Exploring Earth's mantle through microseisms

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The ocean is constantly whirring with activity. The pressure from this constant roiling and swelling is one cause of microseisms—random, nearly imperceptible vibrations of Earth that also can be produced by

human activities like vehicular traffic.

Microseisms release far less energy than earthquakes, but they still offer scientists important information. Instead of the isolated shock of an earthquake, microseisms happen all the time, producing a constant background hum that can provide insights into deep-Earth structure not available from studies of larger seismic events.

As with larger seismic waves, microseisms can travel along Earth's surface as surface waves, or through its interior as body waves. In new research published in *Geophysical Research Letters*, Kato and Nishida study body wave microseisms emerging from the ambient noise of the ocean and traveling through the mantle.

The researchers looked at data from 690 seismic stations recording 5,780 microseisms that occurred in the North Atlantic Ocean as well as the North and South Pacific. Instead of analyzing the microseisms using seismic interferometry—a technique often used to study seismic noise under the assumption that microseisms are generated everywhere—they examined the tiny tremors more like they would larger earthquakes.

By developing a novel receiver function method and treating the microseismic body waves as having spatially isolated source locations, they produced 3D imaging of Earth's mantle structure.

The imaging corroborated the depths of mantle discontinuities—changes in rock density and composition that mark the transition zone between the upper and the lower mantle—at 410 and 660 kilometers below the surface. According to the authors, the new technique for unpacking microseismic body waves could lead to a more thorough understanding—and future exploration—of Earth's enigmatic inner structure.

More information: S. Kato et al, Extraction of Mantle Discontinuities From Teleseismic Body-Wave Microseisms, *Geophysical Research Letters* (2023). DOI: 10.1029/2023GL105017

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