A quantitative analysis of the passive seismic emission tomography using the lattice Boltzmann method

*Sakemi Yuichi[1], Hitoshi Mikada[1], Junichi Takekawa[1]

1. Kyoto University

In recent years, monitoring seismic emission caused by subsurface fluid motion has been widely used in development of hydrocarbon reservoirs. Although this technique can provide the position and the depth of fluid flow in the reservoir, it is difficult to obtain further kinematic information such as flow velocity, fluid viscosity, or pore shape. Previous studies suggested that utilizing waveform analysis of seismic emission would make it possible to image the location of fluid flow, but the mechanism of such seismic emission has not been well revealed. Recently we proposed a model of seismic emission due to fluid flow but found our method has a problem that needs to be worked out, i.e. the utilization of inappropriate sound velocity to reduce the cost of calculation in Lattice Boltzmann method (LBM). In LBM, the incorrect fluid properties are often used since the correct properties induce a numerical instability. This means that it is difficult to evaluate our results in a quantitative manner. In the present study, we focused on this problem and set two types of models to tackle the problem of sound velocity in fluid; one is normal LBM model and the other one has the real sound velocity. We conducted numerical experiments using these models. We have found that the result calculated by the normal model can be modified to fit the results with the real properties by using an appropriate correction coefficient. Therefore, we have concluded that the normal LBM calculation could be adopted to reduce the cost of numerical simulation, and therefore, it is possible to quantitatively evaluate their experimental reuslts.

Keywords: Passive seismic, Fluid flow, Lattice Boltzmann method

