THE OFFICIAL MAGAZINE OF THE OCEANOGRAPHY SOCIETY

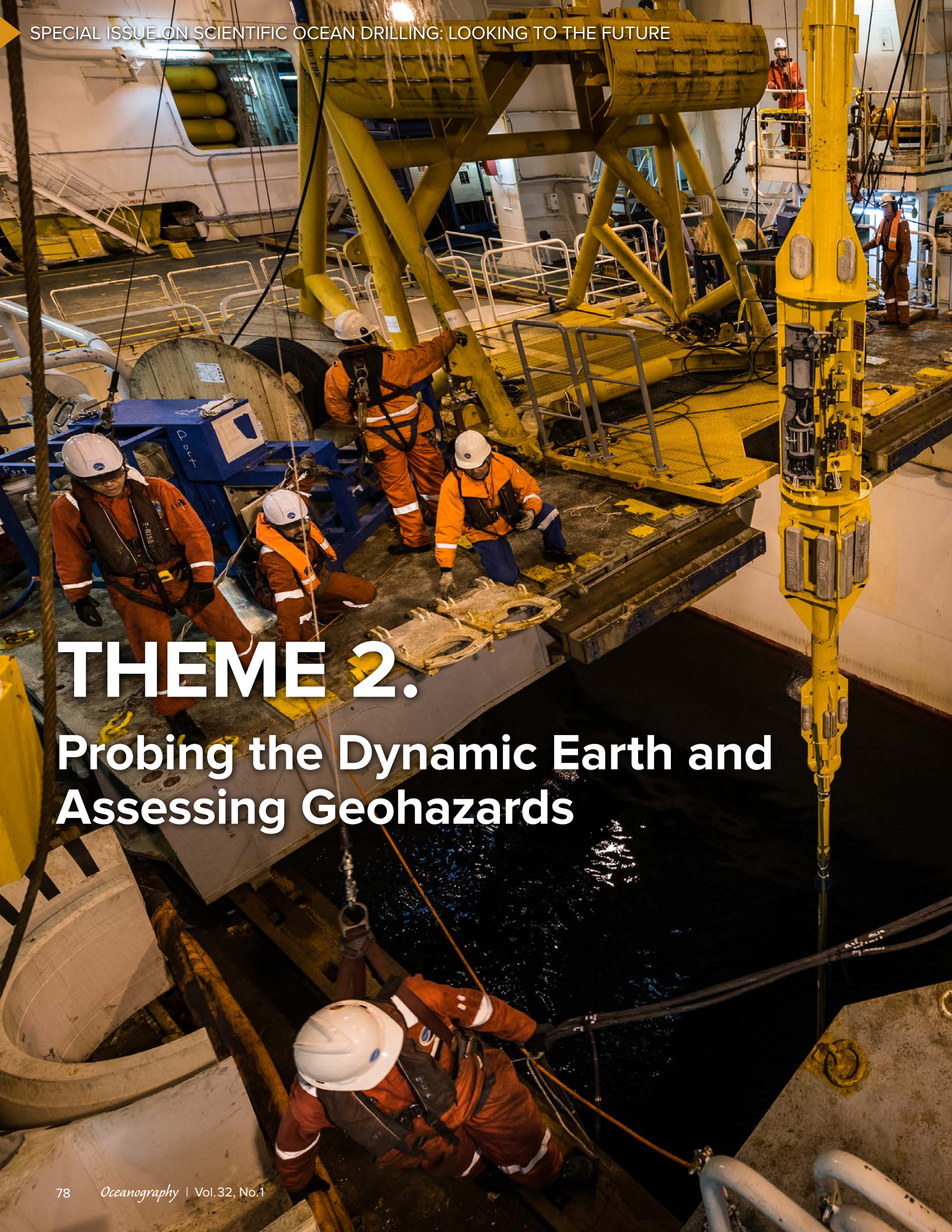
Oceanography

CITATION

Saffer, D.M. 2019. Introduction to Theme 2: Probing the dynamic Earth and assessing geohazards. *Oceanography* 32(1):78–79, https://doi.org/10.5670/oceanog.2019.124.

DOI

https://doi.org/10.5670/oceanog.2019.124



THEME 2.

Probing the Dynamic Earth and Assessing Geohazards

CORK borehole observatory deployment on D/V *Chikyu*, IODP Expedition 365, NanTroSEIZE Stage 3. *Photo credit: Dick Peterse and ScienceMedia.nl*

Scientific ocean drilling lies at the center of fundamental advances in understanding the dynamics of Earth's mid-ocean ridges and continental margins, including some of the earliest underpinnings of the nascent theory of plate tectonics in the 1960s. Over the past five decades, the Deep Sea Drilling Project (DSDP), the Ocean Drilling Program (ODP), and the Integrated Ocean Drilling and International Ocean Discovery Programs (IODP) have provided unique access to the subseafloor that has driven continued refinement of these ideas, led to the discovery of new geological phenomena, and motivated revolutionary borehole sensor and instrument development. Through sampling and continuous in situ monitoring of Earth's most active geological systems, scientific ocean drilling has led to profound insights into the dynamics of earthquakes and associated strain accumulation and release, landslides, hydrothermal circulation, and gas hydrate systems.

These efforts include drilling to sample and log boreholes in order to characterize fluid and rock composition, rock physical properties, and in situ fluid flow, temperature, and stress state in Earth's most active geologic systems. Deep riser-based drilling on *Chikyu* as part of the multi-expedition and multiyear Nankai Trough Seismogenic Zone Experiment, in addition to numerous investigations by *JOIDES Resolution* along the Ring of Fire in the Pacific, have provided access to the deep interior of subduction zones that in the recent past have generated (repeated) historical great earthquakes and tsunamis. This has yielded the most comprehensive view of any such geohazard process in the world.

In addition, borehole observatories emplaced across the spectrum of geological and tectonic settings, from ocean ridges to trenches, are providing a sustained presence in the subseafloor, enabling both continuous monitoring and active in situ experimentation designed to probe the subsurface. These investigations have provided an increasingly clearer understanding of the mechanisms that underlie subduction zone earthquakes and tsunamis. This approach also has provided novel insights into coupled fluid, thermal, geochemical, and biological processes that shape the evolution of newly formed oceanic crust and the nature of episodic, transient flows of methane and fluid in hydrate systems.

In this special issue of *Oceanography*, we highlight foundational DSDP, ODP, and IODP contributions to understanding our planet's dynamic processes over a range of timescales, as well as the exciting new questions that have emerged from these efforts, which lie at the heart of the current program's Earth in Motion theme. These include studies of great subduction earthquake processes, the discovery and underlying mechanisms for slow earthquake phenomena, the use of drilling to probe the energetics and dynamics of both recent and ancient earthquakes, the advances made in our understanding of expansive and vigorous fluid, heat, and chemical cycling in mid-ocean ridge hydrothermal systems, and the collection of a broad suite of observations enabled by borehole observatories.

– Demian M. Saffer