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Vp/Vs ratio in the crust and upper mantle from P- and S-wave receiver functions

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In the last years many estimates of crustal thickness are obtained with the H-k technique by Zhu and Kanamory (2000) for P-wave receiver functions (PRFs). This technique assumes that the P and S velocities (Vp and Vs) in the crust do not vary with depth. As the wave-paths of the crustal multiples contain P-wave and S-wave paths, their travel times depend on both Vp and Vs, and the Vp/Vs ratio can be retrieved from the PRFs. I review an alternative technique and summarize the experience of measuring the Vp/Vs ratio as a function of depth from PRFs and S-wave receiver functions (SRFs). Vp and Vs are allowed to vary only with depth. The Earth's medium is modeled by a stack of layers, and the receiver functions are inverted simultaneously for the P-wave and S-wave velocity profiles by using Simulated Annealing. Several thousands of the best-fitting models are retained in order to evaluate uncertainty (non-uniqueness) of the result. The procedure returns robust estimates of Vs and provides useful constraints on Vp and Vp/Vs ratio. There are a few reasons for a sensitivity of this method to Vp. First, the observed apparent incidence angles of the P and S waves depend on Vp and Vs. Second, the travel-times of all multiples in PRFs depend on Vp and Vs. Third, from PRFs we infer the teleseismic travel-time residuals of P and S, which depend on Vp and Vs and are used as constraints in the inversion. Finally, the travel times of the S410p phase in SRFs (S wave converted to P at the 410-km discontinuity) depend on the Vp/Vs ratio. I will discuss application of these techniques in the recent studies of a few regions: 1 - The Indian shield, Himalaya and Tibet, 2 - The Cape Verde hotspot, 3 - Iberia and the Gibraltaer Arc, (4) The Fennoscandian Shield. The obtained Vp/Vs ratio varies with depth between 1.6 and 1.9 in the upper mantle and between 1.6 and 3.0 in the crust. The lowest Vp/Vs ratio is observed in the depleted mantle keels of Precambrian cratons. The high values are found in low S-wave velocity zones of the upper mantle and in mafic and sedimentary layers of the crust.