IODP Proposal Cover Sheet

Tasman Frontier Subduction

832 - Full 2

Title	Subduction Initiation and Paleogene Climate (SIPC) in the Tasman Frontier, Southwest Pacific
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Abstract

The most profound subduction initiation (SI) event and global plate-motion change since 80 Ma occurred in the Eocene, when Tonga-Kermadec (TK) and Izu-Bonin-Mariana (IBM) SI was synchronous with a change in direction of the Pacific plate (Emperor-Hawaii bend) at c. 50 Ma. The primary goal of our proposal is to precisely date and quantify deformation and uplift/subsidence associated with TK SI in order to test predictions of alternate geodynamic models. We will collect Paleogene sediment cores from strategic locations that constrain seismic-stratigraphic interpretations. We will use sediments, microfossils and geochemistry to reconstruct the paleogeography and climate history of the region for the Cenozoic, with implications for both tectonics and climate research. Tectonic change occurred at the same time in the early Paleogene as Earth reached a Cenozoic pinnacle in ‘greenhouse’ climate. Paleoclimate proxy data from this time period show that the greatest global discrepancy with climate model simulations occurs in the southwest Pacific. Hence, a secondary goal is to determine if paleogeographic changes caused by SI may have led to anomalous regional warmth by altering ocean circulation. Late Paleogene and Neogene sediment cores will complement earlier drilling to investigate tropical and polar climatic teleconnections within the mid-latitude transition zone.

Four prominent bathymetric features in the Tasman Frontier region, the Norfolk Ridge (NFR), New Caledonia Trough (NCT), Lord Howe Rise (LHR) and Tasman Basin (TAS), are known from seismic-reflection profiles to contain appropriate sediment archives. However, only three drill sites with limited core recovery have penetrated the middle Eocene and older sequence (DSDP sites 206, 207, 208). Information from these sites in conjunction with seismic-stratigraphic analysis of a large recently-compiled dataset reveals: (1) Cretaceous-Eocene strata are locally deformed, and (2) the LHR and NFR were uplifted, possibly to sea level, during the Eocene and/or Oligocene. We hypothesise that folding of Lower Eocene and older strata in the southwest Pacific, and subsequent uplift of the LHR, were broad-scale consequences of TK SI. We will precisely date deformation, vertical motions, and volcanism, and confirm the magnitude of uplift-subsidence. This will allow us to test geodynamic model predictions, and establish the order and hence causality in relation to regional and global tectonic events.

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Scientific Objectives

The Tasman Frontier has untapped potential to address major geoscience problems, because of its strategic location and limited available knowledge.

(1) How and why does subduction initiation (SI) occur?
(1a) Did plate convergence precede and induce SI, or did SI happen spontaneously? Observations regarding timing, distribution, and style of deformation will be acquired to test alternative SI model predictions.
(1b) What vertical stresses occurred during SI? The magnitude and timing of uplift and subsidence across a broad region will be determined through drilling targets that will enable evaluation and refinement of geodynamic models. Predictions from seismic stratigraphy of large-magnitude far-field uplift and subsidence challenge existing geodynamic theories, and will be tested.

(2) Did SI influence regional or global climate?
(2a) Why was the Eocene southwest Pacific anomalously warm? New paleogeographic reconstructions and proxy data will be used to refine ocean circulation models in this climate-sensitive region.
(2b) Did SI coincide with Early Eocene warmth? Can SI be linked to global changes in carbon cycling and hence the long-term cooling trend that begins at ~50 Ma.

(3) When did the modern ocean circulation system develop and what role has it played in pole-equator teleconnections through the late Cenozoic. New drilling and paleomagnetic technology will facilitate improved recovery of well-calibrated late Paleogene and Neogene sediment records.

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

Standard measurements will be used.

Proposed Sites

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
REIS-1A	-34.452809, 171.337499	1644	894	0	894	Determine timing of proximal deformation at southern end of subduction. Date onset of subsidence from wave-base. Confirm reworked shallow-marine fossils and hence magnitude of subsidence.
LHRS-1A	-36.346694, 164.577294	1171	650	0	650	Determine age of distal deformation at southern end of subduction system. Test hypothesis of uplift to shelf depths. Date uplift and subsidence.
LHRS-2A	-36.339602, 164.604271	1129	629	0	629	Determine age of distal deformation at southern end of subduction system. Test hypothesis of uplift to shelf depths. Date uplift and subsidence.
LHRS-3A	-36.328973, 164.558677	1239	517	0	517	Determine age of distal deformation at southern end of subduction system. Test hypothesis of uplift to shelf depths. Date uplift and subsidence.
LHRS-4A	-36.303779, 164.532445	1258	404	0	404	Determine age of distal deformation at southern end of subduction system.

-	-	-	-	-	-	Test hypothesis of uplift to shelf depths. Date uplift and subsidence.
TASS-1A	-37.647519, 160.199977	4781	760	10	770	Determine time of deformation of Tasman Sea oceanic crust, to constrain the time of maximum horizontal force through the plate (far-field). Constrain early Paleogene depth of the CCD.
TASS-5A	-37.442183, 160.540186	4952	569	0	569	Determine time of deformation of Tasman Sea oceanic crust, to constrain the time of maximum horizontal force through the plate (far-field). Constrain early Paleogene depth of the CCD.
TASS-4A	-37.579637, 160.331624	4877	500	0	500	Determine time of deformation of Tasman Sea oceanic crust, to constrain the time of maximum horizontal force through the plate (far-field). Constrain early Paleogene depth of the CCD.
TASS-3A	-37.652851, 160.191671	4840	446	0	446	Determine time of deformation of Tasman Sea oceanic crust, to constrain the time of maximum horizontal force through the plate (far-field). Constrain early Paleogene depth of the CCD.
TASS-2A	-37.561097, 160.31561	4847	554	0	554	Determine time of deformation of Tasman Sea oceanic crust, to constrain the time of maximum horizontal force through the plate (far-field). Constrain early Paleogene depth of the CCD.
LHRN-2A	-28.652426, 161.737884	1495	780	0	780	Determine time of distal uplift and then subsidence of northern Lord Howe Rise (central subduction system). Test hypothesis of Eocene uplift to sea-level, and existence of coral reef.
LHRN-4A	-28.653513, 161.73899	1508	684	0	684	Determine time of distal uplift and then subsidence of northern Lord Howe Rise (central subduction system). Test hypothesis of Eocene uplift to sea-level, and existence of coral reef.
NCTN-2A	-26.379908, 166.52621	3576	760	0	760	Determine time of proximal deformation and uplift then subsidence of Norfolk Ridge and central New Caledonia Trough (central part of subduction system).
NCTN-3A	-26.378185, 166.540634	3596	858	0	858	Determine time of proximal deformation and uplift then subsidence of Norfolk Ridge and central New Caledonia Trough (central part of subduction system).
NCTN-4A	-26.29634, 166.521552	3593	875	0	875	Determine time of proximal deformation and uplift then subsidence of Norfolk Ridge and central New Caledonia Trough (central part of subduction system).
NCTN-5A	-26.490999, 166.506409	3580	888	0	888	Determine time of proximal deformation and uplift then subsidence of Norfolk Ridge and central New Caledonia Trough (central part of subduction system).

LHRN-1A	-28.659091, 161.739264	1486	500	0	500	Determine time of distal uplift and then subsidence of northern Lord Howe Rise (central subduction system).Test hypothesis of Eocene coral reef, and hence confirm uplift to sea-level and magnitude of total subsidence. Determine initial subsidence rate through rate of reef growth.
LHRN-3A	-28.661971, 161.740721	1494	599	0	599	Determine time of distal uplift and then subsidence of northern Lord Howe Rise (central subduction system).Test hypothesis of Eocene coral reef, and hence confirm uplift to sea-level and magnitude of total subsidence. Determine initial subsidence rate through rate of reef growth.
NCTS-1A	-34.70807, 165.877782	2920	500	0	500	Determine timing of convergent deformation and subsidence of southern New Caledonia Trough (southern end of subduction system).
NCTS-3A	-34.711508, 165.872625	2737	601	0	601	Determine timing of convergent deformation and subsidence of southern New Caledonia Trough (southern end of subduction system).
NCTS-2A	-34.652186, 165.827652	2913	805	0	805	Determine timing of convergent deformation and subsidence of southern New Caledonia Trough (southern end of subduction system).
NCTN-1A	-26.366498, 166.645592	3401	880	0	880	Determine age of deformation in the central New Caledonia Trough and Norfolk Ridge (central subduction system). Determine time of initial uplift of Norfolk Ridge, and then subsidence below wave-base.