

## **1000 km down: seismologists probe the mid-mantle<sup>1</sup>**

**Many questions remain unanswered about the mid-mantle, 600 to 1200 km below Earth's surface. Does this layer decouple convection between the upper and lower mantle? How are processes here linked to plate tectonics and volcanism? Cambridge Earth Scientists are using seismic constraints to determine the compositional heterogeneity in the mid-mantle. They hope to identify processes which could obstruct or divert convection 1000 km down.**

660 km below Earth's surface there is a globally observed seismic discontinuity which correlates with the well known ringwoodite phase transition. In tomographic models of seismic wave velocity, convecting mantle material appears to pond, stagnate, or divert at this depth. This phase transition presents an obvious boundary between the upper and lower mantle.

Many tomographic models of the mantle also show a possible boundary at depths of around 1000 km, but here there is no observation of another global seismic discontinuity. While tomographic models illuminate the mid-mantle on the scale of 100s of km, higher frequency seismic studies have shown evidence for smaller-scale heterogeneity.

Researchers in Cambridge have already demonstrated how high frequency seismic waves can be used to map heterogeneities around 1000 km beneath Western Europe. They found broad areas where the velocity of seismic waves jumps sharply. These may be caused by diverted material from the Icelandic mantle plume, potentially linking mantle hotspots beneath Iceland and the Eifel (Germany) to a single deep source.

A new three-year NERC funded project, led by Dr Sanne Cottaar at the Bullard Laboratories, will extend the study to a global scale, looking for small-scale features wherever seismic data is available. The team will draw on data from millions of seismograms recording earthquakes across the planet. They will map features in the mantle which those seismic waves have travelled through, and aim to understand how such features relate to locations of upwelling and downwelling, and if they preferentially occur around 1000 km.

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<sup>1</sup> Published April 2018 © Department of Earth Sciences

