IODP Proposal Cover Sheet

730 - Full 2

Sabine Bank Sea Level

Title	Drilling the late Quaternary coral record of climate and sea level on subsiding reefs at Sabine Bank and Bougainville Guyot, Vanuatu
Proponents	F. Taylor, B. Pelletier, M. Hornbach, L. Wallace, G. Cabioch, E. Garaebiti Bule, M. Harrison, C. Shen, L. Lavier, J. Partin, T. Quinn, W. Kim,
Keywords	Coral reefs, paleoclimate, sea-level, tectonics
Area	Central Vanuatu

Contact Information

Contact Person:	Frederick Taylor		
Department:	Institute for Geophysics		
Organization:	Jackson School of Geosciences, The University of Texas at Austin		
Address:	Bldg. 196, Pickle Research Ca	Austin	78758-4445
Tel.:	5124710453	Fax:	5124718844
E-mail:	fwileytaylor56@gmail.com		

Abstract

Western Pacific Warm Pool (WPWP) coral records of Quaternary climate and sea level continue underachieving their potential due to scarcity of samples. Pre-LGM corals are even rarer than post-LGM with virtually no records prior to ~15 ka (e.g., Tudhope et al. 2001; Cohen and Hart, 2004; Delong et al., 2010; Felis et al., 2012); only MIS 3 sea level peaks are dated by corals, while low stands remain poorly defined. Some issues that fossil corals from Vanuatu would illuminate include pre-Holocene WPWP climate variability, including the El Niño-Southern Oscillation (ENSO) and decadal-scale variability, annual cycle sensitivity to insolation, and the response of the South Pacific Convergence Zone (SPCZ) to changes in background conditions and concrete paleosea level evidence. Dated corals from SB and BG would provide unprecedented constraints on the trajectory and rates of convergence and subsidence of a tectonic plate back into the mantle. Because of their geochemical character, corals are perhaps the most precisely datable natural material that records interannual, decadal, and century-scale SST and SSS variability via 18O, Sr/Ca, and, possibly, other proxies at sub-annual resolution. Drilling rapidly subsiding reefs at Sabine Bank and Bougainville Guyot is a new strategy offering many advantages. Both reefs have ridden eastward over the New Hebrides trench outer rise (NHTOR) at mean rates of ~85 mm/yr and are descending into the trench. Bougainville Guyot was drilled at 1066 m depth at ODP Site 831 with extremely poor core recovery. However, an incredibly well preserved ~350 ka Porites sp. coral from ~ 240 mbsf produced one of the only credible pre-MIS 5e coral records (Kilbourne et al., 2004b). This example illustrates how rapid subsidence can facilitate coral preservation. Sabine Banks surface lies at 5 - 35 m depths and MCS profiles indicate up to 500 m of carbonate subdivided into four major units overlying a faulted basement. SB drilling would produce at least a post LGM record, and possibly much more. The western ends of SB and BG are ~100 ka younger in their stratigraphic evolution than the western ends. This enables a strategy of drilling younger strata at the western edges of SB and BG and progressively older strata toward the trench to compensate for the limitations of the Marum Mebo 200 Drill which presently has a 70 mbsf capacity, but is being improved to drill to 200 mbsf.

generated: Tue Sep 15 20:46:34 2015
by if340_pdf
(user 1.1346)

730	-	Full	2

Scientific Objectives

If the overall objective to recover many fossil corals of many ages is achieved then the resulting coral ages and geochemical records would address the following specific objectives.

1. Monitor the response of ENSO to changes in global climate boundary conditions, abrupt climate changes and radiative forcing. For example, both MIS 5e and 11 may be examples of a warmer Earth that could give clues to our future.
2. Determine the relationship between sea surface salinity, sea surface temperature and ENSO in Vanuatu (e.g., Kilbourne et al., 2004a; 2004b; Gorman et al., 2012) under different boundary conditions and changes in radiative forcing.
3. Investigate whether the SPCZ has been the dominant control on seasonal rainfall in this region under previous climate regimes.
4. Determine if MIS 11 sea level was in fact 20-40 m higher than present and how long it persisted (e.g., Olson and Hearty, 2009). This type of information is potentially achievable if subaerial exposures were defined and dated.
5. Determine the paleo-vertical and -horizontal motions SB and BG and thereby their flexural trajectory over the New Hebrides trench outer rise. This would provide the rheology of this lithosphere to compare with that of oceanic lithosphere and enable better understanding of its tectonic influence on the unusual emergent New Hebrides forearc. No one has ever characterized the detailed behavior of a subducting plate before because nearly all are deep beneath the sea surface.

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	
BG-5A	-15.99494, 166.70881	1400	150	0	150	Maximum recovery of coral reef sediments to depth of coring.
BG-4B	-16.038149, 166.631337	750	150	0	150	Maximum recovery of coral reef sediment.
BG-3B	-16.03545, 166.65048	875	150	0	150	Maximum recovery of coral reef sediments
BG-2B	-16.02635, 166.66424	950	150	0	150	Maximum recovery of coral reef sediments to 150 m
BG-1B	-16.01715, 166.67747	1050	150	0	150	Maximum recovery of corals
SAB-6A	-15.946667, 166.147500	110	150	0	150	Maximum recovery of corals and reef sediment.
SAB-5A	-15.945833, 166.145833	95	150	0	150	Maximum recovery of coral reef rock and sediments.
SAB-4B	-15.945375, 166.144583	70	150	0	150	Maximum recovery of corals and reef sediments
SAB-3B	-15.946453, 166.143010	26	150	0	150	Drill for maximum recovery of coral reef to ~150 m depending on condition of material recovered.

SAB-2B	-15.939104, 166.090537	14	150	0	150	Maximum recovery of coral reef rock and corals.
SAB-1B	-15.936196, 166.093543	46	150	0	150	Drill early postglacial transgression before 46 m surface drowned. Recover maximum coral reef material. Total depth needed probably less than 100 m, but reserve option for deeper coring and or for additional nearby holes to increase recovery of shallow portion.