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IODP Proposal Cover Sheet

716-Full2

☐ **New** ☑ **Revised** ☐ **Addendum**

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Title:	Drowned corals reefs around Hawaii: a unique archive of sea-level, climate change and reef response over the last 500 kyr
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Area:	Central Pacific Ocean; Hawaii

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Permission to post abstract on IODP Web site: ■ Yes ☐ No

Abstract: (*400 words or less)*

Our understanding of the links and mechanisms that control eustatic sea-level and global climate changes has been significantly hampered by a lack of appropriate fossil coral records over the last 500 kyr - particularly into and out of the glacial periods. We propose to address this problem directly by drilling a unique succession of drowned coral reefs around Hawaii now at -134 to -1155 m. Abundant observational and numerical modeling data indicate that the internal stratigraphy and tops of these reefs are highly sensitive to sea-level and climate changes, thereby providing a firm template with which to conduct these operations. As a direct result of Hawaii's rapid (2.5-2.6/kyr) but nearly constant subsidence, a thick (100-200 m) expanded sequence of shallow coral reef dominated facies is preserved within the reefs. These reefs span important periods in Earth climate history, either not available or highly condensed on stable (Great Barrier Reef, Tahiti) and uplifted margins (Papua New Guinea, Barbados) due to a lack of accommodation space and/or unfavorable shelf morphology. Specifically, these data show that the reefs grew (for ~90-100 kyrs, albeit episodically) into, during and out of the majority of the last five to six glacial cycles. Therefore, scientific drilling through these reefs will generate a new record of sea-level and associated climate variability during several controversial and poorly understood periods over the last 500 kyr. The project has four major objectives. First, to constrain the timing, rate, and amplitude of sea-level variability over the last 500 kyr allowing a definitive test of Milankovitch climate theory and an assessment of controversial abrupt sea level events (meltwater pulses) that occur on suborbital frequencies associated with events occurring in the extra-tropics (i.e. Dansgaard/Oeschger ice core temperature Events, and related Heinrich ice rafted debris Events in N. Atlantic sediment cores). Second, to investigate processes that determine changes in mean climate and high-frequency (seasonal-interannual) climate variability using high-resolution coral proxy data from times with different climate forcing boundary conditions (e.g. ice sheet size, pCO_2, solar forcing) over the last 500 kyr. Third, to determine the response of coral reef systems to abrupt sea-level and climate changes, test sedimentary models of reef evolution as well as ecologic theories of coral reef resilience and to establish the role of microbial communities in reef building. And fourth, to refine the variation through space and time of the subsidence of Hawaii and contribute to understanding the volcanic evolution of the island.

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Scientific Objectives: (*250 words or less*)

1. To define the nature of sea level-change in the central Pacific over the last 500 kyr, we will construct a new, more complete sea level curve from the drowned Hawaiian reefs that will allow: a) more detailed testing of Milankovitch climate theory predictions and; b) improved constraints on millennial-scale sea-level changes over the last 500 kyr.

2. To identify critical processes that determine paleoclimate variability of the central Pacific over the last 500 kyr, we will: (a) reconstruct the mean and seasonal/interannual climate variability from massive coral samples; and (b) use these records to investigate how high latitude climate (e.g., ice sheet volume), pCO_2, and seasonal solar radiation impact subtropical Pacific climate. This approach can be used to test theoretical predictions of climate response and sensitivity to changes in boundary conditions and climate forcing.

3. To establish the geologic and biologic response of coral reef systems to abrupt sea-level and climate changes, we will: (a) establish the detailed stratigraphic and geomorphic evolution of the reefs in response to these changes; (b) test ecologic theories about coral reef resilience and vulnerability to extreme, repeated environmental stress over interglacial/glacial to millennial time scales; and (c) establish the nature of living and ancient microbial communities in the reefs and their role in reef building.

4. To elucidate the subsidence and volcanic history of Hawaii, we will: (a) refine the variation through space and time of the subsidence of Hawaii, and; (b) improve the understanding of the volcanic evolution of the island.

Please describe below any non-standard measurements technology needed to achieve the proposed scientific objectives.

NA

Proposed Sites:

Site Name	Position	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
Primary						
KON-01A	19.600341N, -156.010975W	-145	140	10	150	H1d reef that spans MIS 1-5 (leeward, dry)
KAW-03A	20.018587N, -155.866458W	-154	140	10	150	H1d reef that spans MIS 1-5 (leeward, dry)
KAW-04A	19.995815N, -156.032933W	-419	140	10	150	H2d reef that spans MIS 6-7 (leeward, dry)
KAW-06A	20.036417N, -156.065696W	-737	140	10	150	H4 reef that spans MIS 8-9 (leeward, dry)
KAW-07A	20.137266N, -156.079341W	-988	140	10	150	H6 reef that spans MIS 10-11 (leeward, dry)
MAH-01A	20.055411N, -156.189697W	-1102	140	10	150	H8a reef that spans MIS 12-13 (leeward, dry)
MAH-02A	20.050262N, -156.192035W	-1154	140	10	150	H8b reef that spans MIS 12-13 (leeward, dry))
KOH-01A	20.290268N, -155.651218W	-410	140	10	150	H2d reef that spans MIS 6-7 (windward, wet)
KOH-02A	20.273958N, -155.490294W	-930	140	10	150	H7 reef that spans MIS 10-11 (windward, wet)
HIL-01A	19.758805N, -154.985708W	-134	140	10	150	H1d reef that spans MIS 1-5 (windward, wet)
HIL-05A	19.876999N,-154.939618W	-402	140	110	150	H2d reef that spans MIS 6-7 (windward, wet)
Alternate						
KAW-01A	20.011332N, -155.848480W	-109	140	10	150	H1b reef that spans MIS 1-5 (leeward, dry)
KAW-02A	20.017325N, -155.857206W	-131	140	10	150	H1c reef that spans MIS 1-5 (leeward, dry)
KAW-05A	19.978715N, -156.029159W	-466	140	10	150	H2d reef that spans MIS 6-7 (leeward, dry)
HIL-02A	19.883005N, -155.029932W	-271	140	10	150	H2a reef that spans MIS 4?-7 (windward, wet)
HIL-03A	19.867141N, -154.973387W	-338	140	10	150	H2b reef that spans MIS 5a?-7 (windward, wet)
HIL-04A	19.869407N, -154.954576W	-354	140	10	150	H2c reef that spans MIS 5a?-7 (windward, wet)
MAH-03A	20.140405N, -156.238194W	-1213	140	10	150	H9 reef that spans MIS 14-15? (leeward, dry)
MAH-04A	20.065165N, -156.266945W	-1234	140	10	150	H10 reef that spans MIS 14-15? (leeward, dry)
MAH-05A	19.994893N, -156.229296W	-1289	140	10	150	H11 reef that spans MIS 14-15? (leeward, dry)