Implication of SV to P conversion at a narrow zone of anomaly associated with stagnant slab

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Anomalously broadened P waveforms of deep focus events with a duration of about 10 s or longer were observed at some regional stations (between 14 and 30deg) after sampling the bottom of stagnant slab in the mantle transition zone. The source processes of these events are short (less than 4 s) and the P waveforms at other stations as well as the corresponding SH waves do not show such anomaly. The rays of the anomalous waves started at a source depth of about 500 or 600 km and propagated in the vicinity of those whose waveforms can be synthesized with a relatively simple model M3.11 or M2.0 for stagnant slab, or their slightly modified versions. As the SH waveforms do not show anomalous broadening, the role of reflections is put aside. If SV to P-wave conversion is the major cause, it should have taken place near the source, i.e., the coda-like duration corresponds to the difference of travel times by SV-wave and by P-wave for the path. This study together with our previous studies reports that the anomalous zones of complex mantle properties are found in very narrow zones that extend about 100 km or so from deep focus hypocenters. The extent of anomalous zones could be just a portion of the entire zone of complexity.

Here the physical conditions to produce SV to P conversion are tested using a model with a layer of a variable Poisson ratio below the hypocenters. When the Poisson ratio is in the range between 0.35 and 0.4, the maximum amplitudes of the converted P waves are about 10 percent or more of the incident SV waves. The variation of structure from M3.11 (high velocity anomaly (HVA) with depression of the 660 km discontinuity) in the Kuriles to M2.0 (HVA without broad depression of the discontinuity) beneath the northernmost Philippine Sea plate suggests lateral temperature variation beneath the flattened slab. Recent results of laboratory experiments suggest significant effects of water in the phase transformation. The creation of the anomalies identified as above may involve in the complex system of phase transformation with water and cold temperature anomaly. The key issues from these studies are that subducting slab is highly hydrous, but can be dehydrated in the transition zone and at the top of the lower mantle. During the progression of cold slab dehydration the transition zone could become a storage of water and the addition of water could enhance the complexity of possible coexisting metastable mineral phases. Assuming this complex system, the lateral temperature gradient should be accounted for in the creation of anomalous narrow zones. The proximity of anomalies to hypocenters may have clues to the occurrence mechanism of deep focus events.