Exploring the volcanic and magmatic architecture of the seafloor

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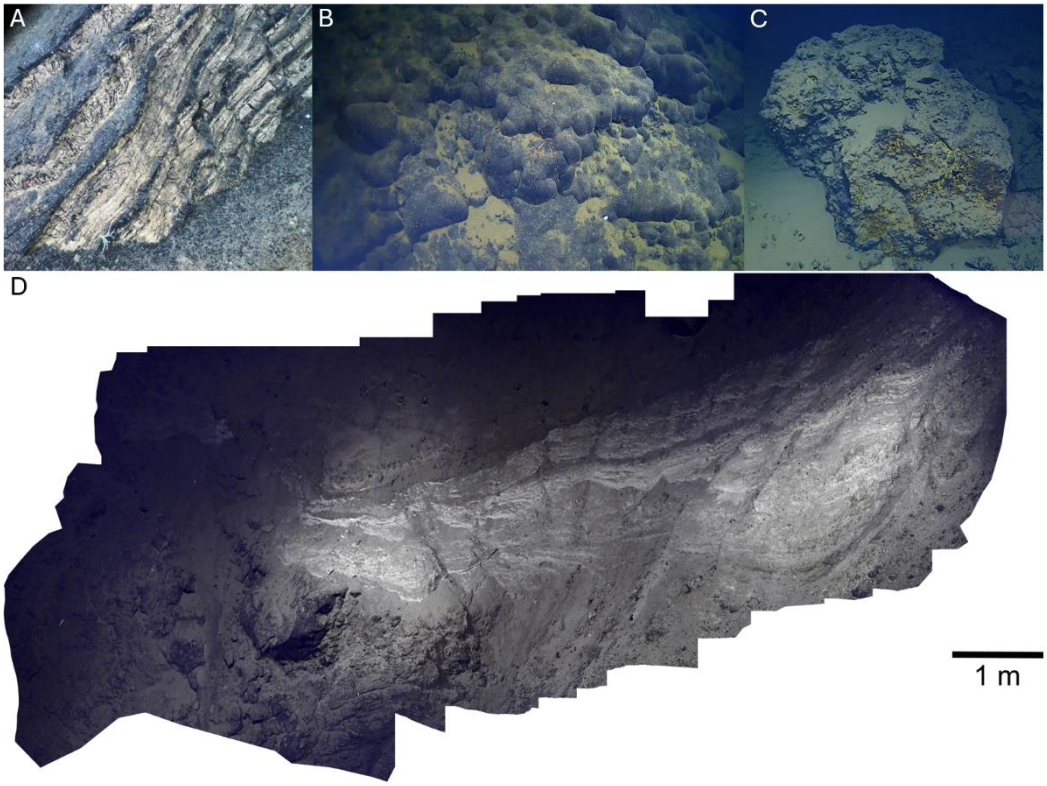
Marine geologists have known that there are volcanic rocks on the seafloor since at least the 1870s, when submarine basalts were recovered from the deep sea by trans-Atlantic cable repair ships (Hall, 1876) and the *Challenger* Expedition (Murray and Renard, 1891). These first lines of evidence hinting at the evolution of our planet were recovered by dredging (dragging a strong, steel mesh bag across steep, rugged areas of the seafloor) a process that although recovers valuable physical samples for use in petrological and geochemical studies, has low confidence in the precise location of recovered material, and can also impact the seafloor environment negatively.

Continued technological developments have provided increasingly sophisticated, higher-resolution imaging and sampling techniques. Improved acoustic data acquisition, remotely operated vehicles and autonomous underwater vehicles all contribute to more refined collection of physical samples and a step-change in our understanding of the geological evolution of the seascape. In particular, the use of submersibles has afforded researchers the opportunity to directly examine and sample the seafloor with pinpoint accuracy. Here we present a compendium of direct observations of the seafloor geology made by the pilots and co-pilots of *Bakunawa* supplemented by free-fall lander imagery, from expeditions to the Tonga Trench and Nova Canton Trough.

These observations are integrated with regional geological mapping to document volcanic, tectonic and sedimentary features across two of the Pacific Ocean's most significant hadal environments. Together, these datasets provide critical ground-truth constraints for seafloor interpretation, support a range of ongoing geological investigations, and identify priorities for future exploration and sampling campaigns.



A) Inter-banded obsidian (black) and finely vesiculated pumice layers (fawn colour) from putative rhyolite lava flow (6200 m depth Nova Canton Trough). B) Pillow lava flows (8000 m depth Nova Canton Trough). C) Volcanic bomb with yellow hydrothermal alteration (8300 m Tonga Trench). D) Pyroclastic density current deposit (~5080 m Tonga Trench).