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Microseismic-based detection of fluid flow in deep seated rock and its application to geothermal development

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In the hydraulic stimulation, massive fluid is injected into subsurface rock through drilled wells. Then a number of microseismic events are commonly observed. By analyzing those data of microseismic events, we can estimate the orientation, i.e. dip and strike, of the fracture which slips to induce microseismic event. From the estimated fracture orientation, taking into account the in situ stresses and the Mohr-coulomb criterion to describe the critical condition of fracture slipping, we can estimate the pore pressure at the location of slipping fracture and at the time when the slipping occurs, in other words, when the microseismic event occurs. The estimated values of pore pressure are sorted in a certain manner for each equally divided spatial region, i.e. block, to give spatial distribution of pore pressure and its variation with time during hydraulic stimulation. We applied this method to the microseismic data observed during the hydraulic stimulation performed in November 2003 at the HDR development site of Cooper Basin in Australia, and we succeeded in showing the pressure propagation through the rock formation during the test.

Keywords: Fluid flow, Microseismicity, Coulomb criteria, Inverse problem, Hydraulic fracturing, Geothermal development