

Effects of thermal cracking on elastic wave velocities and Poisson's ratio of basalt, gabbro and granite

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Marine seismic refraction studies have found that there are high Poisson's ratio regions (>0.35) in oceanic crust at subducting plate. Christensen (1984) performed laboratory measurements of compressional and shear wave velocities (V_p and V_s , respectively) of basalt, which is one of major rocks in oceanic crust, and estimated Poisson's ratio, and suggested that observed high Poisson's ratio can be explained by high pore pressure. This distribution of high pore pressure have been concerned because it should influence fault mechanism of plate boundary at subduction zones. Christensen (1984) used intact rock for the measurements. But there are probably dense cracks near faults in nature. Therefore, to investigate V_p , V_s and Poisson's ratio for fractured rock is important to evaluate distribution of high pore pressure regions by using seismic studies. This study reports the results of measurements of V_p and V_s , and estimations of Poisson's ratio for thermally cracked gabbro, basalt and granite, which are major rocks in oceanic crust and continental crust. Rock specimens were heated at 100 °C, 300 °C, 500 °C and 700 °C to thermally crack them. We performed measurements at atmospheric pressure and dry condition. We also measured V_p and V_s for water-saturated specimens of gabbro and basalt heated at 700 °C, and compared the results with those under dry condition to investigate the effect of pore fluid on V_p and V_s .

As results, specimens heated at higher temperature tended to have slower V_p and V_s . Density of the specimens was also decreased as heating temperature was increased, and especially the density change was clear from 500 °C to 700 °C. This imply that clack density of specimens was increased with increasing temperature, and this might be the reason why V_p and V_s were decreased. Poisson's ratios obtained in this study (0.05-0.25) were lower than the observed high Poisson's ratio. V_p and V_s for water-saturated specimens were generally faster than those for dried specimens, but output signals tended to be smaller and therefore improvements of the measurements systems and methods to analyze the signals should be necessary.

Keywords: Poisson's ratio, Elastic wave, High pore pressure, Basalt, Gabbro, Granite