UDC 622.1

V. D. SIDORENKO, Dr. Eng., Prof., Head of Department, Kryvyi Rih National University
A. O. ROMANENKO, Ph.D.; Mine surveyor engeneer of the rock movement monitoring, "CGZK" PJSC; Student of Group 122-23-1-M, Technical University "Metinvest Polytechnic" LLC

CLASSIFICATION OF METHODS FOR DETECTING VOIDS IN ROCK MASSIVE

Modern geophysical studies in the field of mining are closely related to the detection of voids within rock formations. For effective determination of geological structure, assessment of mineral reserves, and avoidance of hydrogeological issues, it is crucial to utilize methods that accurately detect and evaluate the size, shape, and volume of voids. In this context, the development of various geophysical methods becomes a key component of geotechnical engineering.

The report is dedicated to the investigation and classification of methods for detecting voids in rock formations, which will enable scientists, engineers, and geologists to better understand the variety of approaches to this task. The increasing interest in studying voids necessitates the systematization of methods and their application in various mining environments. The report presents the research results and proposes a classification of void detection methods, highlighting their advantages and limitations. Considering the diversity of methods, a systematic classification is performed, taking into account their advantages and limitations. By examining the essence of each method, their applicability in different mining environments is indicated. Methods such as seismic tomography, electrical resistivity, gravitational geophysics, magnetometry, borehole and ground-penetrating radar methods, laser scanning, and biolocation are analyzed.

A detailed overview of the application, working principles, and areas of use [1-8] reveals the uniqueness of each method and its significance in geoenvironmental investigations. The obtained results not only aid in a deep understanding of the variety of void detection methods but also determine their rational utility in mining operations and engineering geology. Various classification approaches have been explored, considering the physical properties of rocks, measurement principles, method purposes, field types, information transmission methods, and other criteria.

The scientific novelty lies in the development of a classification of void detection methods based on measurement accuracy, allowing scientists, engineers, and geologists to better understand the variety of approaches to this task. Ranking of method classes for void detection has been performed based on comprehensive effectiveness with equal weighting of method determination factors: seismic, optical, acoustic, gravitational, electromagnetic and magnetic, biopole, radiofrequency and microwave.

The conclusions drawn from the research findings can have practical applications in conducting a comprehensive assessment of the geophysical condition of a mountain massif.

References

1. **Suyarko, V. H., Velychko, V. M., Havryliuk, O. V., Sukhov, V. V., Nyzhnyk, O. V., Biletskyi, V. S., Matviiev, A. V., Ulytskyi, O. A., Chuiehko, O. V.,** 2019, Inzhenerna geolohiia (z osnovamy heotekhniky): pidruchnyk dlia studentiv vyshchykh navchalnykh zakladiv, Kharkiv: Kharkivskyi natsionalnyi universytet imeni V. N. Karazina.

2. **Henry Robert Burger, Anne F. Sheehan, Craig H. Jones**, 2006, Introduction to Applied Geophysics: Exploring the Shallow Subsurface.

3. **Parasnis, D.**, Mining Geophysics, 2013. Second edition, Elsevier Science.

4 **Abidi, A.; Demehati, A.; Banouni, H.; El Qandil, M.,** 2017, The Importance of Underground Cavities Detection in the Choice of Constructible Areas: Case of the Agglomeration of Fez (Morocco). Geotech. Geol. Eng., 36, 1919–1932.

5. **Gambetta, M.; Armadillo, E.; Carmisciano, C.; Cocchi, L.; Tontini, F.C.**, 2011, Determining geophysical properties of a near-surface cave through integrated microgravity vertical gradient and electrical resistivity tomography measurements. J. Cave Karst Stud. 2011, 73, 11–15.

6. **Hussain, Y.; Uagoda, R.; Borges, W.; Nunes, J.; Hamza, O.; Condori, C.; Aslam, K.; Dou, J.; Cárdenas-Soto, M.**, 2020, The Potential Use of Geophysical Methods to Identify Cavities, Sinkholes and Pathways for Water Infiltration. Water 2020, 12, 2289.

7. **Griffiths, D. H., & King, R. F.**, 2013, Applied geophysics for geologists and engineers: the elements of geophysical prospecting. Elsevier.

8. **Mohamed, A.M.E.; El-Hussain, I.; Deif, A.; Araffa, S.A.S.; Mansour, K.; Al-Rawas, G.** , 2019, Integrated GPR, ERT and MASW for detecting near-surface caverns at Duqm area, Sultanate of Oman. Near Surf. Geophys. 17, 379–401.