Geophysical Research Abstracts
Vol. 14, EGU2012-652-2, 2012
EGU General Assembly 2012

Results of researches Seismoacoustic Emission and Electromagnetic Radiation of Fractured Rocks in Deep Wells

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Up to the present, measurements of seismoacoustic emission (SAE) and electromagnetic radiation (EMR) have been carried out separately in time, with a time gap between measurements exceeding hours, days, weeks, and more [B. P. D'yakonov, O. A. Kusonskii, A. K. Troyanov, V. A. Fadeev, 1990]. In order to know the SAE and EMR nature in the rocks, the principal thing was discovery of correlation relationships between them at various depths in wells [B. P. D'yakonov, A. T. Ivaev, A. A. Kalmykov 1986]. The issue on leading mechanisms of SAE and EMR generation in various geodynamic environments still stays the most topical. A visible contribution to the solution of this issue can be made through simultaneous measurements in SAE and EMR. Among all EMR excitation mechanisms, those of them that are sources of SAE in the same time are of the most interest. Indeed, research into the background acoustic and electromagnetic fields in sections of deep wells has shown that the maximal signal levels of both geneses mostly coincide spatially by their depths with intervals of higher fracturing of rocks [B. P. D'yakonov, A. K. Troyanov, A. N. Nazarov, V. A. Fadeev, P. S. Martyshko, 1985, 2010].

In-well measurements in SAE and EMR have certain peculiarities and restrictions. It should be noted that a well proper has an influence on the appearance and evolution of fracturing in the massif of rocks. The boring process causes a substantial increase in the density of defects in the near-well volume, especially when fractured rocks are drilled. This is a favorable factor for emission intensity to be increased in the sequel. Moreover, a well with broken rocks is a concentrator of both quasi-static and variable stresses, which influence the initiation and development of fractures in the volume of the medium.

For measurements, we used a program-apparatus complex developed in the Institute of Geophysics, Ural Division, Russian Academy of Sciences [Yu. G. Astrakhantsev, A. K. Troyanov, 1998], which enables simultaneous recording of SAE (in units of recorded accelerations, mm/s2), EMR (in pT), and magnetic susceptibility (used for lithological differentiation of the section) signals. The sampling cycle is two seconds for all sensors. At every single point, measurements are carried out and consist of ten cycles.

Simultaneous measurement in SAE and EMR in wells when studying fractured rocks enable us to obtain information on manifestation of deformation processes in fields with varied physical nature, and, consequently, to determine zones of high tensosensitivity, favorable for monitoring of geodynamic phenomena in the Earth's crust.

This work was supported by the Russian Foundation for Basic Research (project no. 08–05–01084) and by the Presidium of the Ural Division, Russian Academy of Sciences (project no. 09–S–5–1002).