Response of an aquifer to the passage of seismic waves in the close-in zone of a ripple-fired explosion in mine

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A possible change of the hydrogeological regime is one of the important aspects of the effect of mining on the stress-strain conditions of a rock massif. In 2018 a new type of monitoring was tested - precise measurements of the dynamics of water level in an observation well produced by the action of a ripple-fired explosion at a mining enterprise. Measurements were held in the observation well No.632 located in the town of Gubkin, Belgorod district, at the territory of the KMAruda Mining Enterprise. The well was drilled above the Stretenskaya accumulation of the I.M.Gubkin mine. The well is 141m deep. It penetrates to the Archean- Proterozoic complex of complicatedly dislocated rock, in which mining operations take place. Underground water of the fracture-stratum type is linked to the upper zone of the exogenous weathering of iron ores and oxidized quarzites. The water level at the moment when the measurements started was 83.41m from the free surface. The measurements were held with sensors of three types - a sensor of water level, a sensor of atmospheric pressure and a 3-component seismometer, which was installed at the surface near the well head.

According to the data of long standing precise monitoring of water level at the Geophysical Observatory of IDG RAS «Mikhnevo» the lower sensitivity threshold for water bearing horizons in plate areas is 0.1mm/s. For the hydrogeological response to an explosion to be reliably registered the source should be located not further than 1-3 km from the well. An explosion at the mine was chosen for measurements, when one of the chambers was located extremely near to the observation well. The distance from the water level sensor, which was sunk into the well to the depth of 85.5m, to the ceiling of the chamber, in which about 10 tons of explosive was blasted, was only 120m.

The results of measurements showed that the maximal amplitude of dynamic oscillations of water level turned to be two orders of magnitude higher than the corresponding value of vertical ground displacement in seismic wave at the surface. This testifies that secondary hydrodynamic effects may be triggered in the aquifer, such as, for example, gradual dissolution of colloidal plugs leading to an abrupt change of fluid pressure in local areas and emergence of intensive flows [Brodsky et al., 2003].

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