IODP Proposal Cover Sheet

001 - Pre-LEAP

Ontong Java Plateau Collision

Received for: 2023-11-01

Title	Can soft collision lead to plate tectonic reorganisation? Revisiting the Ontong Java Plateau collision paradox
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Keywords	subduction initiation, soft docking, collision
Area	Ontong Java Plateau and Solomon Islands Arc

Proponent Information

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Abstract

Arc polarity reversal constitutes one of two subclasses of induced subduction initiation. The prototypical example of this process is the collision of the Ontong Java Plateau (OJP) with the Solomon Islands Arc. A widely accepted model holds that collision occurred in the Early Miocene, emplacing the Malaita Terrane by obduction, halting arc volcanism, and terminating Pacific Plate subduction, with complete reversal of subduction polarity delayed until the Late Miocene. The absence of a significant geological response to the collision – ascribed to "soft docking" – appears to be at odds with the substantial far-field consequences that have been ascribed to it, including a reduction in the rate of Australian plate motion. Constraints on the timing of the collision are inferential, and an Early Miocene age appears to be inconsistent with a sequence of volcaniclastic-bearing sediments on the Malaita Terrane, which extend from the Late Eocene to the Late Miocene, and with palaeomagnetic evidence. Post-reversal subduction has consumed the record of back-arc spreading behind the Solomon Islands Arc, and so reconstructions of the relative positions of the arc and plateau in the Oligocene and Miocene are arbitrary.

DSDP and ODP drill holes on OJP recovered a series of volcanic ashes which peaked in the Late Oligocene and Early Miocene, before decreasing sharply. Despite the inference that these ashes were the product of Melanesian Arc volcanism, no results of any petrological, geochemical or isotopic study have been reported from any of the ashes recovered on the plateau.

Our proposal is to conduct geochemical and isotopic analyses on these ashes, to determine whether they represent an arc source, or hot-spot volcanism. We will include detailed sedimentological description to assess the likely distance from the source. In parallel, we will sample the on-land record from the Malaita Terrane, conducting isotopic analyses on magmatic zircons for comparison with the plateau ash record. Microfossil biostratigraphy on these Malaita Terrane samples will provide depositional ages, and comparison with zircon magmatic ages will allow a test of whether arc volcanism may have persisted through the Miocene.

Combining the results from the legacy core study with those from the on-land study, and taking atmospheric circulation models into account when reconstructing the position of the likely source of the plateau ashes, will allow us to test competing hypotheses for the relative positions of the arc and the plateau in the Miocene, and reconstruct the paleogeography of the OJP – Solomon Islands collision.

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Scientific Objectives

Our overall objective is to discriminate between two competing hypotheses:
1. OJP – Solomon Islands Arc collision was a single event at about 25 Ma, immediately halting or reducing Pacific Plate subduction but with a delay before arc reversal; or
2. At least two collisions with fragments of Ontong Java Nui occurred from the Late Eocene to Late Miocene, with obduction in the Late Eocene phase being followed by continued subduction of the Pacific Plate.

To achieve this, we will aim to answer the following:

Were the OJP ashes sourced from the arc or from local hot-spot volcanoes?
- We will determine the age and geochemical character of ashes from glasses and (if present) zircons. Arc-derived ashes will be compared with existing data for Oligocene to Early Miocene magmatic rocks from the Solomon Islands and any contemporary volcaniclastics that may be present in the Malaita Terrane rocks.

How far were the ashes transported?
- Assessed from measurements of grain-size and ash-layer effective thickness

Are the volcaniclastics exclusively derived from pre-Miocene sources or is there evidence for continued arc volcanism?
- We will compare zircon isotope geochronology of the bands of volcaniclastics with biostratigraphic ages of the carbonates that include them

What was the pre-collision paleogeography?
- Palaeogeographic models will be tested against the source and transport distance of the ashes. Models will incorporate atmospheric circulation models for ash dispersal from the competing sources. We will also attempt to reconcile the proximal nature of the Malaita Terrane volcaniclastics, and paleomagnetic evidence.

Have you contacted appropriate IODP Curator(s) to discuss sampling needs and core facility access

yes