Crack aspect ratio in the serpentinized peridotites inferred from onboard ultrasonic data by the Oman Drilling Projects

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To assess pore geometry in the highly altered peridotites collected by the Oman Drilling Projects, we analyzed ultrasonic velocity of the serpentinized dunites and harzburgites from mantle sections at Holes BA1B, 3A, and 4A. First, we estimated serpentine fraction based on grain density to obtain the porosity-free reference velocity, suggesting a nearly complete serpentinization at shallow depth but decrease of hydration at deeper depth. We assumed that the difference between reference and measured velocity attributes to pores with spheroidal shape that are embedded in the samples. Application of effective medium theory to onboard P-wave and porosity data indicates that pore aspect ratio mostly lies between 0.1 and 0.01 and crack density is ranging from 0.58 to 0.02. We found a positive relationship between aspect ratio and serpentine fraction, suggesting a change in pore shape controlled mainly by the dissolution–precipitation processes during hydration, consistent with microstructural observations. The relatively high aspect ratio and hence high fluid flux at shallow depths also agree with the present-day hydration processes that are inferred from the borehole fluid chemistry. The inversion of ultrasonic data provides a series of elastic moduli, and we can estimate Poisson’ s ratio, which is a key physical property to interpret geophysical observations in the oceanic lithosphere.

Keywords: pore geometry, serpentinite, Oman ophiolite

