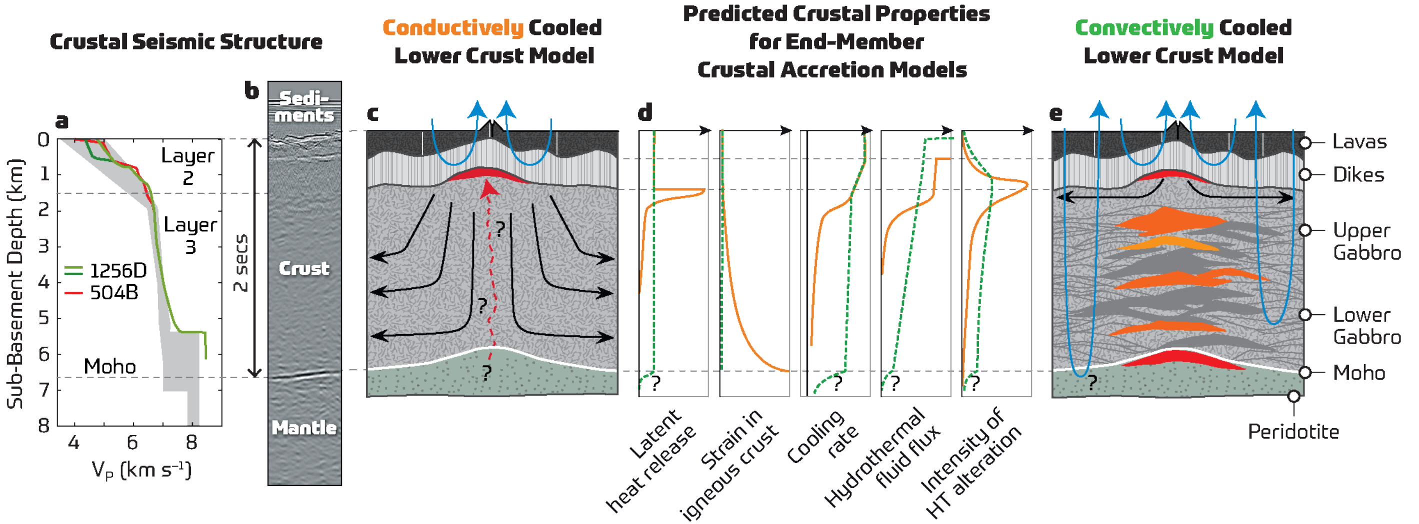

Recovery of a complete crustal section via scientific ocean drilling will allow us to test two competing end-member crustal accretion models that were developed from seismic observations of the oceanic crust combined with geological and petrological evidence from the Oman ophiolite. In the gabbro glacier ductile flow model (c; for example, [1]) lower crustal cooling is predominantly conductive, whereas in the sheeted sill model (e) of on-axis intrusions[2], there is convective cooling of the lower crust. The two models predict profoundly different variations in a range of crustal properties (d) that can be determined from drill cores with depth, providing an opportunity to test these two models.

(a) Average seismic structure of fast/super-fast-spreading oceanic crust older than 7.5 million years. Gray shading: bounds of average "normal" crust older than 29 million years.[3] Green lines: Ocean Drilling Program (ODP) Site 1256.[4] Red line: Deep Sea Drilling Project (DSDP) Site 504.[5] (b) Example of a multichannel seismic reflection image showing a crustal column over a sharp, strong single Moho reflection.[6] Black arrows in (c) and (e) show the movement of the solid lower crust, and blue arrows show the dominant zones where hydrothermal circulation removes latent and sensible heat. The red arrow in (c) shows the tentative movement of magma. (d) Predicted differences in the relative variations of latent heat release, strain rate, cooling rate, hydrothermal fluid flux, and intensity of high temperature (HT) alteration with depth for the end-member gabbro glacier model (orange) and the sheeted sills model (green) provide an opportunity to test the accretion models using drill cores. *(a,b) Illustration by Benoit Ildefonse, (c,e) after Korenaga and Kelemen (1998), https://doi.org/10.1016/S0012-821X(98)00004-1. (d) Illustration by Rosalind Coggon. [1]Henstock et al. (1993), https://doi.org/10.1029/92JB02661; Quick and Denlinger (1993), https://doi.org/10.1029/93JB00698. [2]Kelemen et al. (1997), https://doi.org/10.1016/S0012-821X(96)00235-X. [3]After Christeson et al. (2019), https://doi.org/10.1029/2019RG000641. [4]Teagle et al. (2006), https://doi.org/10.2204/iodp.proc.309312.2006. [5]Swift et al. (2008), https://doi.org/10.1029/2008GC002188. [6]Modified from Nedimović et al. (2005), https://doi.org/10.1038/nature03944.*