

Temporal change of V_p/V_s ratios in the upper crust during eruptions of Redoubt volcano

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For mitigation of volcanic hazards, it is essential to understand the change of medium properties before and after eruptions. The velocity ratios between P and S waves, V_p/V_s , reflect the physical and chemical properties of medium including temperature, density, and rock composition. Temporal variations of V_p/V_s ratios in volcanic regions allow us to infer the changes in medium and magma properties beneath volcanoes. Redoubt volcano is an active volcano that is located at 175 km southwest from Anchorage. The dimension of volcano is about 10 km in diameter, and its volume is around 30-35 km³. The volcano has erupted several times since 1902, and most recently in 2009. The eruptions were generally explosive, and produced lava and pyroclastic flows. Seismic events in the volcano-tectonic (VT) seismic swarm zones of Redoubt volcano are well monitored by Alaska Volcanic Observatory (AVO). We investigate the V_p/V_s ratios in the VT seismic swarm zones from observed P and S arrival times. The hypocentral information is collected from the AVO seismic catalogue. Seismic data with high signal-to-noise ratios for earthquakes with epicentral distance less than 10 km are selected for analysis. A total of 6425 P and S travel-time pairs is collected. The V_p/V_s ratios are estimated using a modified Wadati method that is based on the S-P differential travel times versus P travel times. Tomographic V_p/V_s ratio models are calculated before and after eruptions eruption. It is observed that the V_p/V_s ratios drop significantly from 1.95 to 1.73 during eruptions, reflecting the changes in the properties of medium.