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Propagation speed of pore pressure throughout permeable fracture during hydraulic stimulation

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Abstract Text:

Hydraulic stimulation/fluid injection is essential technology for extraction of subsurface fluid energy by enhancement of permeability on target formation. Monitoring of induced seismicity is the practical way to monitor and explore the size and shape of artificial reservoir and effect of stimulation. However, the detailed process of creation of reservoir has not been understood. Total understanding of the reservoir creation process would have big contribution to design stimulation process and energy exploitations system, as well as the prevention of induced seismicity with large magnitude.

In this study, by using the estimates of pore pressure increase, we investigated how pore pressure migrated in the reservoir and which parameter is responsible for pore pressure behavior. The regional stress information of orientation of S_{Hmax} and magnitude and fault mechanisms of several larger events occurred at hydraulic stimulation at EGS at Basel, Switzerland were used to compute the pore pressure increase. Pore pressure increase is calculated using coulomb failure criterion with constant friction coefficient of 0.85.

One dimensional distribution of pore pressure in the relation with distance from injection point (Figure 1a) shows time series propagation of pore pressure. Before 4^{th} day, the region of higher pore pressure was limited within the near field of the injection well (~200m), meanwhile lower pore pressure propagated to farther edge. After 4^{th} day of the stimulation, the region of higher pore pressure started expansion to further edge. So, we revealed that the lower pore pressure progressed faster than the higher one. Lower pore pressure was estimated from favorably-oriented fault plane more permeable to other faults, which is consistent to faster propagation of lower pore pressure. So, we conclude that permeable fractures host induced seismicity easily and play important role of propagation of pore pressure at the stimulation.

Topic Selection: Conventional, Enhanced, and Emerging Geothermal Systems: Characterization, Integration, Stimulation, Simulation, Induced Seismicity, and Reservoir Energy Management

Submitter's E-mail Address: mukuhira@geo.ifs.tohoku.ac.jp
Abstract Title: Propagation speed of pore pressure throughout permeable fracture during hydraulic stimulation
Requested Presentation Type: Assigned by Program Committee (oral, panel, poster, or lightning poster talk)
Previously Published?: No
AGU On-Demand: Yes
Abstract Payment: Paid (agu-fm16-167441-7910-8485-1439-6547)

I do not want to be involved in OSPA or the Mentoring program.

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