Host rock elastic parameters and their relationships with ore location at the uranium deposit in granites

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The Antei vein stockwork uranium deposit is located within the granitic basement of the Sterltsovskaya Caldera in NE Transbaikalia. The deposit consists of steep ore bodies confined to the branches of the Central fault zone trending with a wide (up to several tens of meters) area of dynamic influence (Laverov *et al*., 2008). The Antei deposit is dissected by the deep fault No 13. with offshooting ore bodies located in the hanging wall. Studies were conducted on mining levels 9, 10, 11, 12, and 13 located at depths of ~ 550, 610, 670, 730 and 790 m from the surface, respectively. The host granitic rocks were sampled on each level.

We studied the elastic properties of rocks; velocities of compression (Vp) and shear (Vs) waves in dry and saturated states of rocks. Oriented samples were cubes with edges at least 50 mm long. The used equipment complex consists of generator - receiver ultrasonic signals «Panametrix RR5072» (USA) and a pair of emitters P-and S- waves «Panametrix» with operating frequency of 1 MHz. The resulting wave pattern was digitized using an oscilloscope «TieRie508» (Netherlands). Polysaccharide gel was used as a contact lubricant. Wave velocity measured in the dry state after drying at 70°C for 4 hours, and after 7 days of stepwise saturation by water. Practice shows that this method leads to full saturation of low porosity rock samples in contrast to the forced vacuum saturation by water. Error in determining the V_P and V_S after calibration on reference samples of quartz and steel did not exceed 1 % (Petrov *et al*., 2011; Minaev *et al*., 2013).

By measuring the velocities of Vp and Vs for the investigated core samples, the elastic moduli were calculated: K - the bulk modulus, GPa; G - shear modulus, GPa; E - Young's modulus, GPa and Poisson's ratio.

The values of all the parameters with calculation of standard deviation were adjusted to an average over the level. Graphs were constructed for each of the parameters. An example of these graphs is shown on Fig. 1.

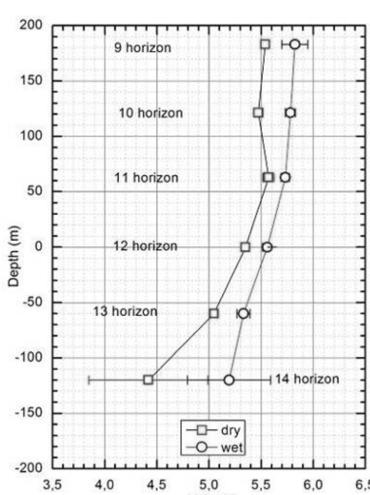

Fig. 1.: Variations of P-wave velocities in dry and wet conditions with depth.

All findings, what we can see on the graphs, suggest that with effect from 12th level the mechanical properties of the host rocks are deteriorate - they become brittle, porous and fractured. All this could create favorable conditions for circulation of ore-bearing solutions and ore location. In accordance with that the number of ore bodies and ore grade should increase with depth. In fact, we observe opposite situation – the ore bodies are becoming less and their power is reduced with the depth. What is the reason for this contradiction? The following hypotheses were constructed by the authors:

1. Preliminary calculations of the main values of the normal stress for the rock mass (not supported yet by instrumentally established parameters) shows that in the deep levels (level 12 and below) the dextral shear faulting regime changes to normal faulting regime with strike-slip component.
2. This normal faulting regime is realized along the fault No 13. plane and in the hanging wall within the network of ore-bearing small faults and fractures. The main intersection point of the fault No 13. and the ore faults is located near the level 12. Here all the petrophysical properties of the wall rocks are decreased with depth as probably result of tectonic stress impact on the fault knot.
3. As a result of multiple tectonothermal events, the fault knot could create an environment preferable for circulating meteoric waters and their mixing with hydrothermal ore-bearing solutions in particular down to the level 12. In this regard, a need for drilling directional wells in order to undercut the hidden uranium mineralization at the depth of the deposit is suggested.

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