地震波動シミュレーションをデジタル岩石に適用して得られた南海トラフ周辺の地震断層の特徴
Characterization of Nankai Seismogenic Fault by Applying Dynamic Wave Propagation Simulation to Digital Rock Models

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In the Nankai Trough , the Philippine Sea plate is subducting beneath the Japanese Island at 4-6.5cm/s. The plate interface in the Nankai Trough is active seismogenic fault and causes massive earthquakes and tsunamis. However, the active seismogenic fault is too deep to drill through it. Thus, it is difficult to investigate its characteristic. To understand the characteristics of the deep active fault (i.e., plate interface), we use P- and S-wave velocities (Vp, Vs) of the digital rocks extracted from outcrop of ancient plate boundary fault at Nobeoka in Kyushu, southwest Japan. By comparing the elastic properties derived from digital rock with seismic velocity (e.g., Vp/Vs) acquired around the in situ seismogenic fault, we characterize the deep seismogenic fault. We extract 3D digital rock models with the size of 5mm x 5mm x 5mm from 3D micro-CT images. By using Finite Difference Method (FDM), we perform the dynamic wave propagation simulation and measure the effective Vp, Vs, and ratio of P-and S-wave velocities (Vp/Vs) of 3D digital rock models. Moreover, using this approach, we can identify the heterogeneity, which strongly influences to the seismic velocity. Here, we investigate the sensitivity of Vp and Vs to crack-filling materials. The heterogeneous texture, such as fracture or pore space was identified based on comparison of the density and porosity from digital rock model with the average of porosity from laboratory measurement. We can measure Vp and Vs for heterogeneity texture with any fracture-filling materials by replacing the pore space with dry, water saturated and mineral filling (quartz and calcite) conditions. The results demonstrated that the pore space in the dry and water saturated conditions significantly decreases velocity. The Vp/Vs ratio of water saturated case (Vp/Vs=~1.84) is higher than dry condition (Vp/Vs=~1.75). In the mineral-filling model (quartz and calcite), the P and S-waves travel faster than dry and water saturated conditions. This is because the bulk and shear modulus are increased in these mineral filling condition. The Vp/Vs of mineral-filling cases is lower than water saturated case, because S-wave cannot travel through the fluid which highly decreased in water fill pore case. Therefore, low Vp/Vs at coseismic region observed in the Nankai Trough region could be explained by the mineral filling of cracks.

キーワード：震源断層、南海トラフ、動的波動シミュレーション、デジタル岩石
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