Evidence for dry mantle transition zone from the electrical conductivity of wadsleyite

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Electrical conductivity of water-doped and undoped wadsleyite was measured in its stability field to examine the conductivity variation associated with the olivine-wadsleyite phase transition and to infer the water contents in the mantle transition zone.

Electrical conductivity of anhydrous wadsleyite in the mantle transition zone is about 3×10^{-2} S/m. Hydration enhances the conductivity of wadsleyite, by containing 0.1 wt% of water, the conductivity of wadsleyite increases by 0.3 log units. At 1.0 wt % of water, the conductivity becomes 1×10^{-2} S/m. The conductivity jump associated with the dry olivine-wadsleyite transition is only 0.7 log units. The hydration of olivine and wadsleyite decreases the conductivity jump if water is distributed homogeneously at the bottom of the upper mantle and top of the transition zone, and it should become ~0.5 log units by 0.1wt % hydration. If water is partitioned between olivine and wadsleyite, the water content of wadsleyite should be 5 times higher than the olivine, resulting in the conductivity jump of ~0.9 log units.

This study shows the hydration of wadsleyite has only small contribution to the conductivity at the mantle transition zone. It is difficult to determine the water contents less than 0.1 wt % for normal geotherm from electrical conductivity measurements due to small activation enthalpy of proton (H^+) conduction. On the other hand, our conductivity-depth profile for anhydrous olivine and wadsleyite generally agrees with the recent geophysical models. Thus, it is not necessary to introduce globally hydrated mantle transition zone.

Coexisting jadeite and omphacite in metabasites from the Escambray Massif, Cuba

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The Escambray Massif is an isolated mountainous area in the south-central part of the Caribbean Island of Cuba. It is made up of a heterogeneous nappe stack with LP/HT units of a volcanic island-arc sequence as well as HP/LT units of subducted rocks (Stanek *et al*., 2006). The most prominent HP/LT unit, the Gavilanes nappe, is a heterogeneous, mélange-type assemblage of serpentinite, metagabbro, greenschist, blueschist, deerite-bearing metaquartzite (Grevel *et al*., 2006) and eclogite. Here we report an unusual occurrence of metagabbros in the Gavilanes nappe characterized by both jadeite and omphacite in the same rock. Although compositions are variable, almost pure jadeite can be observed. When coexisting, the compositions of Jd and Omph generally bracket the suggested two-phase region (e.g., Carpenter and Smith, 1981). The rocks contain quartz. Garnet is absent. Amphibole compositions vary from taramite to glaucophane. Very late epidote and albite are present. The metagabbros contain relics of magmatic augite topotactically replaced by omphacite and jadeite. The omphacite is "*P*-type" (ordered) and shows fine-scale antiphase domain textures. Three types of jadeite-omphacite intergrowths can be identified: l) jadeite + omphacite + pumpellyite + chlorite in the matrix between augite relics; 2) jadeite + omphacite + pumpellyite intergrowths enclosed as lamellae in augite, whereby lamellae and augite clearly mimic an original ophitic texture; 3) jadeite + omphacite + chlorite intergrowths in fractures traversing the entire rock. In many cases jadeite and omphacite show straight grain boundaries suggestive of phase equilibration. This unusual occurrence of jadeite in a metabasic rock is probably due to local domain equilibration in a rapidly subducted "spilitized" basic rock.

References

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