Geophysical Research Abstracts
Vol. 14, EGU2012-6975, 2012
EGU General Assembly 2012

Interrelation of rock mass seismicity change and subsoil hydrogen emanation

Iu.V Fedotova and S. A. Zhukova

Mining Institute of the Kola Science Center RAS, Rock Mechanics, Apatity, Russian Federation (olja-zh@yandex.ru, +7 815 55 7 53 51)

For more than semicentennial history of gases investigations in the Khibiny massif undeservedly little attention was focused on hydrogen. Meanwhile, in geoecological terms, research of molecular hydrogen emanations is more important because of its higher reactivity, mobility and abundance. Being inflammable and highly explosive, gases of spontaneous emanations under special conditions can accumulate in the atmosphere of mine workings and, thus, disturb a technological cycle and threaten the health and live of mining workers. Along with gas content unusually high for magmatic formations the Khibiny massif is characterized by irregular distribution of tectonic stresses which sometimes exceed lythostatic stresses in tens and by presence of natural and essential induced seismicity. One of the topical problems for developed deposits is an issue of assessment of rocks stress-strain state and prediction of rock pressure's dynamic occurrences (rockbursts and shallow-focus mining-induced earthquakes). Therefore a special attention is focused on detection of various interrelations between gasometric and geomechanical parameters of the rock massif.

The paper given presents the research results concerning dependence of seismicity increase in the region of the United Kirovsky mine on increase of subsurface hydrogen emanations. The correlation coefficient was calculated for three observation years. The results have confirmed a suggestion concerning good tracing of interrelation between rock mass seismicity increase and decline according to increasing and decreasing peaks of emanated subsurface hydrogen.

To discover this interrelation there was treated a database and phonogram registry from Automated System of Rock Mass Seismicity Monitoring from Geomechanical Monitoring Center (ASMSM GMC), "Apatit" JSC, for 2007-2009. The most important seismic events were found and analyzed using Seismic Time System software (subsystem of ASMSM summarized analysis). They are bulk blasts, natural events with [U+FFFD]>10^6J and events having been occurred out of registration zone but having necessary information for the work according to time and coordinates. To obtain hydrogen-metrical indicators there was used a VG-3modification device, which measurement range of hydrogen concentration in the air is 0,0001 – 0,01 vol.% (1 – 100 ppm), resolving ability is 0,0001 vol.%, relative error is +- 3 %, and memory period is from 1 sec to 99 hr.

Comparison of time of small seismic events occurrence with hydrogen motion has demonstrated that they are often preceded by increase of gas emanation intensity equaling, thus, the hopes. But, in general, interrelation of these events at this research stage doesn't seem to be single-valued. Many seismic events, including large ones, occurred before and during weak increase of hydrogen emanation or at a time of its relatively stable low concentration.

From the other side, not all the gas emanation bumps are accompanied by the following seismicity occurrences. Some of reasons are: insufficient duration of time series, neglect of seismic events remoteness from a station for hydrogen monitoring and absence of at least one or two such monitoring stations within a mine field and out of rock massif.

In the following the time series will increase and will be computer treated. At that an account of spatial coordinates of seismic events is provided for; and over hydrogen emanation it is suggested to select and examine separately components conditioned by global geophysical factors and by change of stress-strain state of rock massif's local parts.

So, prospects seem to be more realizable concerning gas-metrical indicators of assessment and prediction of seismic hazard from local mining natural-engineering systems. The obtained experience can be used when solving an extremely difficult task of predicting large mining-induced earthquakes.