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Waveform cross correlation as a tool of mining explosion identification – the joint use of seismic array Miknevo and IMS array AKASG

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There are hundreds of mines and quarries within the Russian platform using blasts with varying yields and firing schemes. Since the East-European platform is an aseismic zone mining-related explosion occupy a larger part of the seismic catalogue issued by the Geophysical Service of the Russian Academy of Sciences for this seismic region, with data chiefly provided by seismic array Mikhnevo (MHVAR, 54.950 N; 37.767 E). This array was deployed and operated by the Institute of Geosphere Dynamics (IDG) of the Russian Academy of Sciences in 2004. Mining explosions represent a major challenge for unbiased interpretation of natural seismicity in seismotectonic studies and for seismic monitoring under the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Moreover, the task of finding and indentifying the nature of various seismic events in aseismic areas is more difficult because the size (magnitude, yield, energy) of studied events is small. Our main task is to evaluate the benefit of joint usage of (academic) seismic array Mikhnevo and seismic array AKASG of the International Monitoring System for the study of mining activity within the Russian platform. The advantage of location at regional distances from several major quarries and the availability of historical bulletins/catalogues of mining explosions recorded by MHVAR allow estimating the increase in resolution and identification power of two arrays. Waveform data obtained by MHVAR and AKASG from quarries Mikhailovskiy, Stoylenskiy, and Lebedinskiy are processed jointly using waveform cross correlation technique in order to find similar signals. Since the latter two quarries are separated by a few kilometers, there exists a problem to accurately identify their seismic waves. We demonstrate that the cross correlation technique allows reducing the detection threshold of repeated events by an order of magnitude as well as accurately identifying mining explosions separate by several kilometers. The performance of cross correlation critically depends on the quality of waveform templates recorded from a carefully selected set of master events for each of the studied mines. We also test the possibility to use the Principal Component Analysis to produce sets of synthetic templates, which best fit the whole set of master events for a given mine.