IODP Proposal Cover Sheet

SW Australia Margin Cretaceous Climate

760 - Full 2

Title	Tectonic, paleoclimatic and paleoceanographic history of the Mentelle Basin and Naturaliste Plateau at southern high latitudes during the Cretaceous
Proponents	R. Hobbs, B. Huber, I. Borissova, K. MacLeod, D. Grocke, D. Watkins, N. Exon, M. Coffin, R. Brown, S. Robinson, C. Poulsen, H. Jenkyns, B. Cramer, N. Direen,
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Contact Information

Contact Person:	Richard Hobbs		
Department:	Department of Earth Sciences		
Organization:	Durham University		
Address:	South Road	Durham	DH1 3LE
Tel.:		Fax:	
E-mail:	r.w.hobbs@durham.ac.uk		

Abstract

The unique tectonic and paleoceanographic setting of the Naturaliste Plateau (NP) and Mentelle Basin (MB) offers an outstanding opportunity to investigate a range of scientific issues of global importance with particular relevance to climate change. Drilling of volcanic rocks in different parts of NP will provide detailed information on the timing of different stages of the Gondwana breakup and the nature of the various phases of volcanism, which will lead to an improved understanding of the evolution of the NP and MB. Previous spot-core drilling at DSDP Site 258A on western MB demonstrated the presence of an expanded upper Albian~~-~~lower Campanian chalk, marl and claystone sequence that is nearly stratigraphically complete and yields calcareous microfossils that are mostly well preserved. This sediment package and the underlying Albian volcanic claystone unit extend across most of the MB and are targeted at three proposed drill sites, located between 1200~~3~~900 m water depth. The proposed sites are well positioned to monitor the mid-Eoceneearly Oligocene opening of the Tasman gateway and the Miocene~~P~~liocene restriction of the Indonesian gateway; both passages have important effects on global oceanography and climate. Drilling the Cretaceous MB sequence at different paleodepth settings will allow recovery of samples suitable for generating paleotemperature and biotic records that span the rise and collapse of the Cretaceous Hothouse (including Oceanic Anoxic Events 1d and 2), providing insight to deep and surface water circulation that can be used to test predictions from earth system models. The high paleolatitude (60-62°S) location of the sites is especially important because of the enhanced sensitivity to changes in vertical and latitudinal temperature gradients. The new paleotemperature proxy and other data will reveal whether there were any Cretaceous cold snaps that reached surface water temperature thresholds where continental ice sheet growth is predicted by earth system model experiments. The data will also indicate the timing, magnitude and duration of peak Supergreenhouse temperatures, which are poorly constrained because of the dearth of sections that can be used for paleotemperature studies, because of insufficient preservation and incomplete stratigraphy. The likely recovery of stratigraphically complete marine sediment records spanning OAE1d and OAE2 will allow characterization of the relative roles of productivity and ocean circulation during these major carbon cycle perturbations, thus revealing differences between biological and geochemical responses at southern high latitudes compared to more tropical and temperate regions of the Cretaceous world.

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Scientific Objectives

1) Rise and collapse of the Cretaceous Hothouse: what was the timing for onset of warming into the Cretaceous Hothouse, when were peak Hothouse temperatures reached, when did Hothouse cooling begin, what were the causes for these climatic transitions and how did the climate-ocean system and biota respond?
2) Oceanic Anoxic Events: what were the relative roles of productivity and ocean circulation during these major carbon cycle perturbations?
3) Cretaceous deep and intermediate water circulation: where were the main source regions for regional watermasses in the southeast Indian Ocean and how did these change during Gondwana breakup?
4) Cenozoic paleoceanography: how did oceanographic conditions at the Naturaliste Plateau change during opening of the Tasman passages and restriction of the Indonesian gateway?
5) NP basement composition and depositional history: how many volcanic phases occurred on the Naturaliste Plateau, what is the nature of basement terrain beneath the volcanic rocks and how did the environment change after volcanism?
6) Gondwana breakup: what was the position of the Naturaliste Plateau against the Antarctic terrains, when did NP fully separate from India, when did the separation with Antarctica begin and how was the Diamantina Zone formed?

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

None

Proposed Sites

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
MBAS-3C	-33.91324, 113.21206	3120	1420	80	1500	Close to depocentre of the western Mentelle Basin, to sample the Valanginian breakup unconformity and the post-breakup succession including the Aptian-Albian black-shales/claystones
MBAS-9A	-33.26981, 114.32278	850	1200	0	1200	MBAS-9A is a stratigraphic calibration well on the continental slope (eastern Mentelle Bain) with the principal goal to define the sediment age beneath the Valanginian unconformity that records pre-breakup depositional history in the region prior to the final rifting of Greater India and Antarctica.
MBAS-4A	-33.79545, 112.47463	2790	880	0	880	Redrill of site DSDP-258. Strata intersected by DSDP-258 are a very condensed section of what we are trying to investigate in the Mentelle Basin (MBAS-3B), original core recovery from the original drill hole was insufficient to provide detailed

-	-	-	-	-	-	enough reference frame for the Cretaceous OAEs. Site will capture depositional history prior to and during OAE 1 and 2. The new well will continue down to the extrusive basalt layer at the Valanginian unconformity.
MBAS-5B	-34.39853, 112.81727	2700	468	282	750	Site targets the basement on the southern margin of the Naturaliste Plateau and to test a very condensed Albian to Cenozoic succession, which will allow to define the southward extent of sediments deposited during OAE-1 and 2 and any 18_O changes associated with this distal position.
MBAS-6A	-33.88254, 114.22490	1200	1200	0	1200	This is a stratigraphic calibration well on the continental slope (eastern Mentelle Bain) with the principal goal to define the sediment age and provenance beneath the Valanginian unconformity that records pre-breakup depositional history in the region prior to the final rifting of Greater India and Antarctica and the provenance of the sediments. It will also provide information for shallow paleoceanography studies.
MBAS-8A	-33.08220, 113.08074	3890	1055	5	1060	This site targets sediments deposited during the collapse of the Cretaceous warmhouse (including OAE-2) which is an under-sampled interval in the 18O record. The site also samples a series of erosional features which will provide insight into the Cretaceous and Cenozoic paleoceanography of the south-west corner of Australia