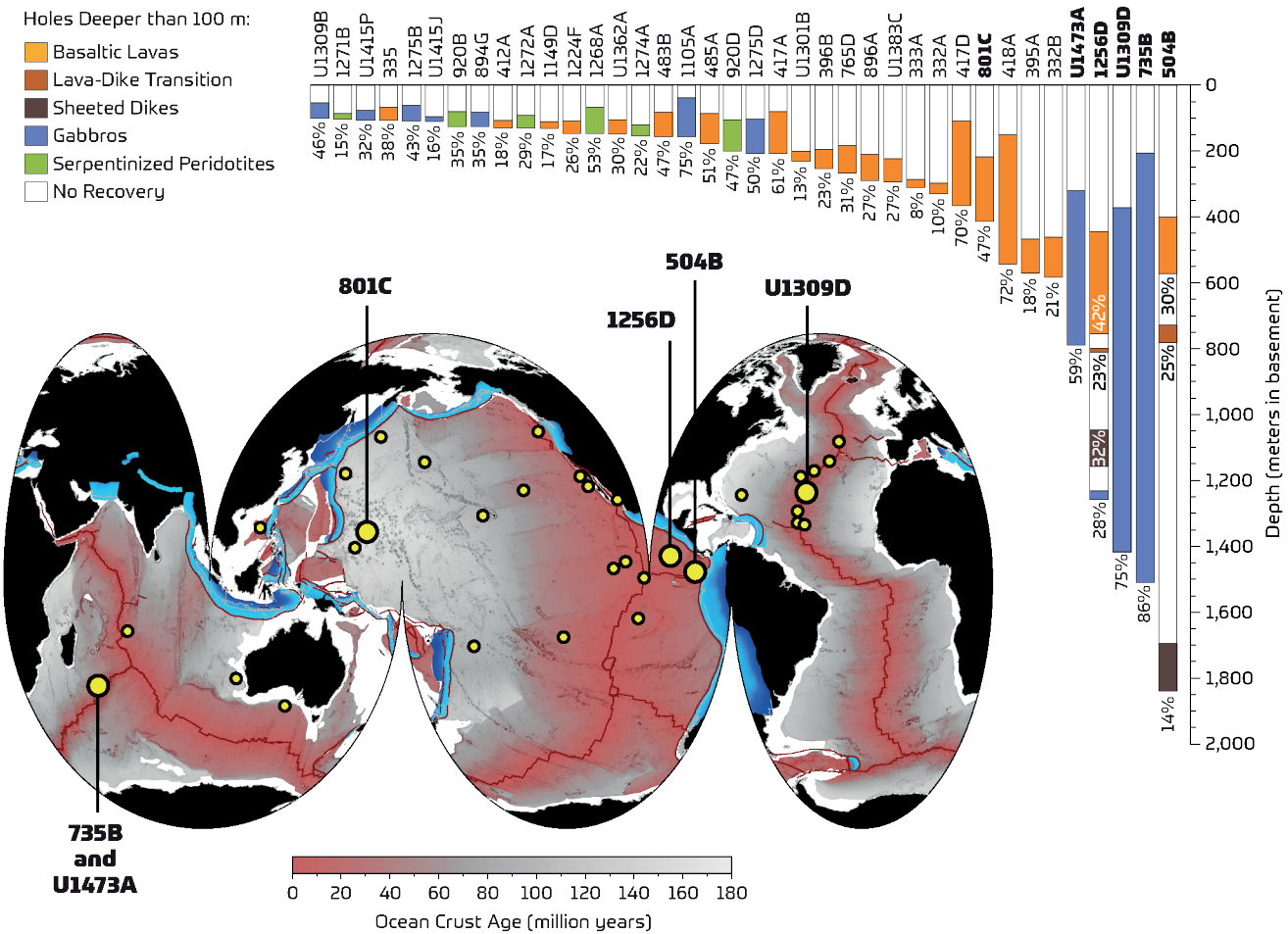
Transforming Our Knowledge of Earth's Interior

The transfer of residual internal heat from Earth's formation 4.5 billion years ago, along with energy released by radioactive decay of isotopes, powers the plate tectonic cycle. Volcanism is the most obvious manifestation of this energy transfer. More than 80% of Earth's volcanism occurs along globe-encircling mid-ocean ridges, creating new oceanic crust. The motion of plates across Earth's surface, predominantly driven by the pull of rigid cool lithospheric slabs as they sink into the mantle at subduction zones, causes oceanic gateways to open and close, which in turn affects ocean circulation, ocean chemistry, and climate on geologic timescales. Scientific ocean drilling has transformed our knowledge of Earth's interior by pushing the boundaries of science exploration deep into oceanic crust. Since confirming seafloor spreading in 1968, scientific ocean drilling has delivered critical information about the processes that govern plate tectonics and its impact on the interconnected Earth system. Ocean drilling has shown that the volume, composition, and architecture of the oceanic crust varies radically with seafloor spreading rate and the nature of the underlying mantle.



Compilation showing scientific ocean drilling holes that penetrated >100 m into intact oceanic crust and tectonically exposed lower crust and upper mantle from 1968 to 2018. The bar chart provides the number designation for each hole and the recovery (in percent) for each basement lithology. The yellow dots indicate the locations of these drill holes on the global map of ocean crustal age; holes that have been particularly instrumental in informing our understanding of the formation of oceanic crust are labeled (504B, 735B, 801C, 1256D, U1309D, and U1473A). This compilation does not include "hard rock" drill holes into seamounts, oceanic plateaus, back-arc basement, hydrothermal mounds, or passive continental margins. The locations of plate boundaries (red) and subducting slabs (blue shading) are also shown. Note that the majority of drill holes are in crust younger than 40 million years. *Sources: Michibayashi et al. (2019), https://doi.org/10.5670/oceanog.2019.136; Hayes (2018), https://doi.org/10.5066/F7PV6JNV; Müller et al. (2016), https://doi.org/10.1146/annurev-earth-060115-012211*