IODP Proposal Cover Sheet

005 - Pre-LEAP

Cenozoic Carbonate Fields Reconstruction

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Title	Reconstructing fields of seafloor sedimentary composition to constrain the Cenozoic carbonate system
Proponents	Sandra Kirtland Turner, Jessica Tierney, Bridget Wade, Pincelli Hull, Sarah Greene, Pam Vervoort, Andy Ridgwell, Mathis Hain, David De Vleeschouwer, Heiko Pälike
Keywords	Carbonate, carbon cycle, model-data assimilation
Area	Global

Proponent Information

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Abstract

Measurements of sedimentary carbonate content represent a major underexploited resource within the DSDP/ODP/IODP databases to constrain the ocean carbonate system, and hence the atmospheric CO2 concentration, through time. This proposal aims to formalize the creation of spatially gridded datasets (lat, lon, depth) using the Network Common Data Form (netCDF) for sedimentary carbonate content in timeslices across the Cenozoic. Biomagnetostratigraphic age information will be included in the netCDF in order to accommodate future refinements of age models. Water depth, sediment thickness, depth below seafloor, initial basement age, and initial basement depth (necessary for reconstructing paleo-water depth) will also be included in the netCDF in order to accommodate later adjustments. Following reconstruction of carbonate fields, the science team will conduct formal data assimilation in order to combine data with carbon cycle model output and constrain the seawater carbonate system in each timeslice. Data assimilation will use the intermediate complexity Earth system model cGENIE configured for the same timeslices across the Cenozoic that represent the intervals defining each carbonate field reconstruction. These timeslices will be based on the Scotese paleogeographic reconstructions for 19 intervals that have also been used to model the ocean-atmosphere-vegetation (physical climate system) necessary to derive each climate configuration in cGENIE. Timeslices correspond to 5 million year intervals evenly spaced across the Cenozoic as well as 5 Pleistocene intervals using modern plate boundaries. For each timeslice, we will use an ensemble of cGENIE model simulations with varying carbonate system parameters (including CO2, alkalinity, productivity). An off-line data assimilation method will formally combine sedimentary carbonate data with modeled fields to provide the best estimate of the carbonate system for each Cenozoic timeslice. By rigorously compiling legacy ocean drilling data and assimilating this data with a carbon cycle model, this proposal will revolutionize constraints on the Cenozoic evolution of CO2 and seawater carbonate chemistry. Together, these constraints will enable new understanding of the sensitivity of the carbon cycle and climate to perturbation across the modern Era.

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Scientific Objectives

Formal model-data assimilation maximizes the joint potential of paleoclimate reconstruction and modeling to understand the controls on the climate system through time. DA techniques are increasingly applied to constrain the surface climate of multiple past intervals, with much of the proxy data derived from DSDP/ODP/IODP sites. Equivalent spatial constraints on the ocean's carbonate system are rare, even though this knowledge is key to constraining past atmospheric CO2. In order to formally combine model and data constraints on the carbonate system in seawater, detailed fields of sedimentary carbonate content are required. Weight percent (wt%) CaCO3 data has been collected since the earliest drilling expeditions; however, researchers cannot readily access age-constrained maps of this data for specified past intervals. This LEAP proposal aims to create novel data products that maximize the potential use of DSDP/ODP/IODP datasets for formal comparison with spatially gridded numerical models. This proposal addresses Objective 3 - Earth's Climate System - of the 2050 Science Framework. In particular, generating a data product in the form required for data assimilation to provide constraints on the carbonate system through time will maximize the potential for ocean drilling to 'increase...the accuracy of paleoclimate reconstructions to enhance our understanding of how Earth's climate system operates.'

Have you contacted appropriate IODP Curator(s) to discuss sampling needs and core facility access

no