The influence of OH content on elastic constants of single-crystal topaz studied via sphere-resonance method

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Transport of ocean floor sediments by plate motions might play an important role in the circulation of materials within the Earth. Imaging subducted sediments through seismological observations requires a thorough understanding of elastic properties of sediment origin hydrous minerals. Topaz is a hydrous mineral with ideal chemical formula $Al_2SiO_4(F_{2-x},OH_x)$, which can be formed from subducted sediment at high pressures. Although elastic constants of topaz have been reported, experimentally determined values show no systematic relationship between elastic constants and OH molar content. Moreover, there are significant differences between experimental and theoretical values. To understand the influence of OH content on elastic constants, we have studied elastic constants of three single crystals of topaz with different OH contents (x=0.28, 0.45, 0.66) by the sphere-resonance method.
Sphere samples (D=2.6~6.5 mm) were made from single crystals of natural topaz by the two-pipe method. Lattice parameters were determined and orthorhombic symmetry was confirmed by XRD. Resonant frequencies were measured with different specimen-holding forces. Extrapolating to the specimen-holding force of zero, we obtained frequencies of "free" oscillation. Elastic constants were determined by comparing measured and calculated resonant frequencies. The xyz algorithm (Visscher et al., 1991) was employed to calculate resonant frequencies of the sphere samples. At an ambient temperature, Our determined elastic constants C_{11}, C_{22}, C_{44}, C_{66}, C_{12}, C_{23} and C_{31} increase with increasing OH molar content, while C_{33} and C_{55} decrease. These changes are similar to those seen in theoretical values (Ulian and Valdre, 2017) except for C_{11}, though there are significant differences between experimental and theoretical values.

Keywords: Topaz, Elastic constants, Water

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