IODP Proposal Cover Sheet

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Nadir K-Pg Impact Crater

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Title	Into the Nadir: a new Cretaceous-Paleogene impact structure?
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Keywords	impact crater, K-Pg boundary
Area	Guinea Plateau

Proponent Information

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Abstract

The hypervelocity impact of large asteroids and comets represent an important geological hazard and can cause major perturbations of Earth's climate and biological systems. Seismic sections across the 8.5-km wide Nadir structure offshore Guinea, West Africa, show numerous characteristics consistent with a complex impact crater. The feature is relatively shallow, at only ~300-400 m below the seafloor, and uniquely accessible by riserless drilling. Leveraging planned IODP Expeditions in the Central Atlantic, we request up to 9 days JOIDES Resolution ship time to test the hypothesis that this structure was caused by a hypervelocity impact of Late Cretaceous to Early Paleogene age. Drilling will allow us to test conceptual and numerical models of crater formation based on seismic data, by drilling different components of the crater (crater floor, central uplift, damage zone, external ejecta blanket). We also seek to determine the age of the impact lithologies and therefore determine the age of the crater, testing the hypothesis that this impact was coeval with the Chicxulub impact event in Mexico (i.e. Nadir could potentially be a secondary impact site). If the crater pre-dates or corresponds with the K-Pg boundary then the selected sites will provide a high-resolution archive including K-Pg impact ejecta and the Paleogene recovery of life following the K-Pg mass extinction. It will also provide an important low-latitude record of early Cenozoic oceanographic and climatic conditions, likely including the Paleocene-Eocene Thermal Maximum (PETM) and Eocene hyperthermal events. This proposal addresses the IODP Science Plan themes on climate and ocean change, as well as discrete elements of the new 2050 Science Framework (Natural Hazards Affecting Society and Terrestrial to Extraterrestrial Enabling Element) and has strong synergies with recently drilled and planned IODP expeditions.

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Scientific Objectives

The overarching aim of the proposal is to test the hypothesis that the Nadir structure was caused by a Late Cretaceous / early Paleocene meteorite impact, particularly from the presence of diagnostic shocked mineral phases. The submarine location of this crater also preserves key structural features that are rapidly eroded on land, and that can be sampled with the proposed drilling. Secondary objectives are:

A. Recovery of samples from the central peak and crater rim to test models of crater formation, including central peak exhumation, shock melting and initial crater fill.
B. Recovery of samples from below the crater floor and rim to test the extent of shock metamorphism, thermal alteration and greenhouse gas (GHG) emissions.
C. Recovery of samples from near the potential crater rim to test for the presence and composition of an ejecta blanket and to obtain unshocked samples of the target stratigraphy.
D. To determine the precise age of this impact event and establish if this crater is synchronous, and hence potentially co-generic, with the K-Pg boundary Chicxulub impact structure.
E. Recover a high-resolution post-impact sequence to document ecological recovery locally for comparison with other submarine impact craters
F. Recover a full stratigraphic Paleogene sequence producing a rare equatorial record of later environmental perturbations (PETM, Eocene hyperthermals)
G. Constrain the age of Cretaceous and Cenozoic seismic stratigraphic surfaces overlying the crater to constrain the stratigraphic evolution of the wider plateau, and support a potential full IODP Expedition

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

Have you contacted the appropriate IODP Science Operator about this proposal to discuss drilling platform capabilities, the feasibility of your proposed drilling plan and strategies, and the required overall timetable for transiting, drilling, coring, logging, and other downhole measurements?

yes

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Proposed Sites (Total proposed sites: 4; pri: 2; alt: 2; N/S: 0)

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
GC-01A (Primary)	9.393794 -17.08129	903	640	0	640	Primary site (GC-1A) is located near the centre of the crater, to allow maximum recovery of crater fill sediments and calibration of seismic facies (objective A), to obtain material suitable for dating (objective C) and to penetrate the central peak below the crater floor to a depth of 640 m below seabed (~200 m below the crater floor; objective B). The site will also recover core from the Paleogene sequence documenting recovery of life (E) and paleoclimate/ocean archives (F).
GC-02A (Alternate)	9.389207 -17.06619	903	600	0	600	Alternate site GC-2A is located at a crossing line location within the crater, to allow recovery of some crater fill sediments and calibration of seismic facies (objective A), to obtain material suitable for dating (objective C) and to penetrate the deformed sediment below the crater floor (objective B). The site will also recover core from the Paleogene sequence documenting recovery of life (E) and paleoclimate/ocean archives (F).
GC-03A (Alternate)	9.406276 -17.12273	907	600	0	600	Alternate site GC-03a is intended to penetrate the crater rim (including proposed ejecta blanket deposits; objective D) and to penetrate the subsurface, to document the extent of shock metamorphism and deformation on the margins of the crater (objective B) and to recover core across the main seismic reflections in the Upper Cretaceous (Objective G) that represent the target rock. The site will also recover core from the Paleogene sequence documenting recovery of life (E) and paleoclimate/ocean archives (F).
GC-04A (Primary)	9.378413 -17.02969	904	600	0	600	Primary site GC-04a is intended to penetrate the crater rim (including proposed ejecta blanket deposits; objective D) and to penetrate the subsurface, to document the extent of shock metamorphism and deformation on the margins of the crater (objective B) and to recover core across the main seismic reflections in the Upper Cretaceous (Objective G) that represent the target rock. The site will also recover core from the Paleogene sequence documenting recovery of life (E) and paleoclimate/ocean archives (F).