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Probing the Earth

Most of our knowledge of the interior of the Earth has come from indirect inference based on near-surface observations. Seismology has provided much of the information, with important constraints from gravimetry and electromagnetic sounding. Geophysical sampling is available for most of the globe, but most measurements provide a snapshot of current structure, though the recovery of the Earth from glacial loading gives a window into the near past. Geochemical sampling is much more heterogeneous across the surface, but provides important constraints on time. Geodynamic modelling can project back into past states of the Earth. Our aim is to combine all the different sources of information into a coherent view of the way that the Earth works, but we have to be aware of the nature of the different probes. With residence times for geochemical species of up to 1 Ga the geochemical state of the mantle may not be the same as the present. Advances in mineral physics provide insight into the nature of the deep Earth but these must be linked to the geochemical constraints to provide a description of the full systems inside the Earth and its connection to the surface environment.