Behaviors of Wet Plume Controlled by Olivine-Wadsleyite Phase Transition and Water Distribution

Hyunseong Kim, Youngjun Lee, Doyoung Kim & Changyeol Lee
Dept. of Earth System Sciences, Yonsei University, Seoul, Republic of Korea

Intraplate Volcanism in Northeast Asia
1. Quaternary intraplate volcanoes locate 1000 km away from Japan trench.
2. Pacific plate is stagnated in the mantle transition zone (MTZ) under Northeast Asia.
3. Water amount in the MTZ is the largest in Northeast China and decreases outward.
4. Isotope features of igneous rocks are thought to be contributed by EM1 (ancient sediments in partially hydrated MTZ) and/or EM2 (sediments on subducting slab).

Wet Plume by Chemical Buoyancy

1. Olivine–wadsleyite phase transition (a positive Clapeyron slope and density jump).
2. Partial hydration (bound-water) of the mantle in the MTZ.

Results and Implications
1. Olivine–wadsleyite phase transition acts as a barrier which retards wet plume to enter the asthenospheric mantle.
2. Hydrated mantle in the MTZ enables shorter onset time and increased spacing of wet plumes (45 km → 480 km) than when absent. The spacing is comparable to the distribution of intraplate volcanoes/clusters in Northeast Asia.
3. The larger bound-water in the MTZ results in the larger incorporation of the mantle in the MTZ into the wet plume, consistent with the isotope features.
4. Wet plume experiences a partial melting up to 4.6 wt.%, similar to the value calculated from rock samples.