts a lot of effort into mine automation and is currently improving the whole equipment for development and production at the coal mine Prosper Haniel to a top level of automation. SANDVIK Mining & Construction develops the correlating roadheader concept.

Roadheaders have to fulfill different tasks simultaneously and should provide high flexibility during operation. These machines have to cut predefined profiles along a planned tunnel following the coal seam and considering different rock and rock mass conditions. Furthermore these systems have to provide the whole equipment for roof support like setting arches, shotcreting and roof bolting.

The presentation outlines the requests and boundary conditions for an automatic cutting cycle. It tells about the different kinds of measurement and information that is needed as a prerequisite for automation. It introduces the practical solutions (laser scanner to identify the coal seam, mine-laser for navigation) and evaluates their cost and benefit for the whole system. Furthermore it describes the strategy for planning and performing an automatic cutting cycle, where cutterload-optimization and handling of bad roof condition is addressed.

Finally a feedback about prototype-introduction and -testing as well as an outlook for future development will conclude the presentation.

In den letzten Jahren ist ein Trend zur breiten Einführung der Automation im Bergbau bemerkbar, der in erster Linie zur Erhöhung der menschlichen Sicherheit und zur Gewährleistung einer kontinuierlichen Produktivität der eingesetzten Maschinen eingesetzt wird. So rüstet auch die Ruhrkohle AG im Zuge der Aufwertung des Bergwerkes Prosper Haniel die gesamte eingesetzte Ausrüstung auf einen möglichst hoch entwickelten Automationsgrad auf. SANDVIK Mining & Construction entwickelt dazu das entsprechende Teilschnittmaschinenkonzept.

Die Automation einer Teilschnittmaschine stellt dabei eine große Herausforderung dar, da dieses System viele Aufgaben zugleich erfüllt und dabei ein sehr hoher Grad an Flexibilität gefordert ist. So stellt dieses System neben dem schneidenden Vortrieb auch die Arbeitsplattformen und Infrastruktur für den Bogenausbau und das Ankersetzen zur Verfügung. Andererseits beherrscht dieses System im Vortrieb verschiedenste Ausbruchsprofile und stark schwankende Gesteins- und Gebirgsverhältnisse. In diesem Zusammenhang bildet die automatische Planung und Durchführung des Abschlagschneidens eine Kernkomponente dieses Konzeptes.

Der Vortrag stellt die Ansprüche und Randbedingungen, die für den automatischen Schneidablauf notwendig sind, dar.

Es wird erklärt, welche Informationen dabei verwendet werden (Laserscanner zur Grenzschichterkennung, Grubenlaserstrahl zur Navigation allgemein), wobei auch auf Aufwand und Nutzen der Komponenten eingegangen wird. Weiters geht er auf die Strategie ein, wie der automatische Schneidablauf geplant und schließlich durchgeführt wird. Dabei werden Funktionalitäten, wie Schneidlastoptimierung und Beherrschung des gebrächen Bereiches vorgestellt. Den Abschluss bilden erste Rückschlüsse von der Prototypenerprobung untertage und ein Ausblick auf die weiteren Entwicklungen.

Topic: Mine Development

Author / Autor: **Nikolaus Sifferlinger,**
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Title of Paper: **Selection criteria for in-place mining and place-change mining in room and pillar operation**

Vortragstitel: **Auswahlkriterien für den Einsatz von Bergbaumaschinen mit integrierter Ankerbohr- und Setzeinrichtung oder Bergbaumaschinen in Verbindung mit getrennten Ankerbohr- und Setzeinrichtung-Fahrzeugen im Kammer-Pfeiler-Bergbau**

Coal mining is a very important part of the mining industry and is also affected by the economical crisis. Every mine section is different to the next section and has different needs concerning equipment selection. Now it is more important than ever to define and analyze the local mining conditions before new equipment investments are made. After that, the mining method and mining equipment can be selected which will optimize the raw material output and / or the mining advance rate and makes the mining section more economical.

The presentation will give a comparison of in-place mining method and place-change mining method with the corresponding available mining equipment. Different mine parameters which influence this selection process will be described and discussed. Furthermore, it will also include a list of advantages and disadvantages for the different mining equipment and how different coal clearance systems can influence the production rate.

Last but not least we want to compare the described mining methods for the following applications:

- Mining of shallow and deep coal seams
- Mining of low and high coal seams
- Using for room and pillar Mining and longwall development

Topic: Mine Development

Author / Autor: **Hakan Ozsen,**
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Ihsan Ozkan,
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Title of Paper: **Assessment of pillar dimensions of cankiri-turkey rock salt mine by numerical analysis**

Vortragstitel: **Numerische Analysen zur Bewertung der Abmessungen von Pfeilern im Steinsalzbergwerk in der Provinz Çankiri, Türkei**

Çankiri rock salt formation is one of the most important rock salt sources of Turkey. Rock salt production in this area is performed by underground room and pillar mining method approximately 150 m under existing topography. However, pillar dimensions which are used in Çankiri rock salt mine are determined by trial and error method. Aim of this study is to create a model which will overlap long and short term rock mechanics analyses results with in-situ stresses and in-situ deformations. By the evaluation of these results pillar dimensions were determined by numerical methods. Numerical analyses were carried out with PHASE2 software which uses hybrid numerical modeling method. Firstly the pillar dimensions applied at the present time were investigated then different pillar dimensions were tested in order to investigate the boundary conditions of safe pillar dimensions.

Author / Autor: Jaroslaw Brodny,
Silesian University of Technology, PL

Title of Paper: Load-carrying capacity of mine road supports as a factor protecting mine work environment against rock bursts

Vortragstitel: Die Tragkraft von Streckenauffahrungen als Faktor zum Schutz der Arbeitsumgebung vor Gebirgsschlag

Rock bursts constitute one of the main natural hazards of work environment in the Polish mining industry. Their consequences may be tragic both for people and for machines and other equipment present in their influence zone. This contribution presents results of research work aimed at determining if and how load-carrying capacity of mine road supports influences a possibility of occurrence and intensity of rock bursts. The research work was performed for coals in triaxial stress conditions analogous to the in-situ conditions existing in rock mass where rock bursts come into being. Load-carrying capacity is a parameter that unambiguously characterises a mine road support and at the same time allows determining the supports' influence on a possibility of rock burst occurrence. Therefore the performed research was aimed at determining what was the influence of load-carrying capacity of supports on values of the stress components during rock bursts.

Investigations were performed for four measurement systems. The first of them was a system without a support model and the remaining three with models of mine road supports with different load-carrying capacities. The different load carrying capacities were attained by different densities of supports set up along the same length of mine road section under investigations.

Based on an analysis of obtained results it is justified to state that load bearing capacity of mine road supports has an essential influence on possibility of occurrence and intensity of rock bursts. The pressure exerted by mine supports on surrounding rock mass influences the pressure state at which rock bursts come into being. Based on the performed research it has been affirmed that the rock mass capability to produce rock burst is one of its characteristics. The conditions that have to take place for a rock burst to occur were also determined. The analyses were accomplished based on results obtained during stand tests.

Topic: Mine Development

Author / Autor: **Suresh Kumar,**
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Title of Paper: **Managing existing mineral resources in Indian coal mines - Technological option and challenges for underground reserves**

Vortragstitel: **Management mineralischer Rohstoffe im indischen Bergbau - technische Möglichkeiten und Herausforderungen zur Gewinnung der untertägigen Reserven**

In India, the most of the coal production comes from open pit mines. Open pit mining has its own implications due to depth and environment pollution. Therefore, a proper underground resource management needs to be explored and implemented at this juncture to bridge the technological void. Proper planning and methodological adoption for existing underground resources only would do. The study of history of Long wall method in the country has not shown attractive results, but introduction of new era Long walls would break the earlier records. Enormous quantity of coal is locked up in underground standing pillars in the country. Extraction of these pillars by Short wall method and thick seam mining are the area where the Indian mining community has to have a focus to liquidate the existing underground standing pillars. This paper introspects and explores the possibility of sustainable winning of existing today's underground resources with the viable technological option, based on past experiences and present world mining scenario so as to ensure tomorrows supply.

World coal institute estimates coal is the major contributor for energy generation to the tune of 60% and remaining from gas, diesel, nuclear, wind and hydel. In India, 75% coal is consumed by power sectors. The demand tends to outstrip domestic supply. The power sectors continue to report generation losses from coal shortages. The pace of power capacity additions has hardly been commensurate with the need. Less than 30 GW of the planned 40 GW for 2002-07 could have been materialized as reported by The Energy and Research Institute of India (TERI). The Government's recent effort to build several 4000 MW power plants under ultra mega power schemes would require coal blocks with reserves of 600-700MT. The projected coal demand for the year 2024-25 for power, steel, cement and others nearly 1147 MT which is doubled the existing coal production. Hence the present 6% growth in coal production would not be sufficient.

The country has nearly 95 BT proven and 55 BT extractable coal reserves. The coal industry in the country is governed by CIL 80% with 8 subsidiaries, SCCL 9% and 5% captive mines by others. As per the coal mines amendment bill, Government of India has identified captive coal blocks and nearly 291 blocks were allotted for Private and Public sectors to augment the coal production. But this is only transitory solution for the deficit. Because, most of the coal production comes from open pit mining and it nearly contributing over 84% of absolute production in the country. Open pit mining has its own implications due to depth and environment pollution whereas billion tonnes of coal locked up in underground standing pillars and in thick seams requiring suitable technology. This not only shows lack of resource management but leaves a great technological void to compensate opencast coal production with proper exploitation of existing underground resources.

Bulk production of coal at faster rate from underground, particularly at depth is possible from Long wall which is proven technology worldwide. Besides, nearly 40% of the proven reserves are in thick seams posing technological challenge for long time. The conventional underground methods like pillar extraction and multi stage mining are only proven technologies so far in the country. The percentage of extraction in these methods is well known to be less than 40%. The other mining methods like Wide stall, Long wall with increased height of extraction and Top coal caving are having their own drawbacks. The Blasting gallery method of winning thick seams introduced in SCCL in 1989, witnessed to be great success. On the other hand, the coal pillars staved in underground both in CIL and SCCL due to various complex mining conditions need to be rightly exploited to the present country's coal requirement or otherwise in-justification to the nation's wealth. CIL has introduced short wall mining, a variant of Long wall mining to extract underground pillars. SCCL has identified few properties for short wall to be introduced in near future. High wall mining is the state of art of mining, gifted to the mining community world wide to survive the open pit mines suffering from uneconomical stripping ratio. It conglomerates both underground and open pit technologies being practiced in US, Australia etc., In India CIL and SCCL have identified blocks to introduce this method in coming years.

This paper deals with the tale of success and failures of mining methods practiced so far in the country and explores the possibility of sustainable winning of underground resources with the viable technological option and the challenges ahead.

Topic: Mineral Resources

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Title of Paper: **Impacts of "good governance" on mining project evaluation**

Vortragstitel: **Wirkungen von "Guter Regierungsführung" auf die Projektbewertung von Bergbauunternehmen**

In recent years, Good Governance in the extractive sector has been recognized as a key factor for the utilization of revenues generated by exploitation of mineral resources for the benefit of a society as a whole.. This applies especially to developing countries potentially profiting from the new mineral resource boom, for instance DR Congo, where Good Governance has become a focus of development cooperation.

According to a World Bank study issued in 2007, the official tax share from the mining sector of DR Congo added up to only about 20 % of the calculated 185 Mio. USD that could have been earned corresponding to the mineral production statistics. On one hand, these obvious revenue losses are attributable to mismanagement in the resource administration – e.g. mining authority and cadastre are not suitable to relate amount and value of the mining production to the actual exports –, aggravated by the total lack of fiscal control over extensive parts of the country and on the other hand they seem to be an immediate consequence of corruptive behaviour at all levels of state administration, combined with widespread tax evasion perpetrated by some of the mining enterprises.

Compared to other mineral resource rich countries in Africa, DR Congo did not only suffer from revenue losses, but, due to adverse investment conditions, underperformed regarding exploration and project development in the mining sector despite the countries' extraordinarily rich mineral resources. Nevertheless, recent efforts of the Congolese government to implement Good Governance policies in the mineral resource sector resulted fructiferous: From the perspective of the international mining industry they already reduced political project risks in the DR Congo.

In the long term the improved country risk rating will be reflected in the economic evaluation of mining projects in the DR Congo. As project risks correlate with the need for short term turnarounds on investments, a decrease of political project risks should facilitate a reduction of the acceptable profit expectations and an increase of reasonable payback periods in the evaluation of mining projects. The following explanations are based on studies of economic mining models and shall provide indications to what extent a reduced investment risk can increase the resource potential of the DR Congo, resulting in a boost of the fiscal revenues from extractive businesses. Furthermore, they aim at an examination of the effects of Good Governance on the investment behaviour of multinational mining companies and their considerations regarding investments in the DR Congo.

„Gute Regierungsführung“ im Rohstoffsektor wurde in jüngerer Vergangenheit als eine der wichtigsten Bedingungen für eine den Wohlstand der gesamten Gesellschaft fördernde Nutzung der mineralischen Reichtümer erkannt. Sie bildet seit dem Beginn des neuen Rohstoffbooms einen Schwerpunkt in der Entwicklungszusammenarbeit mit den so genannten rohstoffreichen Entwicklungsländern, wie z.B. mit der DR Kongo.

Nach einer Studie der Weltbank über den Rohstoffsektor in der DR Kongo aus dem Jahr 2007 betragen die offiziellen Staatseinnahmen aus dem Bergbausektor nur rund 20 % des gemäß Förderstatistik zu erwartenden Wertes in Höhe von 185 Mio. US \$. Die nicht realisierten Einnahmen des kongolesischen Staats resultieren hauptsächlich aus der Misswirtschaft in der staatlichen Rohstoffverwaltung – z.B. können von der Bergaufsicht und dem Katasteramt Angaben über Bergbauproduktion nicht nachvollzogen werden – und sind auch eine direkte Folge von Steuerhinterziehung und Korruption.

Neben den direkten fiskalischen Einnahmeverlusten sorgte auch das mangelhafte Investitionsklima in der DR Kongo in der Vergangenheit dafür, dass trotz Ressourcenreichtums die Erkundung und Nutzung der Rohstofflagerstätten gegenüber anderen afrikanischen Ländern ins Hintertreffen geriet. In den letzten Jahren haben allerdings die Bemühungen der kongolesischen Regierung um „good governance“ im Rohstoffsektor aus Sicht der internationalen Bergbauindustrie zu einer Verringerung der politischen Projektrisiken geführt.

Langfristig wird sich die geänderte Risikoeinschätzung auch in der wirtschaftlichen Bewertung von Bergbauprojekten in der DR Kongo niederschlagen. Ein vergrößertes Projektrisiko führt bei den Investoren im Allgemeinen zu Forderungen nach höheren Gewinnen bzw. einer verkürzten Amortisationsdauer (Paybackperiode) des Projektes. Im Umkehrschluss ermöglicht ein vermindertes Risiko bei der Projekteinschätzung eine Reduzierung der akzeptierbaren Gewinnerwartungen und eine längere annehmbare Amortisationsdauer.

Die folgenden auf Modelluntersuchungen basierenden Ausführungen sollen Hinweise liefern, inwiefern durch ein vermindertes Investitionsrisiko das Ressourcenpotential der DR Kongo erhöht wird und sich die staatliche Teilhabe am Rohstoffwert vergrößern lässt. Weiterhin wird untersucht, welche Auswirkungen auf das Investitionsverhalten der multinationalen Unternehmen in der DR Kongo zu erwarten sind.

Topic: Mineral Resources

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- Title of Paper:** **Securing the Mineral Resources of Wales for Future Generations: The National Minerals Map of Wales and Aggregate Safeguarding Map of Wales**
- Vortragstitel:** **Sicherung der mineralischen Rohstoffe in Wales für zukünftige Generationen: Entwicklung der "National Minerals Map of Wales" und der "Aggregate Safeguarding Map of Wales"**

Minerals are important, non-renewable national assets and their extraction and use makes an essential contribution to the Welsh economy. Minerals are vital for the construction and manufacturing industries as well as for the energy needs of Wales. In Wales, mineral production is dominated by aggregates – crushed rock, sand and gravel.

The extraction of minerals competes with other land uses and is often contentious. In Wales it is the responsibility of each Unitary Authority to ensure that adequate mineral resources are available, and to balance society's need for minerals with the inevitable impact on the environment through the appropriate siting of development and mitigation measures.

Partly funded by the Aggregates Levy Sustainability Fund, the Welsh Assembly Government and the British Geological Survey are currently considering the issues of mineral resource supply and security for the whole of Wales. The final product of this exercise will be a National Mineral Map of Wales which will identify all mineral resources at a national level.

Based on the National Mineral Map, an additional product, the Aggregate Safeguarding Map of Wales, will also be produced to highlight at a national scale those resources suitable for aggregates that need to be considered during the safeguarding process undertaken by each Unitary Authority. This approach is different to that undertaken in England, where the selection of mineral resources for safeguarding is undertaken independently by each Mineral Planning Authority,

These maps will be available for use as a consideration in land use planning decisions and will assist in meeting future minerals demand in Wales.

Topic: Mineral Resources

Author / Autor: **Chloe E. Wrighton,**
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Title of Paper: **Towards the effective consideration of mineral resources in land-use planning: Challenges and way forward in England**

Vortragstitel: **Der Weg zur nachhaltigen Berücksichtigung mineralischer Rohstoffe in der Flächennutzung: Herausforderungen und nächste Schritte in England**

The planning system in England is underpinned by the principle of sustainable development. Through the system, regional and local planning authorities seek to implement a strategy that balances the social, economic and environmental components of an area whilst also considering the needs of existing and future generations. Adequate and steady supplies of minerals are central to sustaining the economy in England, and as the need for and supply of minerals crosses national and international boundaries, they are vital assets for the European Economy also. Consequently, there is a need for on-going support and commitment from the European Union to protect our domestic mineral resources from unnecessary sterilisation from non-mineral development.

Despite commitment to sustainable development at both European and national level, spatial planning has had limited impact on the protection of mineral resources. However, growing concerns over security of raw material supply is forcing policy makers and regulators to appreciate the importance to safeguarding mineral resources for future generations. Underpinned by research and guidance published by the British Geological Survey (BGS), mineral planning policy for England now provides a framework for the safeguarding of minerals, but the application of this policy has been fraught with challenges. The policy obliges planning authorities at the local level to define Mineral Safeguarding Areas in their development plans and to include policies to ensure that the resources identified are effectively protected when making land-use planning decisions. In trying to implement this obligation, difficulties such as the clarity of wording in national policy, the lack of relevant expertise in planning officers to complete the duties expected of them and the practicalities of implementing the system through development control, have been faced.

This paper presents the latest research undertaken by the BGS in relation to mineral safeguarding in England. Challenges encountered during implementation of minerals safeguarding policy and guidance are explored and the way in which these are being approached, is discussed.

Topic: Mineral Resources

Author / Autor: **Deborah J. Shields,**
Colorado State University, USA

Title of Paper: **Results and follow-on of the meeting "Engineering Solutions for Sustainability: Material and Resources"**

Vortragstitel: **Ergebnisse und geplante Schritte der Tagung: "Engineering Solutions for Sustainability: Material and Resources"**

The American Institute for Mining, Metallurgy, and Exploration (AIME) hosted Engineering Solutions for Sustainability: Materials and Resources, an international workshop at the Ecole Polytechnique Federale de Lausanne in Switzerland. The event was co-sponsored by the American Society for Civil Engineers (ASCE) and the American Institute of Chemical Engineers (AIChE) and its Institute for Sustainability, and supported by a generous grant from the United Engineering Foundation (UEF). The meeting brought together academics, industry and economic experts, and governmental and non-governmental representatives to discuss societal challenges in the areas of transportation, energy, recycling, housing, food and water, and health and potential ways that the engineering profession can aid in addressing those be it through technological, educational, or public policy solutions.

Participants debated the meaning of sustainability and how the engineering professions can contribute to the achievement of a sustainable future. A multidimensional, operational definition of sustainability was developed; it emphasized the importance of enabling current and future generations of society to be resilient to anticipated and unanticipated changes in economic, environmental, political and social systems. And therefore engineered systems and practices will need to be adaptable to unforeseen demands and technical capabilities.

Over the course of the meeting common themes emerged from the 6 focus areas. One of the most important was recognition of the need to escape the 'Silo Mentality', and to approach challenges in cross-disciplinary, cross-sectoral ways. Resource-efficient design was also highlighted and linked to life cycle assessment and costing. Given the critical need for engineers in all disciplines if we are to achieve sustainability, participants agreed to extend an invitation to young scientists and engineers to participate in ongoing discussions. Other general conclusions, focus-area specific results, and planned future steps will be discussed in this paper.

Topic: Mineral Resources

Author / Autor: **Deborah J. Shields,**
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Geological Survey of Slovenia, SI

Title of Paper: **Debating the concept of resource scarcity: physical versus socioeconomic definitions**

Vortragstitel: **Erörterung zu den Ursachen der Rohstoffknappheit - physikalische versus sozialwirtschaftliche Gründe**

Once a mineral is considered useful to humans, it is relabeled as a resource and its abundance and availability, i.e., supply, becomes important. Abundance is a question of geologic and economic stocks. In contrast, availability is a question of flows through the mineral system. Mineral resources are said to be scarce if the amount offered for sale in markets is less than consumers would like to purchase regardless of price. In this paper we distinguish among the various physical and socioeconomic reasons that minerals are or become scarce.

Some mineral resources are quite rare, i.e., there is little of them in the earth's crust. However, a mineral may have only recently become viewed as a resource and so only limited exploration has taken place. For example some rare earth oxides are currently scarce, but more deposits may be found as exploration activity increases. The third possibility is that resource stocks are being depleted, that new deposits are not being found at a rate adequate to replace the amount of mineral being extracted each year. Some would argue this is the case for copper.

The flow of a resource through the mineral system may be restricted for various socioeconomic reasons. We distinguish among situational, political and social scarcity. Situational scarcity is caused by one or more of a broad set of circumstances that act to limit the flow of minerals to markets, e.g., a temporary cessation of production due to extreme weather. Political scarcity occurs when the flow is halted or restricted due to choices made or actions taken by governments, e.g., embargoes. Socially driven scarcity may occur if citizens of a producing country decide that the environmental and social costs of extraction are too great to bear. We compare and give examples for the various situations, addressing how different definitions lead to different views about the urgency of resource scarcity.

Topic: Mineral Resources

Author / Autor: Arne Bayer,
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Title of Paper: Long term development of the world's seaborne steam coal export markets focusing on producing countries and

Vortragstitel: Langfristige Entwicklung der weltweiten Steinkohleexportmärkte mit Fokus auf Produzentenländer und Qualitäten

Kesselkohle wird weltweit an Warenterminbörsen auf Basis von Standardqualitäten z.B. API4 gehandelt. Diese liquiden Märkte sorgen dafür, dass Verbraucher sich mit der benötigte Kohle innerhalb der Handelsperiode eindecken können. Für den darüber hinausgehenden Zeithorizont steht die grundsätzliche Verfügbarkeit von Kohle ebenfalls nicht zur Diskussion – Kohle wird auch in 2030 in ausreichenden Mengen zu beschaffen sein. Doch ist damit für Kraftwerksbetreiber noch nicht die Frage nach den Beschaffungskosten oder die in Zukunft zu erwartenden Kohlequalitäten beantwortet. Letztere beeinflussen maßgeblich die Dimensionierung neuer Kraftwerke und damit Investitionsentscheidungen als auch die Betriebskosten. E.ON Kraftwerke analysiert seit Jahren die weltweiten Kohlemärkte mit Fokus auf die Exportnationen sowie auf die entsprechenden Kohlequalitäten. In diesem Beitrag soll im Detail auf die zukünftige Entwicklung der Exportnationen und daraus abgeleiteten Volumina und Qualitäten eingegangen werden.

Topic: Mineral Resources

Author / Autor: **Mario-Luis Rodriguez Chavez,**
Ecole Nationale Supérieure des Mines de Paris, F

Title of Paper: **Breaking present schemes of the access to the aggregate resource**

Vortragstitel: **Neue Zugriffsmöglichkeiten auf die gesamten Ressourcen**

The classic belief that construction minerals are available in virtually infinite quantities has been dampened in many European countries by the permanently rising difficulties in access to the resource. A growing demand in construction aggregates has to face growing social, political and environmental constraints. The fact that the aggregates market is mainly regulated by mechanisms on the scale of the local surroundings of a consumption centre makes macro-economic predictions difficult. This paper presents the results of the French-Austrian research project "ANTAG" (Anticipation of the access to the aggregate resource by breaking present schemes on the long term). It shows an innovative approach of modelling macroeconomic mechanisms in the aggregates market to conceive and simulate long-term scenarios. The calibration of the model describing a base case scenario is performed using the principle of System Dynamics. The sub-models reflect the dynamics of demand, accessibility, production, transport and environmental impacts, and their interaction. Four selected breaking scenarios are presented and their simulation results will be compared to the base case. One scenario studies the effects of a potential long-term economic slowdown on the aggregates market. The second scenario shows how an increase in substitution of aggregates by other materials and new technology for building construction reduces the local demand. A further scenario covers the penetration of aggregates imported to France and the effects on the market equilibrium. A fourth scenario shows why a move away from road transport towards alternative transport modes does not result in an expected significant decrease in environmental impacts.

Topic: Mineral Resources

- Author / Autor:** **Achim Freund,**
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- Title of Paper:** **Results of new geological studies for copper at the concession area
Weißwasser / Lausitz**
- Vortragstitel:** **Ergebnisse neuer geologischer Untersuchungen auf Kupfer im
Erlaubnisfeld Weißwasser in der Lausitz**

In 1958 first prospecting works for copper started in the area of the Mulkwitz Anticline in East Germany. In 1974 exploration was completed and the decision was made to develop a mine in the Spremberg-Graustein copper deposit.

In the period 2008 – 2009 a German-Polish team reviewed and evaluated the old exploration data southeast of the known Spremberg-Graustein deposit within a concession area of 364 km² on the territory of the Freestate of Saxony/Germany. Based on the outcomes of this study a drilling programme and seismic measurements have been commenced southeast and northwest of Weißwasser, which provided significant new facts about character and extension of the copper mineralisation at the Zechstein basis in this area.

Im Bereich der Mulkwitzer Antiklinalstruktur in Ostdeutschland begannen 1958 erste Prospektionsarbeiten auf Kupfer. 1974 wurde ein Explorationsbericht vorgelegt, der die Grundlage für damalige Investitionsentscheidungen zum Aufschluss der Kupferlagerstätte Spremberg-Graustein darstellte.

Im Rahmen einer Kenntnisstandsanalyse durch ein deutsch-polnisches Team wurden die alten Erkundungsunterlagen verifiziert, die Verbreitung der Kupfervererzung südöstlich der bekannten Lagerstätte Spremberg-Graustein innerhalb eines Erlaubnisfeldes von rund 364 km² Größe im Freistaat Sachsen/Deutschland untersucht und bewertet. Auf dieser Grundlage begannen 2009 Erkundungsbohrungen sowie seismische Messungen im höffigen Gebiet südöstlich und nordwestlich von Weißwasser, die einen erheblichen Erkenntnisgewinn zur Ausbildung und Verbreitung der Kupfermineralisation erbrachten.

Topic: Mineral Resources

Author / Autor: Eike von der Linden,
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Title of Paper: Oil-shale deposit Al Lajjun in Jordan

Vortragstitel: Ölschieferprojekt EL Lajjun in Jordanien

Jordan Energy & Mining Ltd (JEML) is developing the oil-shale deposit Al Lajjun in Jordan. Syncrude from oil-shale will contribute to the global supply of oil supported by a long term oil price forecast of USD 90/bbl.

The project has gone through a full FS with 140,000 engineering hours and including infill drilling, trial mining and processing of 500t representative samples in the ATP pilot plant in Calgary.

The expenditures were born by a private placement which raised funds of USD 32m. For binding proposals for supplies and construction front-end-engineering packages have been commissioned.

The project will be in compliance with environmental thresholds related to carbon emissions, water consumption and other relevant criteria.

The key findings of the bankable FS are:

- based on NI 43.101 certified 2p reserves 29year mine life in the northern Al Lajjun concession field
- Total oil-shale mined 210m t containing 140-150m extractable barrels
- Barrels per stream day approx 15,800
- Net carbon emission 210 kg CO₂/bbl
- Water used (predominantly brackish water) about 0.5 m³/bbl
- 70 MW power generated partly for power export
- Engineering and construction 42 months
- Total initial capex before financial costs USD 1,500 million
- Cash unit costs approx. USD 22/bbl, full costs approx. USD 55/bbl

Jordan Energy & Mining Ltd (JEML) entwickelt die Ölschieferlagerstätte Al Lajjun in Jordanien. Syncrude aus Ölschiefer wird zur globalen Rohölversorgung beitragen, getragen von der langfristigen Ölpreisprognose von USD 90/Barrel. Das Projekt ist durch eine vollständige Machbarkeitsstudie gegangen mit 140.000 Ingenieursstunden. Es sind Verdichtungsbohrungen und ein Versuchsbergbau durchgeführt worden. Mit einer repräsentativen 500t Probe ist die Verfahrenstechnik in einer ATP Pilotanlage in Calgary ausgelegt worden.

Die Ausgaben sind durch eine nicht börslich Emission mit einer aufgenommen Finanzierung von USD 32 mio getragen worden.

Für verbindliche schlüsselfertige Angebote sind Front-end-engineering Pakete beauftragt worden.

Das Projekt wird im Einklang mit geltenden Vorgaben des Umweltschutzes bezüglich Co₂-Emissionen, Wasserverbrauch und sonstigen anwendbaren Kriterien entwickelt.

Die wesentlichen Ergebnisse der bankfähigen Machbarkeitsstudie sind:

- Basierend auf NI 43.101 zertifizierten sicheren und wahrscheinlichen Reserven erreicht die Konzession im nördlichen Al Lajjun Feld eine Lebensdauer von 29 Jahren
- Der bergbaulich gewonnene Ölschiefer beträgt 210 mio t mit 140-150 mio extrahierbaren Barrels
- Die netto CO₂ Emissionen sind 210kg/Barrel
- Der Wasserverbrauch (vorwiegend Brackwasser) ist ca. 0,5 m³/barrel
- 70 MW Gasturbinenkraftwerk mit teilweiser Abgabe ins Netz
- Planungs- und Bauzeit 42 Monate
- Investitionen vor Finanzierungskosten USD 1.500 mio
- Ausgabenwirksame Kosten USD 22/Barrel, Vollkosten ca. USD 55/Barrel .

Topic: Mineral Resources

Author / Autor: Mark Mistry,
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Title of Paper: **Critical raw materials for modern and future societies: Nickel as a Case Study**

Vortragstitel: **Kritische Rohstoffe für eine moderne und zukunftsgerichtete Gesellschaft: Nickel as Fallbeispiel**

Modern and future societies highly depend on a sustainable and secure supply with raw materials. The dramatic price increases of e.g. metal commodities in the recent past demonstrated the threats for key downstream user industries in Europe, and especially industry sectors with key importance for a sustainable future. Raw materials supplying industries such as the metals industry, however, are facing a wide range of challenges, covering conflicting interests with the regulatory framework or issues related to trade and competition hampering a continuous and safe supply with raw materials.

Upon request from industry, the topic was addressed in the "Raw Materials Initiative" (COM (2008)699) launched by the European Commission in 2008. The Communication discusses various regulatory measures. They aim at ensuring a safe supply of the EU economy with raw materials being essential for the future of the EU economy. A first draft list of critical raw material is under discussion. Besides some minerals, the list covers a wide range of precious, high tech, rare and base metals, amongst them also nickel.

The presentation will demonstrate the criticality and importance of metals such as nickel to modern societies and important economies such as the European Union. Moreover, an outlook will be provided on future technologies which are seen as solutions for main global challenges (e.g. climate change) and the importance of nickel in these technologies. The presentation will conclude with recommendation for measures that ensure a secure supply of the EU economy with nickel as a good example for a highly critical raw material for the EU economy.

Topic: Mineral Resources

Author / Autor: **Kaepae Ken Ail,**
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Title of Paper: **Economic and fiscal implications of extractive resources ownership structures in Papua New Guinea**

Vortragstitel: **Ökonomische und steuerrechtliche Auswirkungen von Eigentumsverhältnissen auf die Rohstoffindustrie in Papua-Neuguinea**

Minerals[1] resource abundance amidst weak political state and traditional landownership regime in Papua New Guinea, entice the emergence of equity participation and change of minerals laws. There is increasing urgency amongst some sects of political leaders, people from resourceful regions and non-government organisations are pushing for policy shifts. They are pressuring the Government to change the Mining Act (1992). The Government already has legislated policy, which gives the right to own equity in minerals projects. These two regimes are related regimes and predicted to impede export driven growth of the economy, reinvigorate rent seeking behaviour, distort international competitiveness, risk of resource development policy failure and the Nation becomes a predatory political state. The combinations of equity ownership and absolute recognition of minerals resources ownership by local people resembles nationalization, which could destroy the already fragile economy. In the last decade, nationalized mining industry regime likes of Chile, Indonesia, Venezuela and Zambia experienced poor economic performances, marked by periods of socio-political upheavals, export diversification and demise of their citizens' welfares (Auty, 2000).

This paper contents the hypotheses that equity ownership and minerals resources own by the people, resemble nationalization regime. Papua New Guinea's largest ever liquidified natural gas (LNG) project development in recent times and attractive metallic minerals deposits, are enticing the emergence of state owned enterprises like Petromin Holdings Limited, spurred by.

The paper researches into foreign and domestic equity policy characterized by ownerships of mineral, petroleum and gas resources in Papua New Guinea. Central to the hypotheses, this paper analyses commercial and economic benefits and risk attributes of the increasing demands by National and Provincial Governments, and traditional landholders to own equities in the extractive resources sector in Papua New Guinea. Secondly, the paper analyses the purported change to the Mining Act (1992) through introducing a Bill in National Parliament in an attempt transfer resources ownership to traditional landholders from the crown or the State ownership. A hypothetical model of a mine is used assess the risks and benefits of owning equity in mines. The core theme of this research paper is to analyse the issue of national ownership of mineral resources.

[1] Minerals cover metallic minerals, crude oil and gas

Topic: Mineral Resources

- Author / Autor:** **Barbara Radwanek-Bak,**
Polish Geological Institute, PL
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Mineral and Energy Economy Research Institute, PL
- Title of Paper:** **Recent and future utilization of mineral deposits in Poland and the threats to the security of mineral raw material supply**
- Vortragstitel:** **Aktuelle und zukünftige Nutzung von Rohstoff-Lagerstätten in Polen und die Gefährdung der Sicherung der mineralischen Rohstoffversorgung**

The utilization of numerous mineral deposit is limited: by actual and planned land use, which exclude the possibility of their exploitation by land ownership rights (important in the case of opencast mining) and by landscape and environment protection restraints (real and imaginary). They make future development of existing deposits doubtful. It threatens security of mineral commodities supply and may be barrier to future sustainable development. The leading factor of opposition to mining is low society knowledge of mineral commodities importance for everyday needs and traditional vision of mining as exclusively damaging natural environment.

The paper presents the actual state of mineral resources and their utilization in Poland, and the coefficient of available resources stock, as well as some problems of legal and land-use conflicts of mineral deposits exploitation, all in the aspect of future security of mineral raw material supply. The authors are confident of the urgent need of mineral deposits protection.

The protection of deposits for future development should be secured by special Legal Act. The knowledge and real information of mineral raw materials importance for everyday life and for local, regional and country economy as well as of real impact of mining on environment and the modes of its restoration is indispensable for proper mineral deposit.

It should be gained through its proper presentation in school teaching as well as activity in PR domain.

Topic: Mineral Resources

Author / Autor: **Giovanni Andrea Blengini,**
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Title of Paper: **Integration of three inter-dependent Life Cycles in the mining/quarrying industry: proposed LCA methodology within the EU SARMa Project**

Vortragstitel: **Eingliederung von drei voneinander abhängigen Lebenszyklen in der Bergbau/Gewinnungsindustrie: Die LCA Methode innerhalb des EU SARMa Projektes**

Nowadays, an important part of the environmental information used to interpret, forecast or design sustainable development issues related to industrial systems or, more in general, human activities is derived from an application of Life Cycle Assessment (LCA) or a life cycle approach. In spite of such a great interest (and expectations) on life cycle issues, although the general LCA methodology is well defined, there is still lack of sector-specific standardisation in many fields. The mining/quarrying industry is probably one of the sectors where there have been relatively less use of LCA based tools, or where the use of LCA has received less consensus and/or more criticism.

Among other important aspects that fully justify the development of sector-specific LCA tools for the mining industry, a key issue is the need of integrating three deeply inter-dependent life cycles: Project life cycle, Asset life cycle and Product life cycle. While it is certainly true that also for other products, in other sectors, it is possible to distinguish between Project, Asset and Product life cycles, the joint management of these three life cycles is much more important in the mining industry, for at least two reasons: (1) in the mineral industry the Project life cycle is limited by the non-renewability of the natural resource and the geological features of the orebody; (2) for many products/goods the environmental implications relevant to Project and Asset life cycles are usually negligible, in comparison to the Product life cycle impacts, while for the mineral industry this is usually untrue.

This paper presents a common methodology implemented by 14 SARMa Project participants in order to standardise and boost adoption of LCA in the aggregate industry, with emphasis on South Eastern Europe countries.

Topic: Mineral Resources

Author / Autor: **Christopher Kleine,**
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RWTH Aachen University, GER

Title of Paper: **Added value to the mining industry by the integration of sensor based sorting**

Vortragstitel: **Zusätzliche Wertschöpfung für die Bergbauindustrie durch die Integration sensorgestützter Sortierung**

Sensor based sorting is taking its place in the minerals industry. Reliable machines that can handle high throughputs in coarse particle sizes and the development of new sensors open up the possibility to solve new sorting tasks, in particular in terms of preconcentration. Especially the compact sizes of complete sorting plants enable the integration of preconcentration and mining. This article shall illustrate three scenarios in which high economic benefit has been identified.

The first scenario describes the lowering of the cut off-grade. By preconcentration resources can be turned into reserves. This can result in the feasibility of reclaiming waste dumps and mining disturbed zones of deposits and other former uneconomic mining blocks. It offers high savings potential due to lower stripping ratios, higher possible mechanization and mining rates because selective mining is rendered unnecessary. Therefore it can also lead to a significant longer life of mine and to an adapted mine design.

The unloading of downstream processes by rejecting waste close to the mining face is described by the second scenario. Thereby bottlenecks of production capacities, e.g. the shaft, are released and higher production rates and higher revenues are enabled with comparably little additional investment costs. The third scenario describes the situation of satellite mines feeding a central processing plant. By enriching the grade with a dry process, preconcentration can result in significantly reduced transport costs and smaller deposits can be developed with semi-mobile processing plants.

The cases are identified by extensive economic evaluations on the basis of real data conducted by the Department of Mineral Processing of the RWTH Aachen University. The general behavior of the models created allows the introduction of the above described scenarios. The technology of sensor based sorting is able to add high value to mineral operations and must be therefore adopted by both miners and mineral processors.

Topic: Mineral Resources

Author / Autor: **Nikolaos Ioannidis,**
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Title of Paper: **Classification of Greek Lignite Resources and Reserves under the Pan-European Reserves and Resources Reporting Code (PERC)**

Vortragstitel: **Klassifizierung von Braunkohle Ressourcen und Reserven in Griechenland gemäß des PERC (Pan-European Reserves and Resources Reporting Code)**

Lignite resources and reserves in Greece are classified according to the Classification System established and applied by the Institute of Geology and Mineral Exploration of Greece and adopted by the State and the Public Power Corporation of Greece. This Classification System has been examined in the past by the Committee on Sustainable Energy of the Economic Commission for Europe. The Classification System was found to have significant differences in the definition of the various resources/reserves classes compared to the UN International Framework Classification for Reserves/Resources. In this paper an effort is made to classify lignite resources and reserves from a new lignite deposit in the Ptolemais-Kozani area of North West Greece according to the Pan-European Reserves and Resources Reporting Code. This classification is compared to the already established system and the results are presented and analysed. The comparison focuses mainly on the definition of resources/reserves categories, their confidence levels, and the requirements for a Competent Person responsible for the reporting.

Topic: Mineral Resources

Author / Autor: **Jürgen Christian Kopp,**
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Title of Paper: **Revival of Copper mining in Germany**

Vortragstitel: **Die Rückkehr des Kupferbergbaus nach Deutschland**

The discovery of the enormous deposit around Lubin/Lower Silesia established Poland since 1968 as a world-class producer of copper and silver. But the discovery of a new copper- and silver-rich mineralized area between 1953 und 1975 on the south-eastern margin of the Zechstein basin close to Spremberg/East Germany was for a long time nearly forgotten. In the light of the shortage of resources and the price trends the possibility of copper-mining around Spremberg could be realistic and establish Lusatia in the area of SE-Germany as an important producer of copper, silver and other precious metals.

The copper-silver deposit Spremberg-Graustein spans over 15 km in length and up to 3.5 km width. Economic extractable concentrations of copper, silver and other non-ferrous metals are present in the pre-Zechstein sandstones, Zechstein conglomerate, Kupferschiefer, and the lower part of the overlying Zechsteinkalk. The average thickness of the copper ore horizon is 2,5 m, but in different areas the maximum thickness is growing up to > 8 m. Between 1970 and 1975 were explored about 100 million tons copper ores quantities with contend of 1.5 million tons economic extractable pure copper, based on exploration instructions for the copper-exploration of the former GDR. In depending on the cut of grade there are strong indications, that the quantities of manacle copper and silver ores can be considerable enhanced and afford the mining of more than 20 years!

It is intended to produce an ore-tonnage of 8 million tonnes annually with nearly 100 000 t metallic copper. The room and pillar caving with pillar robbing as modern mining method is intended to be used. Furthermore describe the lecture the foreseeable geotechnical problems of shaft sinking inside the Mulkwitz-anticline. The new compiled data demonstrates imposing that the Zechstein base can produce copper grades and tonnages of commercial interest by modern western economic standards.

Durch die Entdeckung der sehr großen Lagerstätten bei Lubin in Niederschlesien etablierte sich Polen seit 1968 zu einem erstklassigen Kupfer- und Silberproduzenten im Weltmaßstab. Dagegen geriet die Entdeckung einer neuen kupfer- und silberreichen Lagerstätte am SE-Rand des Zechsteinbeckens zwischen 1953 und 1974 bei Spremberg in Ostdeutschland fast in Vergessenheit. Im Rahmen der Ressourcenverknappung und enormen Preissteigerung sind die Chancen für einen Kupferbergbau bei Spremberg realistisch geworden. Die Lausitz im südöstlichen Deutschland könnte damit ein wichtiger Produzent von Kupfer, Silber und weiteren Edelmetallen werden.

Die Kupfer-Silberlagerstätte Spremberg-Graustein erstreckt sich über eine Länge von 15 km bei einer Breite von bis zu 3,5 km. Wirtschaftlich gewinnbare Mengen an Kupfer, Silber und anderen Buntmetallen sind an die Sandsteine des Prä-Zechsteins, das Zechsteinkonglomerat, den Kupferschiefer und die unteren Bereiche des Zechsteinkalks gebunden. Die durchschnittliche Mächtigkeit des Erzlagere beträgt etwa 2,5 m, kann aber auf mehr als 8 m anwachsen. Zwischen 1970 und 1975 wurden etwa 100 Mill. t Kupfererz mit einem Inhalt von 1,5 Mill. t Kupfer(Kathoden) auf der Grundlage von Explorationsinstruktionen der früheren DDR nachgewiesen. Es sind jedoch Indikationen erarbeitet worden, die in Abhängigkeit vom verwendeten „Cut of Grade“ eine deutlich größere Erzmenge und damit eine Gewinnung von mehr als 20 Jahren erwarten lassen.

Die Planung sieht vor, jährlich etwa 8 Mill. t Erz mit einem Inhalt von etwa 100 000 t Kupfer(Kathoden) abzubauen. Dafür soll als moderne Gewinnungstechnologie der Kammer-Pfeiler-Bruchbau mit einem späteren Pfeilerrückbau eingesetzt werden. Im Vortrag werden weiterhin die vorhersehbaren geotechnischen Probleme beim Abteufen der Schächte im Bereich der Mulkwitzer Antiklinale dargelegt.

Die neu erarbeiteten Daten belegen, dass Buntmetallkonzentrationen an Zechsteinbasis für die Gewinnung von Kupfer sowohl hinsichtlich Qualität und als auch Menge nach modernen westlichen Standards in Frage kommen.

Topic: Mineral Resources

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Title of Paper: **An Empirical Approach to Structure the Uncertainties of Selected Metal Reserves**

Vortragstitel:

Today, modern civilisations are strongly reliant on the permanent supply of mineral resources. Due to the fact that an increasing number of mineral raw materials is used in many technical appliances, their production volume has risen enormously since the beginning of industrialisation. Moreover, high-grade specialisation and integration of products results in growing numbers of elements being used even in everyday technological applications. Thereby, the demand for several scarce metals increased significantly within the last years, for example indium, palladium or lithium. As nearly all the scarce metals are essential for specific products, concerns are growing that limited resource availability may be an important constraint for technology development. In addition, the unrestricted long-term availability of metals has been more and more doubted and reconsidered due to the rising demand. Consequently, the “criticality of metals” has become a common phrase in discussions on supply security.

Key figures for future availability of metals are their reserves and resources. Therefore figures for reserves and resources frequently appear in supply security discussions and beyond – often in combination with the “range of coverage”. Although these figures are regularly reported and commonly used, their uncertainties are not sufficiently communicated and questioned.

This study aims at providing a structured outline of the key parameters having potential high influence on mineral supply. In this context, various uncertainties of reserve figures will be analysed and discussed. Based on this, the uncertainties of the “range of coverage” are estimated and classified. Starting from the case study of lithium, where published reserve figures differ significantly, empirical findings will be abstracted for more transparent communication.

The results will provide background information for the interpretation of reserve figures. Hence, this study underlines the requirement of further systematic investigations and contributes to improving predictions on future supply of raw materials.