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# Insights into the crustal structure beneath Central Kamchatka revealed by ambient noise tomography

**Igor Egorushkin**[1], Ivan Koulakov[2,1,3], Andrey Jakovlev[4], Hsin-Hua Huang[5,6], Eugeny Gordeev[7], Ilyas Abkadyrov[7], Danila Chebrov[8]

[1] A.A. Trofimuk Institute of Petroleum Geology and Geophysics, Siberian Branch of the Russian Academy of Sciences
[2] Center for Hydrocarbon Recovery, Skolkovo Institute of Science and Technology , Russia
[3] Institute of Earth Crust of the Siberian Branch of the Russian Academy of Sciences
[4] Helmholtz Centre for Polar and Marine Research, Alfred Wegener Institute , Germany
[5] Institute of Earth Sciences, Academia Sinica , Taiwan
[6] Department of Geosciences, National Taiwan University , Taiwan
[7] Institute of Volcanology and Seismology of the Far Eastern Branch of the Russian Academy of Sciences
[8] Kamchatka Branch of the Federal Research Center of the Geophysical Survey, Russian Academy of Sciences , Russia

i.i.egorushkin@gmail.com

The central region of the Kamchatka Peninsula (Russian Far East), bounded by latitudes 52.8 and 54.1 degrees, hosts several active volcanoes of the Eastern Volcanic Front and a number of dormant back-arc volcanoes, as well as parts of two mountain ridges, Sredinny and Ganalsky. The volcanoes of Central Kamchatka pose a tangible threat to the relatively densely populated Petropavlovsk-Kamchatsky urban district (approximately 162,000 inhabitants), and therefore are actively investigated. Another motivation for conducting research in this area is the search for geothermal resources, which should optimize the electricity and heat supply to the local population.

To perform ambient noise tomography, we used the vertical component of continuous seismic records from the permanent stations deployed by the Kamchatka Branch of the Federal Research Center of the Geophysical Survey (KB FRC GS) [1] and the temporary network installed in 2019-2020 within a joint project by Trofimuk Institute of Petroleum Geology and Geophysics SB RAS (Novosibirsk), Institute of Volcanology and Seismology FEB RAS, KB FRC GS (Petropavlovsk-Kamchatsky) and Academia Sinica (Taiwan). The data was processed following the standard workflow developed by [2], resulting in cross-correlation functions that contain information about Rayleigh surface waves [3]. Each of these correlograms was subjected to a frequency-time analysis [4], [5] and based on its outcomes we picked 489 dispersion curves of the fundamental mode of Rayleigh wave group velocities. The tomographic inversion of the dispersion curves was conducted using the SURF_TOMO algorithm [6] that initially generated the two-dimensional maps of group velocities for periods ranging from 1 s to 30 s, then found the optimal 1D model of shear wave velocities and derived the three-dimensional S-wave velocity distribution.

In the resulting model, a prominent low-velocity anomaly is observed beneath the active Avacha and Koryaksky volcanoes, reaching depths of ~40 km and potentially indicating a zone of heated rocks. This anomaly is hypothesized to represent a common magma pathway through the crust feeding both volcanoes. Beneath the active Zhupanovsky volcano, we observe three low-velocity layers at depths of 2 km, 8 km and 20 km, suggesting a multilevel magma feeding system. Our model reveals a high-velocity pattern at shallow depths under the Sredinny Ridge, likely associated with consolidated magmatic structures. We interpret the low-velocity in the lower crust as a high-temperature zone preserved here since the time when this area hosted an active volcanic arc. Below the Ganalsky Ridge, a prominent high-velocity anomaly extending to a depth of ~15 km is attributed to the Precambrian to Carboniferous metamorphic rocks, predominantly of mafic composition.

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