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Reestimated slab dehydration fronts in Kuril-Kamchatka using updated three-dimensional slab thermal structure

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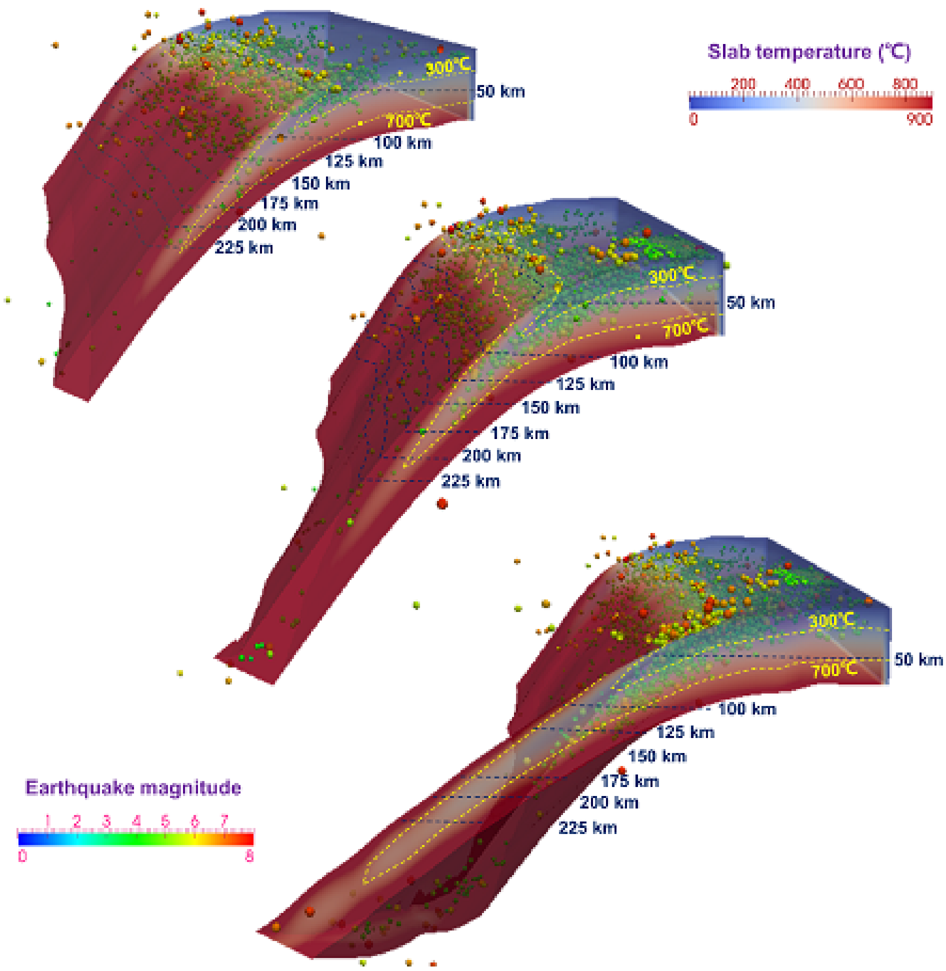
Previous subduction thermal models are inconsistent with the values of forearc heat flow (50-140 mW/m2) and global P□T conditions of exhumed rocks, both suggesting a shallow environment 200~300°C warmer than model predictions. Here, we revaluate these problems in Kuril-Kamchatka using 3-D thermomechanical modeling that satisfies the observed subduction history and slab geometry, while our refined 3-D slab thermal state is warmer than that predicted by previous 2-D models and better matches the observations involving exhumed rock records. We show that warmer slabs create hierarchical slab dehydration fronts at various forearc depths, causing fast and slow subduction earthquakes. The multilayered subduction regime and a large downdip thermal gradient of > 5°C/km beneath Kuril-Kamchatka indicate a stratified characteristic effect on slab dehydration efficiency. We conclude that fast-to-slow subduction earthquakes all play a key role in balancing plate coupling energy release on megathrusts trenchward of high P□T volcanism.



Slab temperature (℃)
200
400
600
800
0
900
300℃
700℃
50 km
100 km
125 km
150 km
175 km
200 km
225 km
Earthquake magnitude
1
2
3
4
5
6
7
0
8