WEDNESDAY, OCTOBER 11

MOZART HALL

DEEP MINING AND TUNNELLING (T04)
Chair: Wulf SCHUBERT, Debashish CHAKRAVARTY
Room: Mozart Hall (ground floor)

02:15 p.m. **Current Situation of and Prevention Measures for Rock Burst of Coal Mines in China**
Dechang ZHOU

02:45 p.m. **Application of a new brittleness index to estimate the proneness to brittle failure of rock around a deep tunnel**
Lorenzo MILAN, Monica BARBERO, Mauro BORRI-BRUNETTO

03:00 p.m. **An investigation of the effect of rock brittleness on rockburst prediction in seismically active mines**
Alexey SHARIPOV, Amoussou ADOKO

03:15 p.m. **Assessment of energy release and redistribution on excavation instabilities for underground mining**
Yang ZOU, Ping ZHANG

03:30 p.m. **An implicit numerical modeling approach for destress blasting design optimization for tunneling and mine development in high stress conditions**
Ali HASHEMI, Neda DADASHZADEH, Kathy KALENCHUK

POSTER SESSION 03:45 p.m. - 04:00 p.m.

Application of hydraulic fracturing for destressing mining-induced stresses in underground coal mines
Hongpu KANG, Yanjun FENG, Fuqiang GAO

A conceptual study on the prediction of destress blasting efficiency using geostatistical approaches
Tawanda ZVARIVADZA

Experimental study of coal bursts caused by decrease of local mine stiffness
Fuqiang GAO, Guiyang YUAN, Xiangyuan PENG

A modification of the nearest neighborhood triggering mechanism in longwall mining: do seismic events only triggered by its closest neighbors?
Xu LI, Guangyao SI, Joung OH, Ismet CANBULAT

COFFEE BREAK

DEEP MINING AND TUNNELLING (T04)
Chair: Wulf SCHUBERT, Debashish CHAKRAVARTY
Room: Mozart Hall (ground floor)

04:30 p.m. **Novel method of multi-face destress blasting efficiency assessment**
Krzysztof FUŁAWKA, Piotr MERTUSZKA, Marcin SZUMNY, Lech STOLECKI, Izabela JAŚKIEWICZ-PROĆ

04:45 p.m. **Numerically simulated Rate of Energy Release and its correlation with measured seismic potency**
Sevda DEHKHODA, David BECK, Vladislav LEVKOVITCH

05:00 p.m. **Numerical modelling of induced seismicity considering metre-scale stress heterogeneity in a fault damage zone**
Atsushi SAINOKI

05:15 p.m. **Modulated thermal wave imaging approach to detect subsurface microcracks and their coalescence in deep mines for rock burst (strain burst) prediction**
Mrityunjay JAISWAL, Resmi SEBASTIAN, Ravibabu MULAVEESALA

05:30 p.m. **A numerically based geomechanics risk assessment of the cut and fill underground mining method**
Kamilya OMIRZHANKYZY, Ali MORTAZAVI

05:45 p.m. **Origin of seismic repeaters in a deep mine: what do we learn from in-situ investigation coupling geology, geomechanics and geophysics?**
Emeline LHOUMAUD, Yann GUNZBERGER, Jannes KINSCHER, Marianne CONIN

POSTER SESSION 06:00 p.m. - 06:15 p.m.

Development of failure criterion for extensile fracturing of Kannur limestone under triaxial stresses
Arpan NANDY, K Seshagiri RAO, Tanusree CHAKRABORTY

Mechanical and fracturing characteristics of defected cement mortar samples under biaxial confinements
Pengxuan JI, Qianbing ZHANG, Gisela VIEGAS

Reliability of Predicting damage in hard rock mass around deep tunnels in terms of its convergence
Rodolfo Enrique CABEZAS, Adeline DELONCA

Coupled Geomechanical CFD Modelling of Goaf under Goaf Gas Drainage: Impact of Goaf Characteristics
Yuehan WANG, Guangyao SI, Joung OH

EUROPA HALL

OPENING CEREMONY

08:30 a.m. **Prof. Wulf Schubert, Congress chairperson, & President of the Austrian Society for Geomechanics**

08:35 a.m **Dr. Florian Kreibich, Municipal Councillor City of Salzburg**

08:40 a.m. **Prof. Resat Ulusay, ISRM President**

08:45 a.m. **Prof. Chungsik Yoo, President of FedIGS**

08:50 a.m. **Cultural moment**

09:00 a.m. **"The status of the ISRM" by the Secretary General**

09:15 a.m. **Keynote Lecture by Prof. Christian Hellmich**

COFFEE BREAK

10:30 a.m. **Rocha Medal Award and Lecture**

11:05 a.m. **Müller Award**

11:55 a.m. **Fellows' induction ceremony**

12:15 a.m. **FedIGS Lecture by Vassilis Marinos**

LUNCH BREAK

02:00 p.m. **Sponsors contribution DSI by Robert Penczek**

CHALLENGING ROCK ENGINEERING PROJECTS (T01)
Chair: Nedim RADONČIĆ, Karoline PRALL
Room: Europa Hall (2nd upper floor)

02:15 p.m. **Burgenland's first tunnel takes its tribute – geotechnical retrospective of a tunnel collapse**
Thomas PILGERSTORFER, Katharina HOFER, Yvonne MONSBERGER, Jürgen VORINGER

02:30 p.m. **Collapse mechanism and treatment technology of large-span soft rock highway tunnel**
Shikang QIN, Chen XU, Xichen LI, Yabin HUANG, Qing YAO

02:45 p.m. **Pandoh Highway Tunnels in Indian Himalaya - a rock mechanical challenge in design and construction**
Andreas GORICKI, Vipin PARIHAR

03:00 p.m. **Tunnelling in Slovenian Dinaric karst: challenges and solutions**
Vojkan JOVIČIĆ, Boštjan VOLK, Gregor VESEL, Jože RATEJ, Markus SCHMIDT

03:15 p.m. **50 km of Tunnels in Inner-City Areas – Rock Mechanics and Tunneling Issues in Connection with the large-scale Railway Project Stuttgart 21 – A Success Story**
Walter WITTKE, Martin WITTKE, Patricia WITTKE-GATTERMANN, Bettina WITTKE-SCHMITT

03:30 p.m. **Soil-structure interaction of preliminary deformable lining for conventional tunnel in squeezing conditions using HiDSte elements**
Lorenzo BATOCCHIONI, Valeria GONZALEZ RODRIGUEZ, Salvatore MILIZIANO

POSTER SESSION 03:45 p.m. - 04:00 p.m.

Complex tasks to evaluate the feasibility of two railway tunnel variants in terms of tunnel construction
Joachim MICHAEL, Lisa WILFING

Theory and practice in the boulders and rock blocks blasting in urban areas applied to civil engineering activities
Lineu Azuaga AYRES DA SILVA, Guilherme Gianotti de ANDRADE, Anna Luiza Marques AYRES DA SILVA, Fábio ZATZ

COFFEE BREAK

CHALLENGING ROCK ENGINEERING PROJECTS (T01)
Chair: Nedim RADONČIĆ, Karoline PRALL
Room: Europa Hall (2nd upper floor)

04:30 p.m. **Brenner Base Tunnel: three DS-TBMs excavating in parallel under the Alps in Italy – Findings, difficulties and achievements from a geological-geotechnical point of view**
Stefan SKUK, Harald EGGER, Emanuele BARNABEI, Umberto Marco CONTI, Giuseppe FODERÀ, Gianluca LIUZZI, Gianluca MAGGIO, Davide RENGHI, Antonio SPAZIANI, Antonio VOZA

04:45 p.m. **Performance of different diameter Double Shield TBMs: experiences from the excavation of exploratory tunnel and main tubes of the Italian lot Mules 2-3 – Brenner Base Tunnel**
Harald EGGER, Marco Giuseppe FODERÀ, Gianluca LIUZZI, Antonio SPAZIANI, Antonio VOZA, Daniela BOLDINI

05:00 p.m. **Semmering Base Tunnel (SBT) - current state of the project**
Gerhard GOBIET, Gernot NIPITSCH, Oliver Kai WAGNER

05:15 p.m. **Semmering Base Tunnel – Geotechnical challenges at crossing a fault system in combination with high water pressure**
Mario HEIN, Zafer EKICI, Christine PEINTNER, Robert HOLZER, Thomas HOFMANN

05:30 p.m. **Challenges faced and mitigation measures adopted in construction of head race tunnel of Kameng hydro electric project (600 MW),**
Arunachal Pradesh, India Rajanish RANJAN, Girish KALITA

05:45 p.m. **Advancements in drillability prediction for conventional hard rock drill and blast tunnelling – implementing automation into the equation**
Tanja SATTLER, Kurosch THURO

POSTER SESSION 06:00 p.m. - 06:15 p.m.

Design of controlled rock blasting for tunneling and tunnel portals
Lineu Azuaga AYRES DA SILVA, Anna Luiza Marques AYRES DA SILVA, Guilherme Gianotti de ANDRADE, Geronimo Lima RODRIGUES

Extensive sensitivity analysis of the Kivenlahti metro center using DEM
Oskar Leonard VAN DER WEIJ, Daniele MARTINELLI

TRAKL HALL

COMPARISON OF INTERNATIONAL TUNNELLING CONTRACTS (T02) NATM VERSUS TBM (T11)
Chair: Dietmar BACH, Davide MERLINI
Room: Trakl Hall (3rd upper floor)

02:15 p.m. **Probabilistic Analysis of the Delivery Models Unit Price and Alliance applied at the Project Gemeinschaftskraftwerk Inn with Focus on the Construction Time**
Carl Philipp FRIEDINGER, Klaus MITTEREGGER, Philip SANDER

02:30 p.m. **Case Histories of contractual management of geological risks**
Davide MERLINI, Daniele STOCKER, Matteo FALANESCA, Matthias NEUENSCHWANDER

02:45 p.m. **Cutting performance evaluation of Actuated Disc Cutting by linear cutting test**
Hoyoung JEONG, Yudhidya WICAKSANA, Sehun KIM, Seokwon JEON, Jeong-Gi UM

03:00 p.m. **Compression test of TBM thrust jack for validation of bucking strength under inclined loading condition**
Han-Young JEONG, Mun-Gyu KIM, Yun-Joo NAM, Min-Gi CHO, Jung-Woo CHO, Sung-Bo SHIM

03:15 p.m. **Performance validation of rock cutting-splitting method by scaled model tests and rock slope excavation**
Mun-Gyu KIM, Han-Young JEONG, Joo-Young OH, Jung-Woo CHO Sang-Hwa YU, Ho-Young JEONG

COFFEE BREAK

EARLY CAREER FORUM (YOUNG RESEARCHERS) (T18)
Chair: Vojkan JOVIČIĆ, Reşat ULUSAY, Yang QIANG
Room: Trakl Hall (3rd upper floor)

04:30 p.m. **Some thoughts on Rock Mechanics and Rock Engineering in Mars**
Ömer AYDAN

04:55 p.m. **How to form competent rock engineers**
Michael ALBER, Leandro ALEJANO, Tobias BACKERS

05:15 p.m. **Experimental assessment of high temperature-induced changes on frictional behavior of planar rock joints**
Gustavo André PANEIRO, Ignacio PÉREZ-REY, Xian ESTÉVEZ-VENTOSA, Leandro R. ALEJANO

05:30 p.m. **Stability analysis of a rock slope: Fully-probabilistic approach**
Renato PEREIRA, José MURALHA, Luís LAMAS

05:45 p.m. **Application of empirical rockfall classification methods to risk management in an Alpine valley road**
Maria Teresa CARRIERO, Maria Rita MIGLIAZZA, Claudio SCAVIA, Leandro R. ALEJANO

06:00 p.m. **A study on the correlation between Hoek–Brown mi constant and Brinell hardness of intact rocks**
Anastasios TSIKRIKIS, Vassilis MARINOS, Theodosios PAPALIANGAS

06:15 p.m. **Mechanical behavior of granitic rocks under elevated temperatures: implications for underground radioactive waste disposal safety and tunnelling**
Andor NÉMETH, Ákos TÖRÖK

06:30 p.m. **Skavica Hydropower plant, one of the most important energetical projects to be constructed in Albania**
Ardita MALAJ, Skender ALLKJA, Iljana KERO, Julian BELLIU, Besian XHAGOLLI

DOPPLER HALL

DEEP GEOTHERMAL ENERGY (T03)
Chair: Kurosch THURO, Klaus VOIT
Room: Doppler Hall (4th upper floor)

02:15 p.m. **Informing deep geothermal reservoir rock mass properties from drilling data - experience from Krafla, Iceland**
Marlene VILLENEUVE, Ben KENNEDY, Anette MORTENSEN, Elodie SAUBIN, Aliaa HAMMOUD

02:30 p.m. **Relationship between thermal conductivity and porosity in sedimentary soft rocks by an experimental approach**
Weiren LIN, Osamu TADAI

02:45 p.m. **Borehole stability in geothermal reservoirs – A combined laboratory and numerical approach**
Justin MATTHEIS, Catharina DREXL, Martin POTTEN, Georg Maximilian STOCKINGER, Kurosch THURO

03:00 p.m. **Induced fracture analysis from microseismic catalogues: Salton Sea EGS case study**
Juan Miguel REYES-MONTES

03:15 p.m. **Carbon dioxide (CO_2) fracturing of volcanic rocks under geothermal conditions**
Kohei TAKUMA, Yuto WATANABE, Kiyotoshi SAKAGUCHI, Kazumi OSATO, Amane TERAI, Noriaki WATANABE

03:30 p.m. **Correlations between thermal properties and elastic wave velocities of volcanic rocks**
Shuai FENG, Weiren LIN, Susumu SHIBUTANI, Terasu SANO, Nana KAMIYA

POSTER SESSION 03:45 p.m. - 04:00 p.m.

Influence of stress state based on hydraulic-mechanical coupling and water loading path on fault activity
Yujie ZHU, Chen XU, Yingguo HU, Xiaoli LIU, Enzhi WANG

Stress and seismicity related to cooling of geothermal wells
Arno ZANG, Hannes HOFMANN, Gergö HUTKA, Bakul MATHUR, Mauro CACACE, Serge SHAPIRO, Beau WHITNEY, Cedric DUVAIL, Ramon Secanell GALLART, Niels GROBBE, Annemarie MUNTENDAM-BOS

Design of CaO-Al_2O_3-SiO_2-H_2O hydrothermal synthesis systems for high temperature and high pressure applications
Chuangchuang WANG, Xueyu PANG, Guodong CHENG, Jiankun QIN, Huajie LIU

COFFEE BREAK

UNDERGROUND STORAGE FOR LIQUID AND GASEOUS MEDIA (T16)
Chair: Robert GALLER, Johann HERDINA
Room: Doppler Hall (4th upper floor)

04:30 p.m. **Mechanical stability of a salt cavern used for hydrogen storage**
Hippolyte DJIZANNE, Benoit BROUARD, Grégoire HÉVIN

04:45 p.m. **Numerical Modelling of Induced Seismicity along a Fault during CO_2 Injection into a Subsurface Reservoir**
James Edward John BURTONSHAW, Adriana PALUSZNY, Robert ZIMMERMAN

05:00 p.m. **Large rock caverns for heat storage in district heating networks – A comparative study for the city of Salzburg**
Sophie MESSERKLINGER, Mikkel SMAADAHL, Daniel PÖTSCH, Carlo RABAIOTTI, Erich SAURER

05:15 p.m. **What can be the future of underground storages in the context of green energy? - Geomechanical aspect**
Philippe VASKOU, Nicolas GATELIER

05:30 p.m. **Hybrid CO_2 based thermo-mechanical underground energy storage - a numerical geomechanical review**
Daniel Hubert BÜCKEN, Tobias BACKERS

05:45 p.m. **A guidance for the optimal site location of Cavern Thermal Energy Storage (CTES)**
Stefan ZELZER, Thomas GEISLER, Thomas MARCHER

POSTER SESSION 06:00 p.m. - 06:15 p.m.

Thermomechanical Behaviour of Rock Salt
Sasan MORAVEJ, Mehdi SERATI, Mojtaba BAHAADDINI, David WILLIAMS

The fracture behavior of rock salt under present gas pressure in mechanical extension experiments
Lukas BAUMGÄRTEL, Feline KÖRNER

Experimental study on creep behavior of rock salt under complex stress paths
Zongze LI, Jinyang FAN, Marion FOURMEAU, Chao DU, Deyi JIANG, Daniel NELIAS

THURSDAY, OCTOBER 12

PAPAGENO HALL

NUMERICAL METHODS IN ROCK ENGINEERING (T13)
Chair: Helmut F. SCHWEIGER, Daniela BOLDINI
Room: Papageno Hall (ground floor)

08:30 a.m. Modelling brittle rock mass behaviour in deep underground excavations
Giuseppe CAMMARATA, Davide ELMO, Sandro BRASILE

08:45 a.m. Anisotropy Effects on the Response of Deep Tunnels Excavated in Claystone
Miguel Angel MÁNICA, Antonio GENS, Jean VAUNAT, Gilles ARMAND, Minh-ngoc VU

09:00 a.m. Numerical investigation of the behaviour of underground strata reinforced with polymer liner, steel mesh and bolts subjected to buckling failure
Saurav KARN, Ian PORTER, Shivakumar KAREKAL

09:15 a.m. Analyzing numerical grouted rockbolt behaviour in jointed pseudo-discontinuum models
Caitlin FISCHER, Mark DIEDERICHS

09:30 a.m. On advanced numerical techniques for the modeling of bolt reinforced rock mass Tuan Anh BUI, Giuseppe CAMMARATA,
Varun Choudary KANCHARLA, Ronald BRINKGREVE, Sandro BRASILE

09:45 a.m. Modeling of joints of segment linings under complex relation between lining and ground conditions
Kyeunghye AHN, Amade POUYA, Gye-Chun CHO

10:00 a.m. Consideration of Creep Deformation in Deep Underground Gallery Excavation in Claystone
Richard WITASSE, Jean-Francois BRUCHON, Sebastien BURLON

COFFEE BREAK

NUMERICAL METHODS IN ROCK ENGINEERING (T13)
Chair: Helmut F. SCHWEIGER, Daniela BOLDINI
Room: Papageno Hall (ground floor)

10:45 a.m. FDEM modelling of hydraulic fracturing in jointed rocks
Mansour SHARAFISAFA, Zeinab ALIABADIAN, Akira SATO, Luming SHEN

11:00 a.m. Numerical modelling of the swelling of clayey geomaterials by a multiscale approach
Hamza MHAMDI ALAOUI, Richard GIOT, Dimitri PRÊT, Philippe COSENZA, Stephen HEDAN

11:15 a.m. A numerical modelling study of the effect of pillar shape on pillar strength
Jan Abram MARITZ, Daniel Francois MALAN

11:30 a.m. Discussion

11:45 a.m. Phase-field model of compressive and tensile fractures in ductile sandstone, calibrated by P wave velocity measurement and moment tensor inversion
Xu LI, Guangyao SI, Joung OH, Ismet CANBULAT

12:00 p.m. Analysing the influence of finite deformations treatment towards the safety assessment of nuclear waste repositories
Steffen BEESE, Ralf EICKEMEIER, Jobst MASSMANN, Sandra FAHLAND

POSTER SESSION 12:15 p.m. - 12:30 p.m.

Evaluation of inclined loads in pillars stability
Edjan BUSTAMANTE, Edgar MONTIEL, Alexandra OSSA

Simulation of the run-out and mobilized volume of a 3D rock slope failure using the Material Point Method (MPM)
Fabrício FERNÁNDEZ, Eurípedes VARGAS JR., Miguel PAGANIN NETO, Elder RIBEIRO, Christiano NOGUEIRA, Camilla EUZEBIO, Joao DELVEAUX, Daniel MONTEIRO MACHADO, Claus NAVES EIKMEIER

The accurate knowledge of the joint term for rock mass classification and for the numerical tunnels analysis and its impact on the on the reinforcement's costs
Wagdi NAIME, Roque GARCÍA

Application of empirical and numerical modelling for stability analysis of developmental workings in an underground coal mine
Surajit SARKAR, Manoj Kumar TIWARI, Syed Shah Ghalib ASKARI, Indranil SAHA, Piyush SRIVASTAVA, D.B. Sundara RAMAM

Evaluation of trends in tunnel lining utilization with regard to the moment of ring closure
Vaibhav SHRINGI, Manuel Bernhard WINKLER, Alexander KLUCKNER, Thomas MARCHER

Estimation of fracture diameter probability distribution based on truncated trace-length data
Jian LIU, Long YU, Xingguang ZHAO, Liang CHEN, Ju WANG

Kinematic simulation of rock cutting performance of a 130t Roadheader in Korea
Mun-Gyu KIM, Hyun-Jun PARK, Joo-Young OH, Chang-Heon SONG, Jung-Woo CHO, Ho-Young JEONG

LUNCH BREAK

NUMERICAL METHODS IN ROCK ENGINEERING (T13)
Chair: Helmut F. SCHWEIGER, Daniela BOLDINI
Room: Papageno Hall (ground floor)

02:15 p.m. The correlation between aperture evolution and induced seismicity during simulated hydraulic fracturing in lab-scale coal samples
Xin ZHANG, Guangyao SI, Joung OH

02:30 p.m. Development and application of a grain-based hybrid finite-discrete element method for investigating fracture processes of heterogeneous rocks under static and dynamic loads
Hongyuan LIU, Daisuke FUKUDA, Haoyu HAN, Di WU, Qianbing ZHANG

02:45 p.m. A 3D breakable Grain-Based Discrete Element model for transversely isotropic rocks
Leandro Lima RASMUSSEN, Ki-Bok MIN

03:00 p.m. Novel numerical approach to modeling excavation in hard rocks
Erick RÓGENES, Leandro RASMUSSEN, Márcio FARIAS, Alessandra GOMES

03:15 p.m. Development of a 3D discrete element method approach to study the evolution of rock cutting mechanism in high-depth conditions: application to Vosges Sandstone
Nicolas GONZE, Fanny DESCAMPS, Jean-Pierre TSHIBANGU

03:30 p.m. A new perspective of load-transfer behavior of rough rock-socketed piles
José G. GUTIÉRREZ-CH, Salvador SENENT, Svetlana MELENTIJEVIĆ, Rafael JIMENEZ

POSTER SESSION 03:45 p.m. - 04:00 p.m.

A continuum-oriented finite-discrete element method (cFDEM) for rock fracturing simulation
Ke GAO, Weibing CAI, Shugang AI

The shear behavior of the rock-concrete interface with different angles: A DEM simulation
Yingcai HOU, Lushan SHU, Kai SHEN, Yadong XUE

Development of an efficient parallelization scheme for fully implicit discontinuous deformation analysis (dda)
Tatsuki TOKUDA, Ryota HASHIMOTO

Shear wave propagation across jointed rocks of varying seismic impedance
Kallol SAHA, Resmi SEBASTIAN

Numerical Calibration of Laboratory Results of 3D Printed Sandstone Analogues using Finite/Discrete Element Method (FDEM)
Dima SHAMSEDINE, Pooya HAMDI, Florian AMANN

Effect of joint dip on the transmission of stress waves from a moving point load in a parallel jointed rock mass
Harry HOLMES, Chrysothemis PARASKEVOPOULOU, Mark HILDYARD, Krishna NEAUPANE, David CONNOLLY

Applicability of DEM - Rate Process Theory approach for rock creep simulation
José G. GUTIÉRREZ-CH, Salvador SENENT, Eliana GRATEROL, Peng ZENG, Rafael JIMENEZ

COFFEE BREAK

NUMERICAL METHODS IN ROCK ENGINEERING (T13)
Chair: Helmut F. SCHWEIGER, Daniela BOLDINI
Room: Papageno Hall (ground floor)

04:30 p.m. Numerical Modelling-Based Methodology for Generating Fragility Curves of Underground Tunnels under Static Loading
Shahriyar HEIDARZADEH, Ali SAEIDI

04:45 p.m. The effective material properties of rock mass inversed from dynamic test data
Rui HUANG, Takafumi SEIKI, Qinxi DONG, Hui WANG, Ömer AYDAN

05:00 p.m. Influence of contact shape and distribution on fluid flow through a fracture
Masoud TORKAN, Amir HOSSEINI KHORASGANI, Lauri UOTINEN, Alireza BAGHBANAN, Mikael RINNE

05:15 p.m. Assessment on the in-situ rock stress condition along an unlined pressure tunnel/shaft of a Norwegian Hydropower Project using numerical modeling
Bikash CHAUDHARY, Krishna Kanta PANTHI, Nghia Quoc TRINH

05:30 p.m. Effect of blast damage on pillars of caving mines
Edgar MONTIEL, Max BLODEL, Edjan BUSTAMANTE, Esteban HORMAZABAL

05:45 p.m. Optimum spacing of TBM disc cutters using an explicit finite element approach
Asif Jeelani BHAT, Dr vidya Bhushan MAJI

06:00 p.m. Data Assimilation for Prediction of Surrounding Rock Mass Behavior during Underground Structure Construction Phases
Yasuhisa AONO, Tetsuo OKUNO

MOZART HALL

ROCK SLOPE ENGINEERING (T17)
Chair: Alexander PREH, Johann Thomas SAUSGRUBER
Room: Mozart Hall (ground floor)

08:30 a.m. Activity and kinematic behaviors of gravitational slope deformation in the slate belt of Taiwan
Cheng-Han LIN, Ming-Lang LIN

08:45 a.m. The influence of a heavy storm on a slope subject to rockfall phenomena: the Bazena case study
Battista TABONI, Gessica UMILI, Anna Maria FERRERO, Simone BLANC, Filippo BRUN, Stefano BRUZZESE, Luca M. ALBERTELLI, Iuri D. TAGLIAFERRI

09:00 a.m. Rock slope stability management along the road by machine learning through databasing disaster prevention records
Hiroyuki HONDA, Yasuhiro MITANI, Hisatoshi TANIGUCHI, Ibrahim DJAMALUDDIN, Yurino KAWAURA

09:15 a.m. Discontinuum modelling of slope instability as a support tool for risk management
Marco BARLA, Santina AIASSA, Francesco ANTOLINI, Alessandra INSANA, Andrea PERINO

09:30 a.m. The Correct Way to use the Hoek-Brown Strength Criterion for Slope Stability Analysis on the Example of Vals (Tyrol/Austria)
Mariella ILLEDITSCH, Alexander PREH, Johann Thomas SAUSGRUBER

09:45 a.m. Interaction between tunnels and slopes. Analysis of weak rock masses considering the Hoek-Brown failure criterion
Carlos Luis GARRIDO GARRIDO, Sergio SÁNCHEZ RODRÍGUEZ, Paula DEL POZO GARCÍA

POSTER SESSION 10:00 a.m. - 10:15 a.m.

Capturing the roughness of discontinuity traces in the field with high accuracy: the effect of photograph resolution
Clarence BUTCHER, Olivier BUZZI, Anna GIACOMINI, Robert BERTUZZI, Vaughan GRIFFITHS

Use of representative values of geometrical properties of discontinuities in rock slope verifications according to EC7
Javier GONZÁLEZ-GALLEGO, José ESTAIRE, María SANTANA

Effect of blast damage zones on the stability of a Himalayan highway cut-slope continuum modelling approach
Som NATH, Ashok Kumar SINGH, Harsh Kumar VERMA, Nachiketa RAI

Evaluation of weathering effects by CIELAB color space and image analysis technique for interbedded metasedimentary rock in the northern region of Peninsular Malaysia
Mazlina RAZALI, Mohd Ashraf MOHAMAD ISMAIL, Sharan Kumar NAGENDRAN, Zuraini ZAINAL, Hayato TOBE, Kensuke DATE, Yasuhiro YOKOTA, Hamzah HUSSIN

Latest developments to increase the quality of flexible rockfall protection barriers
Armin RODUNER, Helene LANTER, Manuel EICHER

Slope safety assessment based on dynamic anchor force
Zhibo JIA, Yan BAO, Lianjin TAO, Jin BIAN, Hu WEN, Haixiang ZHANG

COFFEE BREAK

ROCK SLOPE ENGINEERING (T17)
Chair: Alexander PREH, Johann Thomas SAUSGRUBER
Room: Mozart Hall (ground floor)

10:45 a.m. Developing a Digital Twin: A Semi-Brittle Slope Failure Case Study from Pueblo Viejo Gold Mine
Miosoty BAUTISTA, Juan Carlos COBIAN SALAS, Jessica LOPEZ, Neil BAR, Niccolò COLI, Francesco COPPI, Andreas GAICH, Markus PÖTSCH, Miriam BAUMGARTNER, Alison MCQUILLAN

11:00 a.m. Comparing different rock mass classifications using field and point cloud data on a rock cut
Dragana SLAVKOVIĆ, Aljoša MITIĆ, Miloš MARJANOVIĆ

11:15 a.m. Sub-critical crack growth based time-dependent deformation model and its application to open-pit slope stability
Tao XU, Zhiguo LI, Tianhong YANG, Xiaobing ZHENG, Wancheng ZHU, Tengfei FU

11:30 a.m. A Parametric Study Illustrating the Effects of Moderately Anisotropic Rock Strength on the Stability of Large Slopes using Limit Equilibrium Analysis
Ryan Alexander ZIEBARTH, Andrew G. CORKUM, Ian R. STILWELL, Derek KINAKIN

11:45 a.m. Geotechnical and geophysical investigation of a rock mass for the design check of an ornamental stone quarry
Maria Teresa CARRIERO, Cesare COMINA, Anna Maria FERRERO, Maria Rita MIGLIAZZA, Battista TABONI, Gessica UMILI, Federico VAGNON, Sergio Carmelo VINCIGUERRA

POSTER SESSION 12:00 p.m. - 12:30 p.m.

A reliability-based design approach for geotechnical domain modelling in pit slope design
Amoussou ADOKO, Hayes ANYASODOR

Rock Mechanics Characterization of Columnar Sandstone of Cerro Koi (Paraguay) and Some Slope Stability Issues of the Associated Open Pits
Ömer AYDAN, Reşat ULUSAY, Jose PAVON, Nazli Tunar OZCAN

A critical look to the practical use of Rock Mass Rating (RMR) and Slope Mass Rating (SMR)
Miguel CANO, José Luis PASTOR, Roberto TOMÁS, Adrián RIQUELME, Luis JORDÁ, José SERÓN

Site specific joint spacing distribution of roadcut slopes in a selected stretch of national highway in Indian Garhwal Himalayas
Lal HRUAIKIMA, Mahendra SINGH, Sarada Prasad PRADHAN, Jaspreet SINGH

Assessment of structurally-controlled slope failure in a steeply dipping Iron ore min
Suryajyoti NANDA, Satyam CHOUDHURY, Shantanu PATEL

Rock slope design and residual risk management for Aktogay Copper Mine, Kazakhstan
Nurkhair TELEU, Neil BAR, Herman ZLOBIN, Philipp MOHR

LUNCH BREAK

ROCK AND ROCK MASS PROPERTIES (T15)
Chair: Andreas GORICKI, Thomas FRÜHWIRT
Room: Mozart Hall (ground floor)

02:15 p.m. The Tauernmoos pressure tunnel: a multidisciplinary approach to verify and ensure design rock mass conditions during construction
Andreas MAYER, Franz REITER, Andreas FREUDENTHALER, Miroslav MARENCE

02:30 p.m. Hard soil and rock classification – Pressuremeter data versus tests on samples
Peter ALLAN, Jean-Pierre BAUD, Robert HEINTZ

02:45 p.m. Fundamental study on estimation of permeability at in-situ EDZ from pore air pressure response
Masahiko OSADA, Koji OSAWA, Christina Putri WIDYANINGTYAS, Yota TOGASHI

03:00 p.m. Intact Strength Determination of Rock Containing Mesodefects using the Leeb Hardness Test
Andrew Garnet CORKUM, Derek KINAKIN, Diego MAS IVARS

03:15 p.m. Effect of cyclic thermal loading on a carbonate rock: implications for thermal energy storage
Katharina Meta NEUMANN, Mandy DUDA, Tobias BACKERS

03:30 p.m. Assessment of the creep behavior of siltstone for the Snowy 2.0 hydropower station using multistage uniaxial and triaxial creep tests
Samer ABOU KHEIR, Andrea BROGIATO, Patrick LIGNIER, Angelo LAMBRUGHI, Gabriele DE CARLI, Mark DIEDERICHS, Ivan CHING, Damiano FRONTINI

POSTER SESSION 03:45 p.m. - 04:00 p.m.

A practical approach to determining the basic friction angle of natural and rough discontinuities in carbonate rock slopes
Zhen YE, Qian LIU, Qiang XU, Xiujun DONG, Feng PU

Evaluation of different methods for determining rock masses stiffness
Neil BAR, Wulf SCHUBERT

Estimation of cutting force considering intermediate dynamic rock strength using multiple linear regression
Yudhidya WICAKSANA, Suseno KRAMADIBRATA, Seokwon JEON

Classification of weak, carbonate fault rocks
Vasileios KALLIMOGIANNIS, Charalampos SAROGLOU

Effect of scale and in-situ stress ratio on the deformation modulus of rock mass around tunnels
Sai Srujan Kumar CHALAVADI, Mahendra SINGH, Yogendra SINGH, Jaysing CHOUDHARI

New testing equipment to study dynamic fracture of rock and cement-based materials subjected to the action of roadheaders
Diego-José GUERRERO-MIGUEL, Martina-Inmaculada ÁLVAREZ-FERNÁNDEZ, María-Belén PRENDES-GERO, Celestino GONZÁLEZ-NICIEZA, Covadonga BETEGÓN-BIEMPICA, Emilio MARTÍNEZ-PAÑEDA

COFFEE BREAK

ROCK AND ROCK MASS PROPERTIES (T15)
Chair: Andreas GORICKI, Thomas FRÜHWIRT
Room: Mozart Hall (ground floor)

04:30 p.m. Swelling pressures of clay rocks from laboratory tests: experience and improvements
Walter STEINER, Fritz MADSEN, Jean-François MATHIER

04:45 p.m. The influence of microwave treatment on the Cerchar abrasivity of igneous rocks
Sair KAHRAMAN, Egemen SAYGIN, Mustafa FENER

05:00 p.m. Experimental and numerical study on the creep behavior of a rock mass with filled joints
Maximiliano R. VERGARA, Ana LIBREROS, Karl BALTHASAR

05:15 p.m. Spatial modeling of rock strength heterogeneity and anisotropy using Universal Discontinuity index (UDi)
Amin HEKMATNEJAD, Eduardo ROJAS, Alvaro PEÑA, Benoit CRESPIN

05:30 p.m. A theoretical framework for calibrating the transversely isotropic elastic rock parameters from UCS tests on cylindrical specimens using circumferential strain measurements
Manuel WINKLER, Thomas FRÜHWIRT, Thomas MARCHER

POSTER SESSION 05:45 p.m. - 06:15 p.m.

Estimation models for deformability of marlstones based on their physical and mechanical properties and for variable load range
Srđan KOSTIĆ

Predicting strength loss of igneous rocks treated with microwave energy
Sair KAHRAMAN, Ahmet Niyazi CANPOLAT, Mustafa FENER

Porosity of source rocks eligible for interaction with gases and liquid
Daniela ŘIMNÁČOVÁ, Dominik VÖRÖŠ, Vendula NATHEROVÁ, Richard PŘIKRYL, Tomáš LOKAJÍČEK

Influence of shape surface on the actual stress distribution generated along the contact during the uniaxial compressive strength test
María RAMÍREZ-BERASATEGUI, Diego-José GUERRERO-MIGUEL, Ramón GUTIÉRREZ-MOIZANT, María-Belén PRENDES-GERO, Martina-Inmaculada ÁLVAREZ-FERNÁNDEZ

Geomechanical characterization of two granites to establish an experimentally based benchmark for numerical simulation – a laboratory study
Lucas Conrad WITTE, Mandy DUDA, Murat AYDIN, Hossein ASGHARI CHEHREH, Tobias BACKERS

Correlating uniaxial compression strength and static Young's modulus with Schmidt hardness for prasinites
Dimitrios KOTSANIS, Pavlos NOMIKOS

Comparison of conventional and cyclic oedometer swelling tests on rock specimens
Maximiliano R. VERGARA

EUROPA HALL

ROCK AND ROCK MASS PROPERTIES (T15)
Chair: Andreas GORICKI, Thomas FRÜHWIRT
Room: Europa Hall (2nd upper floor)

08:30 a.m. Physical Modeling in Rock Mechanics and Rock Engineering
Herbert H. EINSTEIN

09:00 a.m. The Interplay between Geometry and THMC Processes
Mengsu HU, Laura PYRAK-NOLTE

09:15 a.m. Flow simulation in digital rough fractures by considering anisotropic roughness and geometrical combinations
Xunhui XU, Weiren LIN, Han BAO, Peijie YIN

09:30 a.m. A modification of nonlinear Forchheimer's coefficient for fracture flow during shear
Min GAO, Xu ZHU, Chengguo ZHANG, Joung OH

09:45 a.m. Temperature-dependent strength of ice-filled discontinuities in frozen and thawing rock masses
Greg GAMBINO, John P. HARRISON

POSTER SESSION 10:00 a.m. - 10:15 a.m.

Temperature- and pressure-dependent dynamic and static elastic moduli
Jian YANG, Li-Yun FU

Low-temperature Thermal diffusion in Rock
Zhiqiang LIU, Linlin WANG, Shihui YU

Physical-mechanical properties of a granite used in the UNESCO World Heritage of the north of Portugal after high-temperature pretreatment
Roberto TOMÁS, Miguel CANO, Luis F. PULGARÍN, Vicente BROTONS, David BENAVENTE, Tiago MIRANDA, Graça VASCONCELOS

Thermal degradation study of Westerly granite by ultrasonic sounding and mercury porosimetry
Tomas LOKAJICEK, Daniela RIMNACOVA, Richard PRIKRYL, Ali AMINZADEH, Matej PETRUZALEK

Influence of grain-size on damage in thermally treated granites- A Review and Novel quantification techniques
Rahul Rooplal KATRE, Nikhil Ninad SIRDESAI, Sandeep PANCHAL

Point Load Strength Index of a limestone exposed to high temperatures and correlation with uniaxial compressive strength
María Elvira GARRIDO, José B. SERÓN-GAÑEZ, Víctor MARTÍNEZ-IBÁÑEZ, Carlos HIDALGO-SIGNES, Roberto TOMÁS, Martina-Inmaculada ÁLVAREZ-FÉRNANDEZ

Modified transient plane source measurements of Olkiluoto migmatite
Risto KIURU, Sophie HAAPALEHTO

Variation in the drilling rate in thermally treated limestones through penetration-time curves from Sievers' J-miniature drill test
Víctor MARTÍNEZ-IBÁÑEZ, Carlos HIDALGO SIGNES, María Elvira GARRIDO, José Bernardo SERÓN GÁÑEZ, Roberto TOMÁS, Celestino GONZÁLEZ-NICIEZA

COFFEE BREAK

ROCK AND ROCK MASS PROPERTIES (T15)
Chair: Andreas GORICKI, Thomas FRÜHWIRT
Room: Europa Hall (2nd upper floor)

10:45 a.m. Direct shear tests on large natural and artificially induced rock fractures in a new laboratory equipment
Lars JACOBSSON, Mathias FLANSBJER, Jörgen LARSSON

11:00 a.m. Physical modelling of bimrocks in large scale direct shear apparatus
Milorad JOVANOVSKI, Jovan Br. PAPIC, Igor PESHEVSKI

11:15 a.m. A Study on Dynamic Shear Properties of Bimrock
Nazlı TUNAR ÖZCAN, Elif AVŞAR

11:30 a.m. Effect of normal stress on dynamic friction weakening of granitic rock joints under cyclic shear
Kai ZHANG, Ling ZHU, Li CHENG, Qingchao LYU, Yaoru LIU

11:45 a.m. Elucidation of microscopic stress state within surface asperities of a rock joint
Bunyuu HASEGAWA, Sota HIGASHI, Atsushi SAINOKI

12:00 p.m. Discussion

POSTER SESSION 12:15 p.m. - 12:30 p.m.

Development and functional verification of an ultra-deep drilling core geological environment true triaxial apparatus
Xiwei ZHANG, Lei SHI

Hydromechanical characterization of Château-Landon chalk behavior
Danielle PAJIEP, Jian-Fu SHAO, Nathalie CONIL, Mountaka SOULEY, Philippe GOMBERT

Shear strength determination of very rough and partially filled extension fractures in thick-bedded and karstified limestones
Petar HRŽENJAK, Ivana DOBRILOVIĆ, Dražen NAVRATIL, Biljana KOVAČEVIĆ ZELIĆ

Study of stress-dependent dynamic properties of jointed rock using resonant column apparatus
Sakshi ROHILLA, Resmi SEBASTIAN

Shear failure and fracturing of horizontally layered shale
Marte GUTIERREZ, Daisuke KATSUKI, Runar NYGRAARD

A Mathematical Model for Shear Stiffness and Dilation for Saw-Tooth Joints under CNL Conditions
Sujeet BHARTI, Rakesh KUMAR, Debasis DEB, K. U. M. RAO

Practical estimation of veinlets shear strength properties in hypogene rock mass
Esteban HORMAZABAL, Andrea RUSSO

LUNCH BREAK

02:00 p.m Sponsors contribution Epiroc by Erik Svedlund

GEOLOGICAL INVESTIGATION AND CHARACTERIZATION (T06)
Chair: Scott KIEFFER, Michael F. GEORGE
Room: Europa Hall (2nd upper floor)

02:15 p.m. Block in Point Cloud Data (BLOCKinPCD): A digital characterization system for rock outcrops
Scott KIEFFER, Qian LIU

02:30 p.m. Roughness measure of a large in situ discontinuity surface by non-contact survey
Maria Teresa CARRIERO, Anna Maria FERRERO, Maria Rita MIGLIAZZA, Battista TABONI, Gessica UMILI

02:45 p.m. A study on point cloud interpretation of fracture intensity and its spatial variability
Yong-Zhi HUANG, Tai-Tien WANG, Fu-Shu JENG

03:00 p.m. Smart detection of limestone cavities in dense urban cities
Chao ZHANG, Wei WU

03:15 p.m. Virtual reality based uncertainty assessment of rock mass characterization of tunnel faces
Erlend SKRETTING, Georg H. ERHARTER, Jessica Ka Yi CHIU

03:30 p.m. Holographic mixed reality: an enhanced technology for visualizing and evaluating complex 3D geologic data
Markus KASPAR, D. Scott KIEFFER, Qian LIU

POSTER SESSION 03:45 p.m. - 04:00 p.m.

Structural mechanisms contributing to large-scale hangingwall instabilities on the UG2 reef horizon
Aletta Gertruida HARTZENBERG, Daniel Francois MALAN

A 2023 perspective on Rock Mass Classification Systems
Georg H. ERHARTER, Tom F. HANSEN, Shengwen QI, Neil BAR, Thomas MARCHER

Key Parameters and Distribution in Rock Mechanics for HLW Site Selection in Korea
Dae-Sung CHEON, Seungbeom CHOI, Won-Kyong SONG

Rock mass characterization during the construction of a twin-tube motorway tunnel in Hungary
Gabor SOMODI, János BORSODY, Ágnes KRUPA, Krisztián PETRIK, Balázs VÁSÁRHELYI

Applications of the Structure from Motion photogrammetric technique to solve geotechnical problems at different scales
Ramiro GARCÍA-LUNA, Salvador SENENT, Rafael JIMENEZ

Application of the point counting technique for estimating the VBP of geotechnically complex formations (bimrocks/bimsoils)
Maria Lia NAPOLI, Lorenzo MILAN, Monica BARBERO, Edmund MEDLEY

COFFEE BREAK

GEOLOGICAL INVESTIGATION AND CHARACTERIZATION (T06)
Chair: Scott KIEFFER, Michael F. GEORGE
Room: Europa Hall (2nd upper floor)

04:30 p.m. Performance of the empirical method with rock mass classification systems to derive optimal rock support design in poor rock mass conditions
Jorge TERRON-ALMENARA, Charlie C. LI

04:45 p.m. Rapid seismic data acquisition in a TBM road tunnel excavation with segmental lining
Thomas DICKMANN, Jozsef HECHT-MÉNDEZ, Dirk KRUEGER, Christoph SINKOVEC, Christian SCHÖNLECHNER

05:00 p.m. Acoustic Emission Characteristics of Mode I Rock Fracturing
Arthur D. DE ALWIS, Mehdi SERATI, Derek MARTIN, Arcady DYSKIN, Elena PASTERNAK, David J. WILLIAMS

05:15 p.m. Hydrogeology and grouting - a field experiment in shallow, crystalline rock
Åsa FRANSSON

05:30 p.m. Physics-informed machine learning of flow and transport problems
Hongkyu YOON, Jennifer HARDING

05:45 p.m. Structural and Geotechnical Investigations for the Remediation of Jetties and Seawalls on Heligoland
Holger JUD, Dieter TRONICH, Gerd SIEBENBORN

POSTER SESSION 06:00 p.m. - 06:15 p.m.

Mitigating the rock fall and rockburst risk in South African gold and platinum mines through advanced knowledge of the ore body
Michelle PIENAAR, Raymond DURRHEIM, Musa MANZI, Glen NWAILA, Hennie GROBLER, Thabang KGARUME, Dean PRETORIUS, Michael VAN SCHOOR, Abrie OBERHOLSTER

Understanding the geological and geotechnical drill core logging process – key to success
Johannes HORNER, Jennifer Andrea BETANCOURT

Pavement failure and flooding of tunnel in limestone geology
Hong-Gyu LEE

Diagnosis of bench stability conditions in an iron ore open pit in the Quadrilátero Ferrífero/Minas Gerais/Brazil
Camila Broetto MILLI, Alberto Ferreira AMARAL, Ana Paula DAHER, Marcos NASCIMENTO, Silas Santos SALGADO, Daniel Chaves dos SANTOS

Monitoring damage evolution in a tectonically faulted clay shale — an experiment of the Mont Terri URL
Martin ZIEGLER, Markus FURCHE, Thies BEILECKE, Thomas BURSCHIL, Anne OBERMANN, Qinghua LEI, Chenxi ZHAO, Simon LOEW

TRAKL HALL

LONG-TERM BEHAVIOUR OF UNDERGROUND STRUCTURES (T09)
Chair: Bernd A. MORITZ, Thomas PILGERSTORFER
Room: Trakl Hall (3rd upper floor)

08:30 a.m. Data and analytical mechanics: a new look on NATM tunnels
Raphael SCHARF, Bernhard PICHLER, Roman HEISSENBERGER, Bernd MORITZ, Christian HELLMICH

08:45 a.m. Investigating the impact of viscoelastic material models for accurate stress estimation in precast concrete tunnel segments
Ali RAZGORDANISHARAHI, Maximilian SORGNER, Adolf Bernd MORITZ, Thomas PILGERSTORFER, Bernhard L.A. PICHLER, Christian HELLMICH

09:00 a.m. Dissolution and precipitation processes governing the hydration heat development in tunnel cements: Green's function-based estimation of heat release in modified calorimetric tests
Hermann HÖLD, Bernhard PICHLER, Helmut RECHBERGER, Philipp ASCHENBRENNER, Christian HELLMICH

09:15 a.m. Effects of water on the time dependent properties of rock
Kimihiro HASHIBA, Katsunori FUKUI

09:30 a.m. Time-dependency and long-term strength of rocks in brittle underground environments – from the lab results to numerical continuum analysis
Chrysothemis PARASKEVOPOULOU, James INNOCENTE, Mark MCDONALD, Mark DIEDERICHS

09:45 a.m. Numerical simulation of nuclide transport at the underground repository scale subjected to thermal loading
Jintong ZHANG, Zhihong ZHAO, Junyu CHEN, Xingguang ZHAO, Ju WANG

POSTER SESSION 10:00 a.m. - 10:15 a.m.

Creep induced tunnel collapse during construction – a case study of a mountain railway tunnel in Taiwan
Wen-Jie SHIU, Fu-Yuan HSIAO, Cheng-Hsien TSAI, Shih-Hui WANG

Coupled thermo-hydraulic-mechanical analysis for a high efficiency high-level radioactive waste repository in South Korea
Kwang-Il KIM, Changsoo LEE, Dong-Keun CHO

Laboratory measurement by geotechnical centrifuge of long-term behavior in a model of vertical emplacement concept with tunnel at a deep geological disposal repository
Soshi NISHIMOTO

COFFEE BREAK

LONG-TERM BEHAVIOUR OF UNDERGROUND STRUCTURES (T09)
Chair: Bernd A. MORITZ, Thomas PILGERSTORFER
Room: Trakl Hall (3rd upper floor)

10:45 a.m. Long term behaviour based on a weakness planes approach: Constitutive model and application to a Meuse/Haute-Marne (France) URL drift
Mountaka SOULEY, Minh-Ngoc VU, Gilles ARMAND

11:00 a.m. Influence of different support systems on drifts closure evolution in Callovo-Oxfordian claystone
Frederico LARA, Lina-María GUAYACÁN-CARRILLO, Jean SULEM, Jana JABER, Jan CORNET, Gilles ARMAND

11:15 a.m. Eighteen years of feedback on the mechanical behavior of a 500m deep shaft on the Meuse/Haute-Marne (MHM) Andra's URL (France)
Jana JABER, Carlos PLUA, Minh-Ngoc VU, Gilles ARMAND, Jad ZGHONDI

11:30 a.m. Evolution of spalling-inducing fractures around a deep geological repository for nuclear waste during glaciations and their effect on the long-term repository stability
M. Cristina SACEANU, Adriana PALUSZNY, Robert W. ZIMMERMAN, Diego MAS IVARS

11:45 a.m. Crush Pillars' Behaviour at Intermediate Depth on Merensky Reef
Hlomani Glen MTHOMBENI, Shane K. DURAPRAJ, Richard T. MASETHE

12:00 p.m. Rehabilitation of old masonry tunnels – challenges and possibilities
Tilman SANDNER, Claas MEIER, Boley CONRAD

POSTER SESSION 12:15 p.m. - 12:30 p.m.

Self-sealing experiments with water and gas injection on Callovo-Oxfordian claystone under X-ray tomography
Mensan Dèlwindé Gildas Cedric AGBOLI, Dragan GRGIC, Albert GIRAUD

Consideration to evaluate maintenance process for utilization of non-supported underground quarries
Rui HUANG, Takafumi SEIKI, Qinxi DONG, Shizuo NOGUCHI, Takeshi OHMURA

Design of underground structures and support systems for extraction of inclined coal seam
Arka Jyoti DAS, Prabhat Kumar MANDAL, Ranjan KUMAR

LUNCH BREAK

GEOLOGICAL RISKS AND NATURAL HAZARDS (T07)
Chair: Christian ZANGERL, Haris SAROGLOU
Room: Trakl Hall (3rd upper floor)

02:15 p.m. Instability phenomena affecting the cultural heritage cave of Antro della Sibilla (Cuma, Italy)
Daniele SPIZZICHINO, Paolo Maria GUARINO, Gabriele LEONI, Mena DILETTO, Edoardo LUSINI, Fabio PAGANO, Marida SALVATORI, Daniela BOLDINI

02:30 p.m. Fracture characteristics obtained from core observations and image logs in a borehole drilled through an active fault zone
Susumu SHIBUTANI, Weiren LIN, Koichiro SADO

02:45 p.m. Characteristics of reinforcement for earthquake resistance in mountain tunnel
Kosuke KAWATA, Minaho FUKUSHIMA, Akira MATSUOKA, Atsushi KUSAKA, Nobuharu ISAGO

03:00 p.m. Impact of climate change on the collapse of shallow mines – feedback from France
Nathalie CONIL, Clara MAGHAMI, Marwan ALHEIB, Philippe GOMBERT

03:15 p.m. Seismic resistance evaluation based on earthquake damage survey data of mountain tunnels
Katsumi KAMEMURA

03:30 p.m. The assessment of dynamic stability of rock slopes with hexagonal jointing through shaking table tests and dynamic limiting equilibrium method (DLEM)
Ömer AYDAN, Yuki MURAYAMA, Takashi ITO, Naohiko TOKASHIKI

POSTER SESSION 03:30 p.m. - 04:00 p.m.

Evaluation of natural foliation effect on deformation characteristic and shear strength parameters of Chamoli (Uttarakhand) rock using a Triaxial system
Dinesh JAGANIYA, Manish SHAH, Usha PATEL

Geomechanical and hydrogeological characterization of fracture systems in Banyoles Karst caprock units, Catalunya
Aline CONCHA-DIMAS, Ivan FABREGAT GONZALEZ

Failure mechanism of the utility tunnel with flexible joints under reverse fault dislocation
Lianjin TAO, Zhigang WANG, Zhibo JIA

Development of post-mining multi-hazard assessment methodology
Hippolyte DJIZANNE, Marwan AL HEIB, Aurélien GOUZY, Christian FRANCK

Review and evaluation of Porosity Rate Model (PRM) for highly frost susceptible soils
Zheng GONG, Jang-guen LEE, Gyu-Hyun GO

Numerical Modelling Study of the 2016 Gyeongju Earthquake Rupture Process and Correlation with Groundwater Level Change
Jeoung Seok YOON, Anne STRADER, Jian ZHOU, Soo-Gin KIM, Jae-Yeol CHEONG

An improved calibration and uncertainty analysis for a ground subsidence using physics-informed neural network (PINN) approach
Hyung-Mok KIM, Yashwanth Kumar GUJJALA, Junya INOUE, Dong-Woo RYU

COFFEE BREAK

GEOLOGICAL RISKS AND NATURAL HAZARDS (T07)
Chair: Christian ZANGERL, Haris SAROGLOU
Room: Trakl Hall (3rd upper floor)

04:30 p.m. Development of a double-corrosion-protected self-drilling micropile for the foundation of rockfall protection structures
Matthias J. REBHAN, Hans-Peter DAXER, Markus SCHUCH, Franz TSCHUCHNIGG, Roman MARTE

04:45 p.m. An approach to assess the detachment propensity of rockfall source areas: the Susceptibility Index to Failure (SIF)
Maria Lia NAPOLI, Monica BARBERO, Marta CASTELLI, Francesco CASTELLI

05:00 p.m. Predicting geomechanical hazard: utopia or reality?
Adeline DELONCA

05:15 p.m. Rockfall instability on high granitic domes: Stawamus Chief, B.C., Canada
Benjamin COUGHLAN, Christian SAMPALEANU, Glyn WILLIAMS-JONES, Doug STEAD

05:30 p.m. The collapse of Torrione Sucai (Mt. Viso, Italy): rockfall analysis and data calibration
Giulia TORSELLO, Marta CASTELLI, Michele MORELLI

POSTER SESSION 05:45 p.m. - 06:15 p.m.

Assessment of face area hangingwall stability in a hard rock bord and pillar mine
Jeane Mokgadi MATSOBANE, Bryan Philip WATSON

Failure mechanism and slip characteristics of landslides on loess plateau by continuous-discontinuous method: A case study
Haojie YANG, Gan QI, Jili FENG, Zhengyuan LIU, Dejian LI

Rockfall hazards – Risk assessment, benefit/cost analysis and the design of flexible rockfall protection systems
Christian BINDER, Anna FREUIS, Michael SCHREINER, Mathias SMESNIK

Study of the influence of anthropogenic galleries on the chalk cliff stability at Normandy region (France)
Ahmed HOSNI, Claire MYR, Bastien COLAS, Isabelle HALFON, Yannick THIERY, Karim BEN SLIMANE

URUCUM Mine: Rockfall protection and monitoring system
Felipe GOBBI, Bruno DENARDIN DA ROSA, Dione Henrique DIAS, Fabio BERTUOL, Nataly AYUMI TOMA, Adoniran COELHO

Rock Fall Risk – Modular Risk Management Process
Rainer KIENREICH, Alexander KLUCKNER, Thomas MARCHER

Experimental simulation of mass flow characteristics for evaluation of the role of flow-bed roughness
Abhijeet SINGH, Deepanshu SHIROLE

Slope stability and engineering characteristics of rock mass at the boundary of slate and schist: Study of Southern Cross-Island Highway in southeastern Taiwan
Pai-Chiao LO, Wei LO, Yong-Zhi HUANG, Ya-Chu CHIU, Tai-Tien WANG, Yu-Chung HSIEH

DOPPLER HALL

MONITORING (T10)
Chair: Werner LIENHART, Urs H. GRUNICKE
Room: Doppler Hall (4th upper floor)

08:30 a.m. Distributed Fiber Optic Monitoring Systems in Tunneling: Implementation from research into practice
Christoph Martin MONSBERGER, Fabian BUCHMAYER, Werner LIENHART

08:45 a.m. Development of tunnel pre-displacement measurement method by fiber optic sensing
Kazuo SAKAI, Toshifumi AKAKI, Yoshimi OHNISHI, Shigeru TANAKA, Tomonori HORIDOME

09:00 a.m. Long-term monitoring of Austrian railway tunnels – A next step forward
Adolf Bernd MORITZ, Johannes FLECKL, Werner LIENHART, Johann GOLSER, Thomas PILGERSTORFER

09:15 a.m. Sinkholes and underground mining activities: the key role of monitoring for the hazard assessment and mitigation
Bartolomeo VIGNA, Adriano FIORUCCI, Federico VAGNON, Marco BARALE

09:30 a.m. Next-generation high-resolution borehole tensor strainmeters for the measurement of six strain-components based on fully automated interferometric displacement sensors
Jiayong TIAN, Kanghua ZHANG, Jiashu LOU

POSTER SESSION 09:45 a.m. - 10:15 a.m.

Analysis of the evolution of a reclaimed coal mining area using historical aerial photographs
Roberto SARRO, Juan LÓPEZ-VINIELLES, Adrián RIQUELME, Mónica MARTÍNEZ-CORBELLA, Juan Carlos GARCÍA-DAVALILLO, Augusto RODRÍGUEZ, José Antonio FERNANDEZ-MERODO, Ángela SUÁREZ-RODRÍGUEZ, Mario HERNÁNDEZ, Rosa María MATEOS, Mercedes FERRER, Joaquín MULAS

First experience with the newly created monitoring system of dynamics of surface changes occurring during the transition into the post-mining stage
Vlastimil KAJZAR, Eva JIRANKOVA, Petr KONICEK

Usage of Monitoring Data to Optimize and Validate the Geotechnical Parameters of Rock Properties in the Underground Space
Ghader SAADATI, Michael METT, Kontrus HEINER, Barbara SCHNEIDER-MUNTAU

Optimization of a large-scale slope monitoring system by the correlation between interferometric radar and geological compartmentalization
Miguel PAGANIN NETO, Elder Lucas RIBEIRO, Christiano NOGUEIRA, João Pedro DELVEAUX, Wesley de Lima SILVA, Camilla Szerman EUZEBIO

COFFEE BREAK

MONITORING (T10)
Chair: Werner LIENHART, Urs H. GRUNICKE
Room: Doppler Hall (4th upper floor)

10:45 a.m. Monitoring and analysis of the behavior of the Salzburg-Clay during the jet grouting works for the S-LINK project
Albert GREINMEISTER, Johann GOLSER, Alexander RADINGER, Gernot JEDLITSCHKA, Manfred EDER, Micheal FELDINGER, Franz RATHMAIR, Erich SAURER

11:00 a.m. Strategy and application of slope monitoring over dam basin in regular periods and during emergencies using SAR and GNSS
Shoji YUKIKO, Kikuchi TERUYUKI, Koike HITOSHI, Shimizu NORIKAZU

11:15 a.m. Regression analysis of slope instabilities evolution for time of failure estimation
Alberto MICHELINI

11:30 a.m. Use of combined monitoring remote sensing techniques for the study of active fractures in a remote area: Case of Cima Del Simano rockslide
Charlotte WOLFF, Tiggi CHOANJI, Marc-Henri DERRON, Li FEI, Michel JABOYEDOFF, Andrea PEDRAZZINI, Carlo RIVOLTA

11:45 a.m. Rockfall simulation and identification their sources locations along Massive external crystalline in Alps zone using LiDAR and Panorama Images: Case of La Grave, France
Tiggi CHOANJI, Li FEI, Charlotte WOLFF, Franck BOURRIER, Romain GAUCHER, Kan Jean KOUAMÉ, Marc-Henri DERRON, Michel JABOYEDOFF

POSTER SESSION 12:00 p.m. - 12:30 p.m.

Monitoring the rock-mechanical safety of underground limestone quarries using fibre optic sensing technology
Edo NOORDERMEER, Roland BEKENDAM, Karlijn BEERS, Auke NACHENIUS, Devrez KARABACAK

A new in-situ monitoring system to determine stability of underground coal pillar subjected to dynamic loading: electrical resistance measurement system (ERMS)
İhsan ÖZKAN, Mehmet MESUTOĞLU, Mahmut Yasin ÇETINKAYA

Low-frequency acoustic emission characteristics from meter-scale fracturing of rock-like brittle materials
June Ho PARK, Jin Seop KIM, Chang Ho HONG, Ji Won KIM, Tae Hyuk KWON

Monitoring long-term hydromechanical processes in swellable Opalinus Clay shale of the new Belchen tunnel (Switzerland)
Martin ZIEGLER, Simon LOEW, Arash Alimardani LAVASAN, Ernando SARAIVA

LUNCH BREAK

DIGITALIZATION & AUTOMATISATION (T05)
Chair: Thomas MARCHER, Helmut WANNENMACHER
Room: Doppler Hall (4th upper floor)

02:15 p.m. Project management in connection with a digital construction site with BIM in tunneling
David HACKER, Martin ZEINDL

02:30 p.m. Utilizing sensor technology in drilling optimization
Jukka-Pekka UUSITALO, Tobias WENDEL-EICHHOLZ, Matleena MELASAARI

02:45 p.m. The creative process for the development of an autonomous bolting arm for underground mines
Ana Raquel Sena LEITE, Hatem MRAD

03:00 p.m. Rock evaluation of NATM tunnel face using deep learning
Masanari NAKATA, Karnallisa Desmy HALIM, Yeboon YUN, Harushige KUSUMI, Akinobu NISHIO

03:15 p.m. Development and implementation of a sensor-supported rock bolt system for underground monitoring
Wolfgang DOLSAK, Mislav MIKULEC

03:30 p.m. Comparison between manual and automated determination of discontinuity orientations in different rock mass types
Julia C. GODLEWSKA, Marc S. OGAN, Julia GALLAS, Sarah SCHUMSKI, Mandy DUDA, Tobias BACKERS

POSTER SESSION 03:45 p.m. - 04:00 p.m.

Influence of SfM reconstruction techniques on the extraction of rock slope discontinuities
Adrián J. RIQUELME, José Luis PASTOR, Miguel CANO, Roberto TOMÁS, Antonio ABELLÁN

Identification of the optimal time series machine learning algorithm for the prediction of the ground subsidence with TBM machine data
Myung-Kyu SONG, Hyun-Koo LEE, Jae-Kyum LEE, Sean Seungwon LEE

Deep learning-aided prediction of peak shear strength of rock fractures
Jinfan CHEN, Zhihong ZHAO, Xingguang ZHAO

Deep Learning based Automatic Fracture Identification in CT Images of Rock
Chuyen Ngoc PHAM, Li ZHUANG, Sun YEOM, Hyu-Soung SHIN

Global Unstructured Digital Image Correlation for determining strains around circular opening
Tushar BHANDARI, Debasis DEB, Chamanth Sai Reddy VEMULAPATI

Intelligent risk management for TBM hard rock tunnelling based on Knowledge
Graph Haojun PANG, Fei JIA, Yingcai HOU, Feipeng HUANG, Yadong XUE

Towards the development of a harmonized inventory database for decision support: automatized information extraction
Alla SAPRONOVA, Paul Johannes UNTERLASS, Vaibhav SHRINGI, Thomas MARCHER

Comparison of an underground rock face 3D modeling performance: SfM-MVS with optimum photographing settings and LiDAR technology
Junsu LEEM, Jineon KIM, Jiwon CHOI, Jae-Joon SONG

COFFEE BREAK

DIGITALIZATION & AUTOMATISATION (T05)
Chair: Thomas MARCHER, Helmut WANNENMACHER
Room: Doppler Hall (4th upper floor)

04:30 p.m. Concept for Tunnel Information Modelling based work-preview and documentation during construction at Tunnel
Angath Hans EXENBERGER, Ines MASSIMO-KAISER, Hannah SALZGEBER, Peter KOMPOLSCHEK, Frédéric HEIL, Matthias FLORA

04:45 p.m. Application of hybrid machine learning based quality control in daily site management
Alexander ZÖHRER, Vincent WINTER, Anika TERBUCH, Paul O'LEARY, Negin KHALILI-MOTLAGH-KASMAEI

05:00 p.m. Automatic Fracture Extraction in Laboratory Rock Sample using Deep Learning method
Jian LIU, Aohui OUYANG, Omar ALDAJANI, Zili LI, Herbert EINSTEIN

05:15 p.m. Integration of Point Cloud Data for Numerical Simulations Using NURBS Surfaces
Andreas-Nizar GRANITZER, Franz TSCHUCHNIGG, Wolfgang SUMMERER

05:30 p.m. MWD data analysis for optimization of tunnel excavatio
Alla SAPRONOVA, Kazuo SAKAI, Shuntaro MIYANAGA, Paul Johannes UNTERLASS, Abdallah Ahmed Fouad Elsayed SOLIMAN, Thomas MARCHER

05:45 p.m. Generation of a Discrete Fracture Network from digital discontinuity data captured using the 3D Axis Mapping method
Josephine MORGENROTH, Jim HAZZARD, Shelby YEE, Davide ELMO

POSTER SESSION 06:00 p.m. - 06:15 p.m.

An example of calibrating physical parameters in a constitutive model based on machine learning framework
Yupeng CAO, Weiren LIN, Feng ZHANG

A machine learning model to estimate in-situ rock strength from borehole geophysical logs
Zizhuo XIANG, Zexin YU, Joung OH, Guangyao SI, Ismet CANBULAT

Comparative Analysis of CAI Estimation using Symbolic Regression and Machine Learning Approaches
Tae Young KO, Ju-Pyo HONG

Virtual learning environments for rock engineering education and training - a guideline for development, examples, and lessons learned
Mateusz JANISZEWSKI, Lauri UOTINEN, Masoud TORKAN, Mikael RINNE

Study on comparing current software for parametric modelling in Tunnel Information Modelling
Hannah SALZGEBER, Larissa SCHNEIDERBAUER, Kathrin GLAB, Matthias FLORA

From prognosis Ground Model to Tender Model and Tunnel Construction Framework Plan with Tunnel Information Modelling
Ines MASSIMO-KAISER, Hans EXENBERGER, Hannah SALZGEBER, Hannah WERKGARNER, Richard LOIDL, Matthias FLORA

Feature Sampling and Balancing for Detecting Rock Bolts from the LiDAR Point Clouds
Sarp SAYDAM, Chengpei XU, Binghao LI, Birgul TOPAL, Serkan SAYDAM

Digitalization and creep modelling for trinocular-cavern based metro statio
Amanda HUANG, Frank LI, Tong Joo SIA, Qianbing ZHANG

Using webcam to visually observe the mechanical behaviors of Shirahama sandstone under triaxial compression
Daisuke ASAHINA, Takato TAKEMURA, Takahisa ENDO, Yu TSUKURIMICHI, Yu AOJI

FRIDAY, OCTOBER 13

PAPAGENO HALL

NEW DEVELOPMENTS IN ROCK SUPPORT (T12)
Chair: Robert GALLER, Karl BÖHM
Room: Papageno Hall (ground floor)

08:30 a.m. **Research of safety-relevant natural and structural factors influencing the load-bearing capacity of rock stabilization with chemical grouts**
Conrad BOLEY, Paul PRATTER, Lisa WILFING

08:45 a.m. **Verification of design relevant parameters for new pipe umbrella support systems**
Günther M. VOLKMANN

09:00 a.m. **Rational design for tunnel ground support with membranes based on the geomechanically classification of Q by**
Barton Roberto LUIS, Rico BRANDLE, Gabriel VON RICKENBACH, German FISCHER, Sergio MARK

09:15 a.m. **Prevention of catastrophic corrosion failure of rockbolt and cable bolt in underground coal mines**
Honghao CHEN, Hamed Lamei RAMAND, Imrana KABIR, Onder KIMYON, Ren CHEN, Naresh KUMAR, Cindy GUNAWAN, Peter CRAIG, Ismet CANBULAT, Micheal MANEFIELD, Serkan SAYDAM

09:30 a.m. **Full-Scale Pullout Tests of Rock Anchors in Limestone Testing the Interfacial Bond Strengths**
Bjarte GRINDHEIM, Charlie Chunlin LI, Are Håvard HØIEN

09:45 a.m. **Experimental Investigations of Instrumented Fully Grouted Rock Bolts under Pull Load**
Jemishkumar Vijaykumar MODI, Debasis DEB, Rakesh KUMAR

10:00 a.m. **Research on application of new combined support structures in reinforcing rocky slopes containing weak interlayers**
Fei ZHAO, Zhenming SHI, Songbo YU

COFFEE BREAK

NEW DEVELOPMENTS IN ROCK SUPPORT (T12)
Chair: Robert GALLER, Karl BÖHM
Room: Papageno Hall (ground floor)

10:45 a.m. **New yielding elements made of high-strength expanded polystyrene (HS-EPS)**
Manuel ENTFELLNER, Helmut WANNENMACHER

11:00 a.m. **Reinforcement effect of deformation-controlled tunnelling supports based on three-dimensional tunnel excavation analysis**
Yasuhiro YOKOTA, Kensuke DATE, Atsushi SAINOKI, Masako ISHII, Kazuhiko MASUMOTO, Mori UTSUNO

11:15 a.m. **Microfibrillated cellulose as additive for wet-mix shotcrete**
Mathias LAURAEUS, Mikael RINNE, Antti LAUKKANEN

11:30 a.m. **On The Expected Location of Fire-Induced Concrete Spalling**
Dorna EMAMI, Souvik SAHA, Mehdi SERATI, Harry ASCHE, David J WILLIAMS

11:45 a.m. **Influence of rock crystal structure on bond strength at the rock-shotcrete interface**
Kunze LI, Hamed LAMEI RAMANDI, Chengguo ZHANG, Sahand TADBIRI, Serkan SAYDAM, Joung OH

12:00 p.m. **Blast Induced Vibrations and Strain Rate Effects in Dynamic Capacity of Underground Concrete Structures**
Frederick KUHNOW

12:15 p.m. **Discussion**

LUNCH BREAK

GEOLOGICAL RISKS AND NATURAL HAZARDS (T07)
Chair: Christian ZANGERL, Haris SAROGLOU
Room: Papageno Hall (ground floor)

01:45 p.m. **System of highway slope disaster information collection, integration, simulation and judgement**
Chia-Chi CHIU, Wen-Jie SHIU, Ching-Fang LEE, Meng-Chia WENG, Che-Ming YANG

02:00 p.m. **Effect of shape on the survival probability of rock replicas during free fall tests**
Olivier BUZZI, Davide GUCCIONE

02:15 p.m. **Numerical analysis of rockfall fragmentation mechanism**
Jian HUANG, Jingqing YUAN, Jianhong LIAO

02:30 p.m. **Closing the gap from spatio-temporal displacement monitoring to geomechanical process understanding of cascading multi-hazards caused by deep-seated gravitational slope deformations**
Johannes BRANKE, Jan PFEIFFER, Thomas ZIEHER, Magnus BREMER, Martin RUTZINGER, Bernhard GEMS, Margreth KEILER, Barbara SCHNEIDER-MUNTAU

02:45 p.m. **10 years of thermo-mechanical monitoring of rock columns - les chandelles de l'Escalette, France**
Muriel GASC-BARBIER, Véronique MERRIEN-SOUKATCHOFF, Jean-Luc GENOIS, Charly MOUGIN, Pierre AZÉMARD

03:00 p.m. **Kinematic Analysis and Distinct Element Modelling of a polyphase Rock Fall**
Reinhard GERSTNER, Christine FEY, Klaus VOIT, Erik KUSCHEL, Gerald VALENTIN, Christian ZANGERL

03:15 p.m. **Discussion**

MOZART HALL

ROCK AND ROCK MASS PROPERTIES (T15)
Chair: Andreas GORICKI, Thomas FRÜHWIRT
Room: Mozart Hall (ground floor)

08:30 a.m. **Application of Digital Image Correlation for Analysis of Anisotropic Materials Under Tension**
Timothy Robert Michael PACKULAK, Émélie GAGNON, Samuel Keith WOODLAND, Jennifer Jane DAY

08:45 a.m. **On the crack initiation location in the Brazilian test: Griffith-based insigh**
Yousef NAVIDTEHRANI, Covadonga BETEGÓN, Robert W. ZIMMERMAN, Emilio MARTÍNEZ-PAÑEDA

09:00 a.m. **Micro-fracturing in SCB test: Acoustic emission analysis Matej PETRUZALEK, Ali AMINZADEH, Vaclav VAVRYCUK, Zuzana JECHUMTALOVA, Petr KOLAR, Josef ROTT, Tomas LOKAJICEK**

09:15 a.m. **Influence of the specimen slenderness on the direct tensile strength of rocks**
Mauro MUÑIZ-MENÉNDEZ, Ignacio PÉREZ-REY

09:30 a.m. **A new simple shear test of rock prism specimen by torsional shearing**
Yota TOGASHI, Riho HIRASAWA, Masahiko OSADA

09:45 a.m. **Determining the transversely isotropic elastic constants from strain data by means of different mathematical approaches**
Manuel A GONZÁLEZ-FERNÁNDEZ, Ignacio PÉREZ-REY, Leandro R ALEJANO, José MURALHA, Seungki HONG, Ki-Bok MIN

POSTER SESSION 10:00 a.m. - 10:15 a.m.

Study on the mechanical characteristics of rock-concrete Brazilian disc based on DEM
Yadong XUE, Lushan SHU, Kai SHEN, Yongfa GUO

Behaviour of a pre-defined crack propagating under dynamic tensile loading condition
Rabin Kumar SAMAL, Gangavarapu Teresa DES DE MONA, Sunita MISHRA

Size effect and correlation with hardness of the microscopic fracture toughness of the minerals of granite
Kiyotoshi SAKAGUCHI, Yuta SHIROSAWA

Determination of an empirical relations between mode I fracture toughness using CB and SCB specimens and Brazilian tensile strength of rocks
Leona VAVRO, Martin VAVRO, Minami KATAOKA

Experimental and Numerical Investigations on Bi-axial Loading of Sandstone Brazilian Disks
Reza MOTTAGHI, Zhongwei CHEN, David J. WILLIAM, Mehdi SERATI

Full-field strain evolution in Brazilian Disc tests using Digital Image Correlation and Adelaide University Indirect Tensile strength test (AUSBIT)
Rupesh Kumar VERMA, Giang Dinh NGUYEN, Murat KARAKUS, Abbas TAHERI

COFFEE BREAK

ROCK AND ROCK MASS PROPERTIES (T15)
Chair: Andreas GORICKI, Thomas FRÜHWIRT
Room: Mozart Hall (ground floor)

10:45 a.m. **Failure response of rocks under different cyclic loading histories**
Abbas TAHERI, Roohollah SHIRANI FARADONBEH

11:00 a.m. **Cracking evolution for deep hard coal using X-ray in-situ micro-CT technology and fractal theory**
Liang ZHANG, Xiaopeng LI, Qingxin QI, Haitao LI

11:15 a.m. **Characterization of Mobilized Cohesion, Friction and Dilation Angles of Brittle Rock During Plastic Deformation**
Sarbartha SARKAR, Rakesh KUMAR

11:30 a.m. **4D imaging of crack evolution and failure mode in 3DP rock-like samples under uniaxial compression by using in-situ micro-ct technology**
Yulong SHAO, Jineon KIM, Jae-Joon SONG

11:45 a.m. **Mechanical properties of 3D printed sandstone analogue with different binder rates**
Minoru SATO, Takato TAKEMURA, Daisuke ASAHINA

12:00 p.m. **Influence of microscopic composition on the strength of rock-like materials under various loading rates**
Meng-Chia WENG, Hoang-Khanh LE, Hung-Hui LI, Chih-Shan LEE, Chia-Chi CHIU

POSTER SESSION 12:15 p.m. - 12:30 p.m.

Study on the relationship between uniaxial compressive strength and elastic properties of limestone with various sample diameter
Hasan ARMAN, Safwan PARAMBAN

Numerical Analysis of Thermo-Mechanical Characterization of Indian Sandstone under Dynamic Compressive Loading Condition
Abhishek MOHAPATRA, Anjali KUMARI, Sunita MISHRA

Evaluation of the dilatant behavior of a crystalline rock using full-field optical imaging and ultrasonic monitoring
Deepanshu SHIROLE, Gabriel WALTON, Ahmadreza HEDAYAT, Sankhaneel SINHA

Effect of rock stiffness change on acoustic emission
Vladimir FRID

The combined effects of water saturation and strain rate on crack initiation and damage stress of rock
Jun ZHU, Jianhui DENG

Characterization of Poisson's ratio and Elastic Modulus of granitic rocks: from micro-crack initiation to failure
Samad NARIMANI GHOURTLAR, Seyed Morteza DAVARPANAH, László KOVÁCS, Balázs VÁSÁÁRHELYI

Understanding the Microscopic Mechanisms of the bi-modular behavior of rock
Samarjeet KUMAR, Aditi NUWAL, Shantanu Kumar PATEL

LUNCH BREAK

PETROLEUM ENGINEERING AND CARBON SEQUESTRATION (T14)
Chair: Marlène VILLENEUVE, Reinhard SACHSENHOFER
Room: Mozart Hall (ground floor)

01:45 p.m. **Determining the Magnitudes of Maximum and Minimum Horizontal Stresses from Borehole Data: Comparison Between Borehole Failure Approach and Poroelastic Strain Model**
Nazir MAFAKHERI BASHMAGH, Weiren LIN, Abbas KHAKSAR MANSHAD

02:00 p.m. **Understanding shale fracture network complexity in the laboratory**
Aly ABDELAZIZ, Phyllis S. WU, Mei LI, Earl MAGSIPOC, Karl PETERSON, Giovanni GRASSELLI

02:15 p.m. **Numerical investigations on THM coupled process during water flooding with multiple well patterns under non-isothermal two phase flow**
Yuhao LIU, Fengshou ZHANG, Dingwei WENG, Hongbo LIANG, Chunming HE

POSTER SESSION 02:30 p.m. - 03:30 p.m.

Mechanical anisotropy and tension-shear characteristics of shale in Pengshui area, Chongqing
Shouding LI, Zhiquan YU, Supeng ZHANG, Jianming HE, Zhaobin ZHANG, Xiao LI

Well Cement Composition Optimization for Deep Well Applications
Guodong CHENG, Xueyu PANG, Zhengsong QIU, Jiankun QIN, Ning LI

Laboratory hydraulic fracturing experiments on thermally treated tight sandstone samples under step up incremental loading
Pankaj RAWAT, Narendra Kumar SAMADHIYA

Carbon dioxide impact on the mechanical properties of a sandstone from San Jorge Gulf Basin (Argentina)
Cecilia LASKOWSKI, Diego MANZANAL, Mauro MUÑIZ-MENÉNDEZ, Sandra ORLANDI, José ALLARD

Prediction of Safe Mud Window Based on Seismic Data in Carbonate Formation
Huiwen PANG, Hanqing WANG, Yan JIN

EUROPA HALL

DEEP MINING AND TUNNELLING (T04)
Chair: Wolfgang HOHL, David BECK
Room: Europa Hall (2nd upper floor)

08:30 a.m. **Addressing rock engineering challenges faced in the development of a novel, deep mining method**
Tobias LADINIG, Patrick GAMS, Horst WAGNER, Matthias WIMMER, Michal GRYNIENKO

08:45 a.m. **Unplanned ore dilution control in longhole mining using sill pillars – A case study**
Tuo CHEN, Hani S. MITRI

09:00 a.m. **Displacement and energy demand imposed by rapid bulking and tunnel shape change**
Fedilberto J. GONZALEZ, Peter K. KAISER, Mark S. DIEDERICHS

09:15 a.m. **Analysis of the behaviour of the Barrier Pillars and Gateroads of the deep Longwall Panel of India using the 3D Finite Element Modelling approach**
Rajashekar Yadav AVULA, Sreenivasa Rao ISLAVATH

09:30 a.m. **In-situ stress measurement using non-destructive and relief methods**
Zulfiqar ALI, Murat KARAKUS, Giang D. NGUYEN, Khalid AMROUCH, Chris CHESTER

09:45 a.m. **Source mechanisms of mining-induced seismicity at Kloof Gold Mine, South Africa – moment tensor analysis of ML≥1.5 events**
Richard MASETHE, Raymond DURRHEIM, Musa MANZI

POSTER SESSION 10:00 a.m. - 10:15 a.m.

Numerical modelling and tunneling experience of the Emergency Stop in Trens, Lots Mules 2-3 (Italy) - Brenner Base Tunnel
Davide MERLINI, Matteo FALANESCA, Gianluca BELLA, Antonio SPAZIANI, Antonio VOZA

Coupled thermal and unloading-induced permeability of rock fractures
Tao LIN, Zhihong ZHAO, Wen MENG, Xingguang ZHAO

Evaluation of rock stresses measured in a long water tunnel at deep depth
Tatsuya YOKOYAMA, Akira MITO

COFFEE BREAK

DEEP MINING AND TUNNELLING (T04)
Chair: Wolfgang HOHL, David BECK
Room: Europa Hall (2nd upper floor)

10:45 a.m. **Prediction of long-term deformation and dimensioning of support in squeezing rock under high overburden**
Jörg-Martin HOHBERG

11:00 a.m. **On the short-term response of Opalinus Clay to tunnelling**
Linard CANTIENI, Alexandros N. NORDAS, Dennis MOROSOLI, Georg ANAGNOSTOU

11:15 a.m. **The influence of brittle failure and its impact on face stability in high-stress tunnelling conditions**
Joel CHIWARA, Ioannis VAZAIOS, Chrysothemis PARASKEVOPOULOU

11:30 a.m. **The Brown-Hoek stress-depth relation revisited**
Tobias BACKERS, Simon KATTENBECK, Mandy DUDA

11:45 a.m. **Comparison of regression and classification Machine Learning algorithms for determining excavation damage zones depths**
Yousef GOLABCHI, Matthew A. PERRAS

12:00 p.m. **18 years of monitoring pore pressure evolution during and after excavation in the Callovo-Oxfordian claystone: the main insights**
Gilles ARMAND, Carlos PLUA, Minh-Ngoc VU

POSTER SESSION 12:15 p.m. - 12:30 p.m.

Modeling uncertainty of activity duration in probabilistic time estimation of tunneling projects
Mohammad MOHAMMADI, Johan SPROSS

Stability analysis of surrounding rock mass in underground powerhouse based on octree and catastrophe theory
Yuepeng SUN, Biao LI, Nuwen XU, Qi WANG, Bei JIANG

LUNCH BREAK

HYDROPOWER PROJECTS AND DAMS (T08)
Chair: Johann NEUNER, Paul BONAPACE
Room: Europa Hall (2nd upper floor)

01:45 p.m. **275 m high Yusufeli arch dam – Geotechnical modelling during construction**
Johannes KLEBERGER, Irmina PÖSCHL, Jonas WEIL

02:00 p.m. **A possible way forward to predict the peak shear strength of a natural, unfilled rock joint under concrete dams based on field data**
Francisco RÍOS BAYONA, Fredrik JOHANSSON, Diego MAS IVARS, Carl-Oscar NILSSON

02:15 p.m. **The material extraction for the Kühtai Da**
Steffen BAUER, Sebastian PERZLMAIER

02:30 p.m. **Discussion**

02:45 p.m. **Evaluation of the effect of rock surface irregularities on energy gradient in unlined dam spillways**
Yavar JALILI KASHTIBAN, Ali SAEIDI, Marie-Isabelle FARINAS, Javier PATARROYO

03:00 p.m. **A Block Theory approach for rock erodibility assessment incorporating 3D high-resolution site characterization data**
Mike GEORGE

POSTER SESSION 03:15 p.m. - 03:30 p.m.

Deformation behavior analysis of an arch dam during initial impoundment based on clustering and panel data regression
Rujiu ZHANG, Wenyu ZHUANG, Jianjun XU, Liang YIN, Haining WEI, Yaoru LIU

HEPP cavern Kühtai, excavation design and construction experience
Rupert STEIGER, Peter WETZLINGER

Challenges associated with the construction of vertical and inclined shafts in the Himalayan Region
Tek Bahadur KATUWAL, Krishna Kanta PANTHI, Chhatra Bahadur BASNET

POSTER SESSION 03:15 p.m. - 03:30 p.m.

Behavior of the Rock Foundation of a Concrete Dam Affected by Alkali-Aggregate Reactivity
Marco QUIRION, Dolice DONTSI MAKEN

3D numerical modelling of stability of underground pumped storage hydropower (UPSH)
Yuxi LIU, Qianbing ZHANG, Ivan CHING

Experimental study of joint opening and block protrusion effects on rock mass erosion in unlined spillway
Marie-Hélène WISSE, Ali SAEIDI, Marco QUIRION

CLOSING CEREMONY

03:45 p.m. **Austrian Society for Geomechanics Leopold Müller Prize**

04:00 p.m. **ISRM 2022 Awards**
- John Hudson Rock Engineering Award to Dr Christine Detournay
- Science Achievement Award to Prof. Jean Sulem
- Young Rock Engineer Award to Dr Yota Togashi

04:15 p.m. **ISRM 2023 Awards**
- Technological Innovation Award to Shandong University
- Young Rock Engineer Award to Dr Wang Qi
- Best Performing National Group Award 2021-2023
- Outstanding Commission Award 2019-2023

04:35 p.m. **Presentation of the main forthcoming conferences**
- 2024 ISRM International Symposium
- 2027 ISRM Congress

04:45 p.m. **Farewell speech by the Chair of the Organizing committee**

04:50 p.m. **Farewell to the outgoing Board**

05:05 p.m. **Inauguration ceremony of the new Board**

05:25 p.m. **The Chair of the Organizing committee declares the Congress closed**

TRAKL HALL

GEOLOGICAL INVESTIGATION AND CHARACTERIZATION (T06)
Chair: Scott KIEFFER, Michael F. GEORGE
Room: Trakl Hall (3rd upper floor)

08:30 a.m. **The impact of rock strength on the measurement of shear modulus from cavity expansion testing**
Yasmin Nicole BYRNE, Robert WHITTLE

08:45 a.m. **Interpreting variability of uniaxial compressive strength with insights from vein microstructures**
Emelie GAGNON, Jennifer J. DAY

09:00 a.m. **Visualization of Fracture Intersections from 3D X-ray Imaging**
Madelyn SUMNER, Laura PYRAK-NOLTE

09:15 a.m. **Discussion**

09:30 a.m. **Development of T-DrillPacker measurement system for groundwater inflow rate and pressure in advanced boring**
Yusuke HIRATSUKA, Sou KUMAMOTO, Hajime YAMAMOTO

09:45 a.m. **Roman gold exploitation at the archeological site of Las Médulas (NW-Spain) by means of Ruina Montium: a rock and fluid mechanics perspective**
Leandro R. ALEJANO, Elena MARTÍN, Ignacio PÉREZ-REY, Brais X. CURRÁS-REFOJOS, Fco. Javier SÁNCHEZ-PALENCIA

Multi-scale analysis of a porous carbonate rock under triaxial conditions
Catherine DORÉ-OSSIPYAN, Jean SULEM, Michel BORNERT, Alexandre DIMANOV, Patrick AIMEDIEU, Vincent DE GREEF, Andrew KING

POSTER SESSION 10:00 a.m. - 10:15 a.m.

Relations between elastic waves speeds and densities
J.C. GRESS, M. FERREIRA, R.M. FAURE

One-dimensional consolidation properties of sedimentary soft rocks from the Boso Peninsula, central Japan using a constant strain-rate loading system
Nana KAMIYA, Weiren LIN

Characteristics of hydro-magnesite of Salda Lake (Türkiye) and their implications on rocks of Jezerro Crater in Mars
Halil KUMSAR, Ömer AYDAN, Hitoshi MATSUBARA, Kouki MORI

Using borehole breakout data to constrain the in situ stress tensor
Junxiong YANG, Sebastian D. GOODFELLOW, John P. HARRISON

COFFEE BREAK

CHALLENGING ROCK ENGINEERING PROJECTS (T01)
Chair: Nedim RADONČIĆ, Karoline PRALL
Room: Trakl Hall (3rd upper floor)

10:45 a.m. **Design and Construction of the Montreal Largest Transit System**
Verya NASRI

11:00 a.m. **Stability issues associated with the construction of underground caverns of Super Dordi Hydropower Project, Nepal**
Sailesh ADHIKARI, Krishna Kanta PANTHI, Chhatra Bahadur BASNET

11:15 a.m. **The Blue Line Jerusalem LRT Underground Section – Public Transport in a challenging Project environment**
Anton KALTENBÖCK, Martin PURUCKER, Bernhard STACHERL

11:30 a.m. **Hard Rock Caverns with low overburden in urban environment – a case study**
Manuel BODE, Magdalena SALLINGER, Paolo ZANANDREA, Thomas MARCHER

11:45 a.m. **PU grouting and sealing measures on the Kramer Tunnel**
Johannes JESSEN, Jochen FILLIBECK, Florian ZAHLER, Raphael ZUBER

12:00 p.m. **Discussion**

POSTER SESSION 12:15 p.m. - 12:30 p.m.

Study on anti-dislocation measures for railway tunnels crossing active faults in complex and dangerous mountainous areas
Lianjin TAO, Haixiang ZHANG, Zhibo JIA, Ming SHI, Zhigang WANG, Cheng SHI

A method for investigating dynamic direct shear behavior of artificial jointed rocks using CNS direct shear box and Long Bar Drop Impact (LBDI) System
Hanlim KIM, Gyeongjo MIN, Gyeonggyu KIM, Youngjun KIM, Jusuk YANG, Kyungjae YUN, Sangho CHO

The phenomenon of tools' wear in a marble quarry: laboratory tests to evaluate the performance of conditioning as a wear preventer
Alfio DI GIOVANNI, Carmine TODARO, Simone SALTARIN, Marilena CARDU

LUNCH BREAK

DOPPLER HALL

NUMERICAL METHODS IN ROCK ENGINEERING (T13)
Chair: Helmut F. SCHWEIGER, Daniela BOLDINI
Room: Doppler Hall (4th upper floor)

08:30 a.m. **Applicability of Artificial Neural Networks (ANN) for equilibrium state prediction in tunnel excavation**
Alec TRISTANI, Lina-María GUAYACÁN-CARRILLO, Jean SULEM, Sebastián Ariel DONZIS

08:45 a.m. **Semmering Base Tunnel, Alternative Numeric Modelling of Long-term Rock Mass Behavior and Conceptual Support Design**
Alexander POISEL, Gunter GSCHWANDTNER, Markus SITZWOHL, Oliver Kai WAGNER

09:00 a.m. **CERN (HL-LHC): challenges and tunneling experience for the design of new underground structures at Point 5**
Davide MERLINI, Matteo FALANESCA, Filippo GIANELLI, Gianluca BELLA, Roberto SCHÜRCH, Anastasia LOPEZ- HERNANDEZ

09:15 a.m. **Production Sequence Analysis of an Overhand Cut-And-Fill Mine in a Narrow-Vein Type Orebody Using Numerical Modeling**
Ahmet Gunes YARDIMCI, Mustafa ERKAYAOGLU

09:30 a.m. **Influence of deep coal mines on the stability of shallow cavities**
Temenuga GEORGIEVA, Fanny DESCAMPS, George AJDANLIJSKY, Sara VANDYCKE, Nicolas GONZE, Jean-Pierre TSHIBANGU

09:45 a.m. **Comparison of analytical and numerical solutions for stresses and displacements around unlined tunnels with arbitrary cross sections inside anisotropic rock masses**
Manuel Bernhard WINKLER, Ali YAZ, Thomas MARCHER

POSTER SESSION 10:00 a.m. - 10:15 a.m.

Numerical modelling of pillars with weak alteration layers using the TEXAN code
Paul Michael COUTO, Daniel Francois MALAN

Slope support analysis at Jwaneng Mine
Christian CANCINO, Loren LORIG, Augusto LUCARELLI, Kabo GABANAKGOSI, Otsile BAREI

Finite element analysis-aided performance examination of the umbrella arch method for tunneling through weak zone Hsin Chen CHOU, Cheng Han LIN, On Lei Annie KWOK, Yu Chao LIN, Ming Lang LIN

An iterative scheme for the determination of the conformal mapping coefficients used in closed-form solutions for tunnels with arbitrary geometry
Manuel Bernhard WINKLER, Thomas MARCHER, Ali YAZ

Simulation of ground deformation of subway station using pile-beam-arch method
Hui HE, Chao WANG, Hua JIANG, Zhengyuan LIU, Zhiyong YANG, Yusheng JIANG, Jili FENG

Numerical evaluation of surface settlement induced by shield tunneling at rock mass
Jun-Beom AN, Jeonguk BANG, Joo-Hyun SEONG, Gye-Chun CHO

COFFEE BREAK

NUMERICAL METHODS IN ROCK ENGINEERING (T13)
Chair: Helmut F. SCHWEIGER, Daniela BOLDINI
Room: Doppler Hall (4th upper floor)

10:45 a.m. **Numerical modeling of cracking process in partially saturated porous media and application to rainfall-induced slope instability analysis**
Meng WANG, Zhan YU, Jianfu SHAO

11:00 a.m. **Numerical prediction of thermal weakening effects on granite rock**
Timo SAKSALA

11:15 a.m. **GSI or JRC – continuum or discontinuum modelling – some suggestions and some critique**
Nicholas Ryland BARTON

11:30 a.m. **A numerical analysis of weakening of a granitic rock by piezoelectric excitation of quartz**
Rafael Arturo RUBIO RUIZ, Timo SAKSALA, Alexandre KANE, Mikko HOKKA

11:45 a.m. **Modelling the hydro-mechanical behaviour of a 3D rough-walled rock joint**
Xu ZHU, Min GAO, Guangyao SI, Chengguo ZHANG, Joung OH

12:00 p.m. **Fluid injection influence on fracture propagation near an underground drift**
Mohammad Youssef FALLAH SOLTANABAD, Amade POUYA, Lina Maria GUAYACAN CARRILLO, Laurent BROCHARD, Christophe DE LESQUEN, Minh-ngoc VU

POSTER SESSION 12:15 p.m. - 12:30 p.m.

Mathematical model to describe the movement of rocks due to gravity in block caving mining
Sergio PALMA, Rodolfo MORALES

Numerical simulation of THM coupled behavior in the high-level radioactive waste disposal using OGS-FLAC
Taehyun KIM, Chan-Hee PARK, Changsoo LEE, Jin-Seop KIM

Modelling time-dependent processes resulting from thermo-viscoelastic behaviour of rocks
Donát M. TAKÁCS, Tamás FÜLÖP, Áron POZSÁR, Róbert KOVÁCS, Mátyás SZÜCS, Peter VÁN

Probabilistic assessment of rock loads for tunnel support design
Jiwoo AHN, Jurij KARLOVŠEK, Adrian SMITH

The effect of different rock mass properties on deformation distribution detected with intelligent rock bolts in underground mining
Michel VARELIJA, Michael NÖGER, Philipp HARTLIEB, Peter MOSER, Dominik DENDL

Seismic velocity estimation using a digital rock without segmentation - tips for accurate calibration and estimation
Kazuya ISHITSUKA, Hitoshi MATSUI, Weiren LIN, Nana KAMIYA, Yoshitaka NARA

LUNCH BREAK