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NoLiMit: Software and Catalogs of Seismic Waveforms for Petro-Physical Analyses of the Earth's Mantle Transition Zone

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This work aims at providing to the community new databases, procedures, models, and software packages for the analysis of the elastic, thermal and petrological properties of the Earth's mantle transition zone (MTZ). To better account for the multiple spatial scales in the thermo-chemical structure and imperfect seismic data in terms of coverage and noise, we developed software modules relying on the partition of the Earth in Voronoi cells, with an optimization algorithm searching to minimize the effect of noise in the data. We use a self-consistent thermodynamical approach to predict the theoretical seismic response from various mineralogical phase assemblages. These modeling efforts lead to the construction of catalogs of synthetic seismic waveforms for SS-, PP-precursors, receiver functions, and ScS reverberations data, for direct comparison with observed seismic data. We illustrate the use of these catalogs and software in a two-case analysis. At a regional scale, we show that the complexity of the MTZ in the subduction zones of North and Central Honshu below the Japan (East) Sea --- single and double discontinuities ranging in depth from 650 to 730 km, as well as a low-velocity zone at the tip of the subducted Pacific plate --- can theoretically be explained by phase equilibria in a pyrolitic mantle composition. At a global scale, we combine PP-, SS-precursors observations and mineral physics modeling, and we demonstrate that imperfect chemical equilibration of a mantle with pyrolitic composition is able to explain the global absence of P-wave reflections underneath the 660-km discontinuity.

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Mots-Clés : Transition zone ; Mineral physics ; Seismology ; Geodynamics

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