Effect of water on P wave velocities of polycrystalline quartz at high temperature and high pressure

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Water might reduce the seismic velocity of crustal materials and cause weakening of mechanical strength of earthquake source areas. In order to estimate water content in the low velocity anomalies, it is important to assess the influence of H2O fluids on the elasticity of crustal materials. Here we determined the effect of water and temperature on compressional wave velocities (Vp) for quartz at pressures to 0.6 GPa and temperatures to 673 K corresponding to the upper crust. The experiments were carried out on natural fine-grained polycrystalline quartz with 0.03, 0.17, 0.37, 0.45, 0.98, 1.48wt% H2O added or initially dried using ultrasonic technique in a piston cylinder type high-pressure apparatus. The P wave velocity measurements at 0.5 GPa in dry polycrystalline quartz yielded Vp = 6.19 km/s to 6.02 km/s with increasing temperature from 298 K to 673 K (its temperature derivatives is -0.44 m s-1 K-1). P wave velocities of wet polycrystalline quartz are systematically lowered by about 10.5% (1.48 wt% H2O), when compared with those of dry polycrystalline quartz. Comparison of their temperature derivatives for wet polycrystalline quartz with those for dry polycrystalline quartz shows their temperature derivatives are insensitive to the addition of water within the limited H2O wt% range investigated. Our results demonstrate that P wave velocity decreases significantly with less than 1 wt% H2O. SEM images indicate that reduction of Vp depends on geometry and distribution of grain boundary pore fluid and pore fluid inclusions.