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Seismology and water; drowning in theory or thriving on facts?

M. van der Meijde (1)

(1) International Institute for Geo-information Science and Earth Observation (ITC)

Is there any water in the Earth's mantle? And if so, how much is there? These questions have been the topic of many studies in the last 10-15 years. Numerous theoretical and laboratory studies show that it is most likely that significant amounts of water can be present in the mantle transition zone, up to a number of times the amount of water present at the Earth's surface. These studies show how water influences the properties of the mantle transition zone discontinuities, like the olivine-wadsleyite phase transition around 410 km depth. Because water prefers to be incorporated into wadsleyite rather than olivine, it stabilizes wadsleyite over a wider range of pressures and temperatures; thereby thickening the transition interval to as much as 40 km. Increased water content in the mantle transition zone would have an opposite effect on the thickness of the phase transition interval at 660 km. Moreover, recent studies indicate that the phase transition interval from wadsleyite to ringwoodite, nominally at a depth of 520 km, can be much sharper under hydrous conditions. But which of these effects can be made visible through seismological analysis and proven?

Although water has a strong effect on physical properties, the indirect observational evidence of water present in the mantle transition zone is limited and still under discussion. Several seismological techniques have been applied in the quest for deep water, e.g., receiver functions, tomography, and PP and SS precursors. They all look in detail at the depth and thickness of the 410 km discontinuity in relation with the presence of water. This paper will review the present status of actual observations, taking into account possible observations that were not interpreted as such. Point of discussion will be the accuracy of such seismological observations and the inherent non-uniqueness. Is water in the mantle transition zone a fact or do we simply drown

in theoretical water?