Editorial for special issue “advances in engineering, environmental and mining geophysics”

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This special issue of the *Acta Geophysica* journal gathers original research articles in the field of engineering, environmental and mining geophysics. It is a follow-up of the 6th International Conference on Applied Geophysics planned for 2020 in Bucharest, which was not held due to the COVID-19 pandemic. The conference itself was initially organized by the University of Bucharest, the Romanian Society of Geophysics, the Geological Institute of Romania and the Romanian Academy. Other institutions such as the Mineral and Energy Economy Research Institute of the Polish Academy of Sciences, Central Mining Institute, AGH University of Science and Technology and Committee of Geophysics of the Polish Academy of Sciences were also collaborating for organizing this cyclic conference. The conference organizers, appreciating the efforts of the conference participants in the preparation of papers, invited them along with the

editors of *Acta Geophysica* to publish their research results in a special issue.

The special issue comprises of articles addressing a variety of geophysical applications in engineering, geotechnics, geomechanics, mining, environmental studies, geological studies and hydrogeology with the use of electrical resistivity tomography, ground-penetrating radar (GPR), gravimetry, well-logging, reflection seismics, magnetotellurics, active and passive seismic tomography and other geophysical methods.

Niculescu and Andrei show that electrical resistivity tomography (ERT) can be applied for the delineation and characterization of seawater intrusion in a freshwater aquifer. They study the Sarmatian (late Middle Miocene) aquifer formation on the outskirts of Vama Veche resort—Romanian Black Sea southern coast. The survey was organized in the framework of a field camp sponsored by the Society of Exploration Geophysicists (SEG) with the participation of teams from the University of Bucharest and the Geological Institute of Romania. Eight ERT profiles were acquired using Wenner, Schlumberger and dipole–dipole array configurations. The processing and interpretation of high-resolution ERT data indicated that the seawater intrusion, evidenced as very low resistivity (5–10 Ω m) anomalous zones starting at approximately 45–49 m depth, has advanced at least 500 m inland. The survey results also allowed the identification of a system of fractures or faults with an approximate NW–SE/WNW–ESE and, possibly, N–S orientation, that might have provided potential pathways for saline water intrusion.

Ważny et al. demonstrate how the missing resistivity log in the borehole can be calculated using artificial neural networks (ANN). Resistivity curve was necessary in modeling and inversion of magnetotelluric parametric soundings. The construction of a geoelectric section is indispensable in magnetotelluric parametric sounding interpretation and is usually based on the detailed information on resistivity from well logging. Resistivity data from the neighboring borehole together with GR, DT and RHOB logs were used

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to construct the optimal ANN, teach it and use it for the final prediction of the missing resistivity curve. High-quality predicted resistivity log was properly included in the magnetotelluric data interpretation process. The presented case study from the Lublin Basin, SE Poland showed that ANN can be useful for archival data supplementation or evaluation of missing interval curve if only other input logs are available. The described approach can be used to predict other missing geophysical data.

Akinsunmade aims to identify the effects of vertical compaction induced by traffic upon soil horizons using GPR. Carried out at a test site at a farmland in the Krakow area, the GPR survey was able to image distortions in the dielectric properties of the soil caused by agricultural vehicles. The intensity of this effect was proportional to the number of vehicle passes. It can be assumed that soil parameters such as porosity and volumetric water content are negatively affected by heavy traffic, and these variations can be mapped with changes in electromagnetic parameters. The study also revealed that the GPR method can delineate indurated soil horizons, which have adverse effects on plants' roots and the overall yield of the crops. From a geotechnical standpoint, hard intercalations may result in differential compaction during buildings/structures foundation preparation. Delineating such zones within the near-surface horizons of the soil allows its optimum utilization and management.

Mierczak and Karczewski present the possibility of locating agate (semi-precious variety of chalcedony) geodes in the volcanic Permian formations of Simota Gully area, Poland, using GPR. The investigations were carried out at two test sites comprising weathered melaphyres and pyroclastic deposits, using a high-frequency antenna of 1.6 GHz. They were complemented by laboratory measurements of dielectric permittivity, performed on samples of materials such as melaphyres, agates and tree roots, to evaluate reflection coefficients for the electromagnetic waves. The main problem encountered in the GPR radargrams interpretation was the clayey character of the weathered rock material. It significantly increases signal attenuation. The presence of numerous tree roots in the near-surface layer caused also unnecessary obstacles on the survey areas. Advanced signal processing procedures, such as the attribute of the signal, was used on the data for a better interpretation and separation of the anomalies. In effect, several agate geodes were identified and excavated from the ground.

Porzucek and Loj study the problem of estimating the depth of the disturbing bodies in microgravity surveys. In processing, Werner and Extended Euler deconvolution methods have been applied. For the Werner method, the authors developed also an algorithm that minimizes the impact of errors on the results and allows to obtain a realistic solution. The analysis was carried out for bodies of simple geometrical shape (sphere, vertical and horizontal cylinder, prism,

contact) simulating subsurface anomalous sources such as voids, unconsolidated zones, mine shafts, tunnels, basement and faults. The best depth estimation results were obtained for a horizontal cylinder and a fault model with a small throw, less accurate results (20–40% estimation error) for the sphere and prism models and the least accurate results for the vertical cylinder model. It can be concluded that Werner and Extended Euler deconvolution can be used in microgravity surveys to estimate the depth of targets/bodies similar to a horizontal cylinder and a fault, whereas estimations carried out for three-dimensional bodies are affected by large errors.

Knez and Rajaoalison present a set of laboratory results of the dynamic Young's modulus and Poisson's ratio determined for the dry and water-saturated Istebna sandstones and their dynamic Biot's coefficient under series of confining pressure conditions at different temperatures. The measured data and predictions from the Wyllie's equation were compared to show the effect of saturation on the rock weakening. The dynamic poroelastic rock properties calculated using P-wave value from the Wyllie's equation were different from the measured ones. It showed the important influence of water saturation on the rock strength confirmed by UCS (Unconfined Compressive Strength) measurement. Linear equations have been fitted for laboratory data, which can be used for the analysis of coupled stress and pore pressure effects in geomechanical problems in drilling applications, for instance evaluation of wellbore stability.

Gogolewska and Smolak deal with the mining-induced seismic risk mitigation in deep exploitation using so-called group winning blasting. The study is aimed to assess the efficiency of such method in energy reduction accumulated in the rock mass. It was approached in two ways. Firstly, the drop of energy and in turn its reduction efficiency was assessed simply using a percentage of provoked tremors' energy and number. Next, the analysis employed passive seismic tomography results to find if induced tremors took place in the high-velocity zones. Positive results were also obtained based on the analysis concerning the location of triggered tremors in zones with increased P-wave velocity, i.e., with a potentially high risk of rock bursts occurrence. The analysis verified the assumption that more successful preventive blasting means more accumulated energy reduced in hazardous zones.

Małkowski et al. show how the selection of a time window for the seismic events' database influences the actual status of seismic hazard for the longwall mining area in one of the Polish coal mines using Gutenberg-Richter law. A time window of 10–90 days was assumed with similar or shorter forecast times. Additionally, for each seismic database, the hazard prediction accuracy was determined. The analysis shows that the 10- and 20-day base periods are too short for prediction purposes. The higher-energy seismic events sometimes do not occur within such short period,

preventing regression analysis and the b parameter determination. The best time window for the seismic hazard prognosis in the analyzed geological and mining conditions was 30–50 days. The shorter periods cause the underestimation of the seismic hazard prognosis. The low range of tremor energies and the relatively low number of seismic events with high energy causes the low probability of prediction of the high-energy tremors.

Chlebowski and Burtan presents the analysis of the state of stress in one of the Polish coal mines determined by a combination of seismic profiling, active/passive seismic tomography as well as analytical calculations. The study was conducted considering the direct relationship between the location of stress concentration zones and the level of rockburst hazard. The results of seismic tomography were given, interpreted and cross-checked using iterative tomography techniques for the reconstruction of P-wave velocity field. Analytical modeling of the stress state was performed based on classical rock mechanics solutions. Modeling of the selected longwall panel based on the applied measurement techniques partially proved their adequacy in practical applications, providing valuable information on the design and performance of mining operations.

Cygal et al. present a case study of the integrated interpretation of audio-magnetotelluric and reflection seismic

data. Authors focused on delineating the accurate geometry of Obrzycko (Poland) Cenozoic graben structure filled with loose deposits, which negatively impacts the seismic imaging of the deeper structures. A novel approach for estimating the thickness of the low-velocity zone based on magnetotelluric data was employed to help interpretation of seismic data.

Results of the geophysical studies presented in this special issue provide only a glimpse of the challenges faced by the geophysicists today. We, the geophysicists, should be ready to address the needs of different fields of geosciences and engineering. *Our aim should be*, as the outstanding Polish "applied" geophysicist prof. Antoni Goszcz said, *so that the results of geophysical studies meet the expectations of the recipients as much as possible, otherwise, such challenges should not be undertaken.*

We sincerely hope that the pandemic situation will disappear from our life at last and the Conference on Applied Geophysics will be continued by the geophysical community and will allow sharing and exchanging of ideas, know-how and expertise in a broad range of applied geophysics and related topics.

Krakow, Bucharest and Warsaw, February 2021.