

IODP Proposal Cover Sheet

897 - APL

Southern Ocean Cretaceous Anoxia

Received for: 2016-04-01

Title	Cenomanian-Turonian OAE2 black shales in the Southern Ocean - an expression of global anoxia at high southern latitudes?		
Proponents	Simon Holford, Peter McCabe, Neville Exon, Andrew Ross, Stuart Robinson, Gianreto Manatschal, Jo Whittaker, Kliti Grice, Marissa Tejada, Michael Wagreeich, Jennifer Totterdell, Mike McPhail, Carole Schaefer, Darren Ferdinando, Ashley Ezzy, Richard Hobbs, Brian Huber		
Keywords	Cretaceous, Australia, paleoceanography, climate, OAEs	Area	Great Australian Bight

Proponent Information

Proponent	Simon Holford
Affiliation	University of Adelaide
Country	Australia

Permission is granted to post the coversheet/site table on www.iodp.org

Abstract

The fundamental objective of this APL is to obtain a continuous record through Cenomanian-Turonian OAE2 (94 Ma) marine black shales in the Great Australian Bight (GAB) using one drill site (WCED-4A). These rocks will be compared with equivalent records that will be collected in a different palaeogeographic setting during IODP Expedition 369 to the Naturaliste Plateau, to better understand the geochemical and biological responses to extreme global carbon cycle perturbations at high southern latitudes. Oceanic Anoxic Events (OAEs) record short-lived (less than 1 Myr) episodes of major environmental and paleoceanographic changes, manifested by enhanced marine organic carbon burial and linked to exceptionally warm climates. OAE2 represents one of the largest carbon cycle perturbations in Earth history, but high latitude evidence for the impact on marine chemistry, ecosystems and organic carbon burial is generally lacking.

DSDP Site 258 on the Naturaliste Plateau off southwest Australia recovered dark mudstones (2% TOC) of presumed OAE2 age and pronounced variations in $\delta^{13}\text{C}$ across the Cenomanian-Turonian boundary. The equivalent rocks will be continuously cored during Expedition 369. However, perhaps the most compelling evidence for OAE2 at high southern latitudes is provided by dredge samples from the GAB. In 2007 Geoscience Australia recovered organic rich (TOC up to 6.9%), Cenomanian-Turonian marine black shales during dredging in the western part of the GAB. The dinocyst assemblages in these samples are typical for OAE2 in both hemispheres, and extractable organic matter displays a strong anoxic marine signature. During the Cretaceous the GAB was situated at the eastern tip of a partial seaway (the Australo-Antarctic Gulf -AAG), with the Naturaliste Plateau situated in the open ocean at the western gateway that connected the AAG with the southern Indian Ocean. Our proposed site is located on seismic data that is tied to the 2007 dredge sites. The recovery of this section from a more restricted setting in an opening seaway will allow a direct comparison with equivalent shales recovered during Expedition 369 at the gateway to the AAG, 1500 km to the west.

The site will test the hypothesis that the GAB black shales record the extension of global anoxia during OAE2 into the opening AAG, and thus increase our knowledge of its extent in high southern latitudes, whilst complementing the objectives of Expedition 369. It is planned to core 90 m of Cenozoic deepwater carbonates, and 480 m of Coniacian-Cenomanian, restricted marine, mud-rich siliciclastics, in a water depth of 3035 m.

Scientific Objectives

- 1) To obtain a continuous record across the Cenomanian-Turonian boundary to test the hypothesis that GAB black shales record the extension of OAE2 into an opening seaway at high southern latitudes.
- 2) To compare this record with equivalent section recovered during Expedition 369, and OAE2 records from high and low latitudes, thereby enhancing our understanding of Cretaceous ocean temperatures and circulation.
- 3) To drill a 570 m deep well through 90 m of Cenozoic fine-grained carbonates and 480 m of Cenomanian-Turonian mud-rich siliciclastics, with the target shales (OAE2) 60 m from the base of the hole. The shallower section may also contain a record of OAE3.
- 4) To constrain the age and sedimentology of the Cenomanian-Turonian section to test the hypothesis that the characteristics of the GAB black shales may differ from other OAE2 black shales due to their deposition at the margin of a major delta.
- 5) To collect biotic records that provide insights into the responses of ecosystems and biodiversity to rapid and profound carbon cycle perturbations at high southern latitudes.
- 6) To reconstruct oceanographic conditions during shale deposition through a suite of inorganic and organic geochemical proxies such as light stable-isotopes (^{13}C , ^{18}O , ^{15}N) of carbonate and organic matter, redox sensitive metals and their isotopes (e.g. Mo), radiogenic isotopes (e.g. Os, Sr, Nd), and stable C and H isotopes of archaeal and bacterial lipids (GDGTs for TEX86 and MBT/CBT), and biomarkers such as isorenieratane, which is indicative of anaerobic photosynthetic sulfur bacteria associated with OAEs.

Non-standard measurements technology needed to achieve the proposed scientific objectives

None

Proposed Sites (Total proposed sites: 1; pri: 1; alt: 0; N/S: 0)

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
WCED-4A (Primary)	-34.027345 127.962673	3035	570	0	570	To obtain continuous core through organic-rich marine shales of Cenomanian-Turonian and younger age in the mid to distal portion of the Late Cretaceous depositional system of the Bight Basin. This site lies immediately to the east of a canyon incised into the northwestern margin of the Ceduna Sub-basin; dredge sampling of this canyon in 2007 recovered organic-rich shales of Cenomanian-Turonian age that had geochemical affinities to Oceanic Anoxic Event (OAE) 2 shales. As this site is located adjacent to the dredge site, intersection of the Cenomanian-Turonian section is considered to be likely.