Statistical and clustering analysis of microseismicity from a Saskatchewan potash mine

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Abstract

Microseismicity is expected in potash mining due to the associated rock-mass response. This phenomenon is known, but not fully understood. To assess the safety and effciency of mining operations, producers must quantitatively discern between normal and abnormal seismic activity. In this work, statistical aspects and clustering of microseismicity from a Saskatchewan, Canada, potash mine are analyzed and quantified. Specifically, the frequency-magnitude statistics display a rich behavior that deviates from the standard Gutenberg-Richter scaling for small magnitudes. To model the magnitude distribution, we consider two additional models, i.e., the tapered Pareto distribution and a mixture of the tapered Pareto and Pareto distributions to fit the bi-modal catalog data. To study the clustering aspects of the observed microseismicity, the nearest-neighbor distance (NND) method is applied. This allowed the identification of potential cluster characteristics in time, space, and magnitude domains. The implemented modeling approaches and obtained results will be used to further advance strategies and protocols for the safe and effcient operation of potash mines.