

Application of super-resolution mapping techniques to natural and induced seismicity

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The authors have been developing super-resolution mapping techniques of microseismicity. In this talk, the authors will show application of these techniques to induced seismicity from stimulation of geothermal and gas reservoirs, natural seismicity, and acoustic emission from compression test of core samples, and will discuss feasibility of these techniques.

1. Application to induced microseismicity from geothermal field

In Cooper Basin, Australia, a large scale hydraulic stimulation was carried out by a private company to create geothermal reservoir for commercial power generation. Microseismic events while the stimulation was collected by the authors and re-located by DD and collapsing method. Sub horizontal planer seismic structures were appeared by these techniques, and they were consistent with the geological data.

2. Application to induced microseismicity from gas field

A injection to a gas reservoir at Yufutsu, Hokkaido was made to investigate seismic activity and their location. Location of the microseismic events by DD clearly showed linear structure consistent with geological information (see figure).

3. Application to aftershocks of Hyogo Earthquake

Coherence collapsing method, which is a optimization method of seismic cloud, has been applied to the aftershocks of the Kobe and Chuetsu earthquakes. The location of coherent events (multiplets) appeared at the edge of the seismic cloud suggesting that mechanism of seismicity is changing around the multiplets.

4. Application to compression test of core sample

Acoustic emission from compression test of core salt specimen was re-located by the coherence collapsing method. The re-located events showed some seismic structure, partly correlating to the features inside the core.

Prospect

Estimation/monitoring of the dynamic behaviour of fluids inside the reservoir is a key from the engineering point of view. We currently understand the multiplet is highly correlated to the permeable zone in the reservoir and further study will be needed. Recently some of the induced events had a large magnitude and they are felt on surface. Development of prediction/control technologies of these large events is also of importance in this area.

