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Pore pressure prediction method using rock physics theory: The effect of crack features on seismic velocity

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We developed a theoretical method for predicting pore pressure distribution from seismic interval velocity, based on rock physics theory. Firstly we modeled aspect ratio spectrum of pore space using laboratory-derived velocity and logging data. From the modeled aspect ratio spectrum, we calculate theoretical velocities parameterized by effective pressures via Differential Effective Medium (DEM) theory and compare the theoretical velocities with the seismic interval velocities derived from three-dimensional reflection tomography. By iteratively fitting the theoretical velocity to the seismic interval velocity by changing effective pressure, we estimate in situ effective pressure distribution. Then, pore pressure distribution can be obtained by subtracting the effective pressure from the confining pressure. In this research, this method is applied to the plate boundary decollement (a detachment that separates a deformed accretionary prism from the underthrust sediments) in the Nankai Trough, southwest Japan. Here we focus on the change in crack characteristics for the plate subduction direction. Especially, because crack sealing associated with heating should be dominant around the plate boundary decollement, we try to consider the crack sealing effects which increase seismic velocity without effective pressure. From the relation between crack porosity and total porosity, we clearly observe the cementation effects. Our results demonstrate that abnormal high pore pressure occurs within the subducting sedimentary sequence.