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Delving deep into the seafloor: how ocean drilling has revolutionized our understanding of Cenozoic paleoceanography and climate

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During the Cenozoic era (past 66 Mio years) Earth′s climate system has experienced continuous changes, ranging from extremes of extensive warmth with ice-free poles, to extremes of cold with massive continental ice-sheets and polar ice caps. High-quality sediment cores recovered by the ocean drilling programs reveal the detailed paleoceanographic history through intense studies of these invaluable archives. The improved perspective provided by these deep-sea records has led to some of the most exciting scientific developments, including the discovery of geologically abrupt shifts in climate, as well as “transient” events, brief but extreme excursions often associated with sincere impacts on global environments and the biosphere, and toward the extension of the “astronomically calibrated” geological time scale back into the early Cenozoic.

The legendary team spirit and international collaboration have proven to be vital cornerstones of the ocean drilling programs. With the recovery of high-quality, multiple-hole cored early Cenozoic successions from the Atlantic and the Pacific, highly suitable material was recovered during several key expeditions to generate stable isotope records in a resolution never achieved before. Carbon isotope data have evidenced to be highly valuable for providing insight into the operation of the global carbon cycle, and, in combination with data from the increasingly established non-destructive core scanning technologies, for stratigraphic correlation. The records have led to the development of astronomically calibrated age models for the 66–34 Ma interval calibrating the Geological Time Scale.

During the past almost two decades the high-resolution records have evolved from spliced/stacked bulk isotope records, stacked benthic isotope records (“Zachos curve”), single site bulk isotope records, single site benthic isotope records, to single site single species benthic isotope records, increasingly reducing uncertainties and errors in age models. These records are proven invaluable for developing and testing new theories on mechanisms of past climate change, and for providing a more accurate framework to assess the influence of climate on the environment in finest detail.

Besides the material from more recent expeditions the archives in the core repositories are equally important – these cores even hold the potential to help closing important stratigraphic and latitudinal gaps, to provide essential information towards compiling drilling proposals for potential future expeditions, and eventually derive from areas where it is currently difficult or impossible to get to due to logistical, budget or safety concerns.

An array of new expeditions is scheduled, e.g. Expedition 378 (“South Pacific Paleogene”) will retrieve unique sections including crucial time intervals of the early Cenozoic for the South Pacific area.