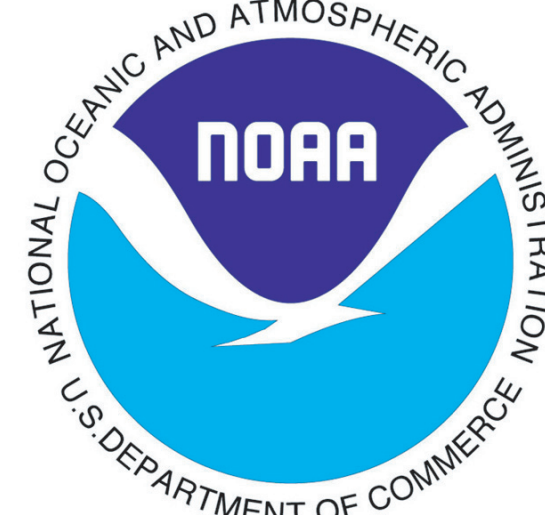


Shallow Seafloor Mapping in the Mariana Archipelago for Coral Reef Ecosystem Research

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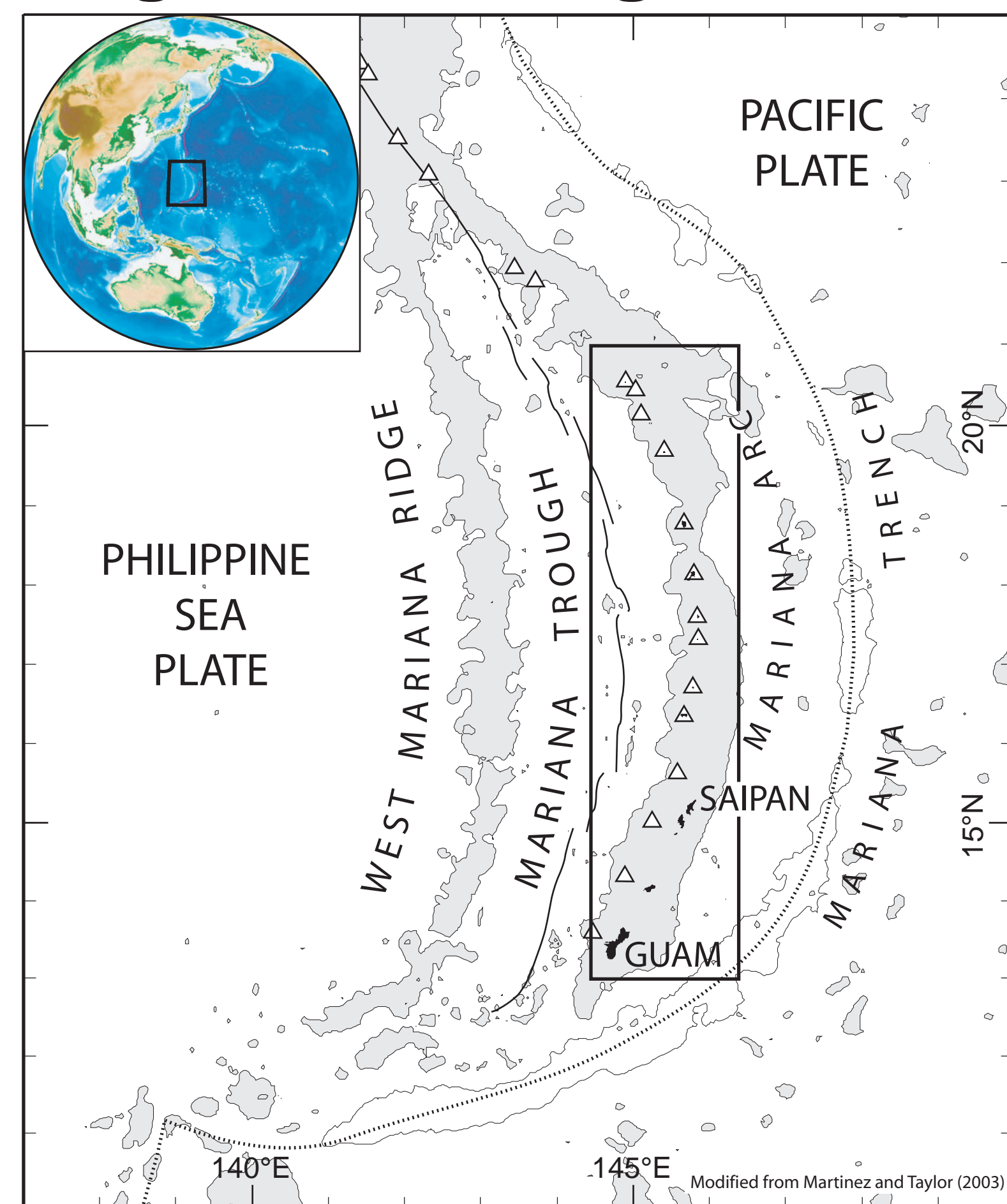
NOAA Pacific Islands Fisheries Science Center, Coral Reef Ecosystem Division & SOEST Pacific Islands Benthic Habitat Mapping Center www.soest.hawaii.edu/pibhmc



1 Introduction

In May and June of 2007 researchers from the NOAA Coral Reef Ecosystem Division (CRED) conducted field operations in the Territory of Guam and Commonwealth of the Northern Mariana Islands (CNMI) for the Mariana Reef Assessment and Monitoring Program (MARAMP). This was the third in an on-going biennial series of cruises in the Mariana Archipelago that are funded by NOAA's Coral Reef Conservation Program. The mission of CRED's Reef Assessment and Monitoring Program is to map and monitor coral reef ecosystems in all of the U.S.-related Pacific islands. In addition to MARAMP's primary focus on coral, fish, algae, and invertebrate studies, multibeam data were collected in water depths ranging from <10-3000 meters using the 224' NOAA Ship Hi'ialakai's Simrad EM300 (30 kHz) and EM3002D (300 kHz) sonars and a Reson 8101 (240 kHz) on the 25' survey launch R/V AHI. The photos above show the Hi'ialakai (left) seen through a sea-level notch on the east side of Saipan and the R/V AHI (right) mapping at Uracas Volcano.

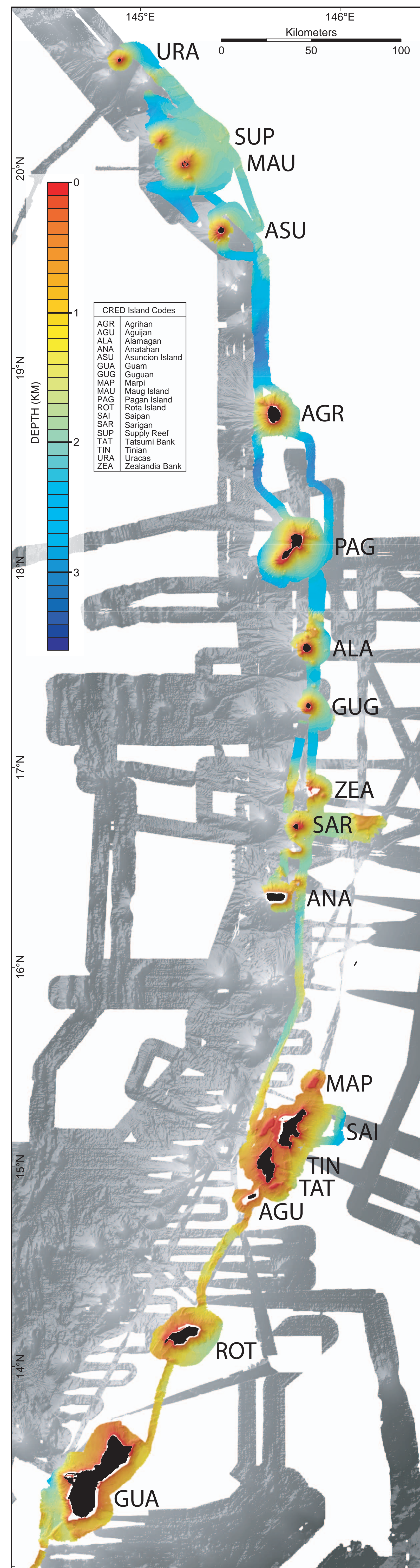
2 Regional Setting



The figure above shows the general tectonic setting of the Mariana Archipelago, located above where the Pacific Plate subducts beneath the Mariana arc at the Mariana Trench (dotted line). The 6000 m-contour, roughly defining the trench, is shown in black and depths above 3000 m are shaded gray. Multiple episodes of volcanism and rifting have formed the Mariana arc, composed of remnant, frontal, and active volcanic arcs. The frontal arc includes Guam, Saipan, and Tinian and is composed of Eocene to Miocene volcanic rocks with uplifted carbonate caps and well developed reefs. The active arc, shown as triangles, located west of the frontal arc, consists of active and/or dormant subaerial and submarine volcanoes with steep slopes and generally sparse, low diversity coral reef communities. MARAMP surveys portions of both the remnant and active arcs and the bathymetry can be used to better understand the structure and evolution of the arc in addition to providing base layers for ecological assessment.

3 Seafloor Bathymetry

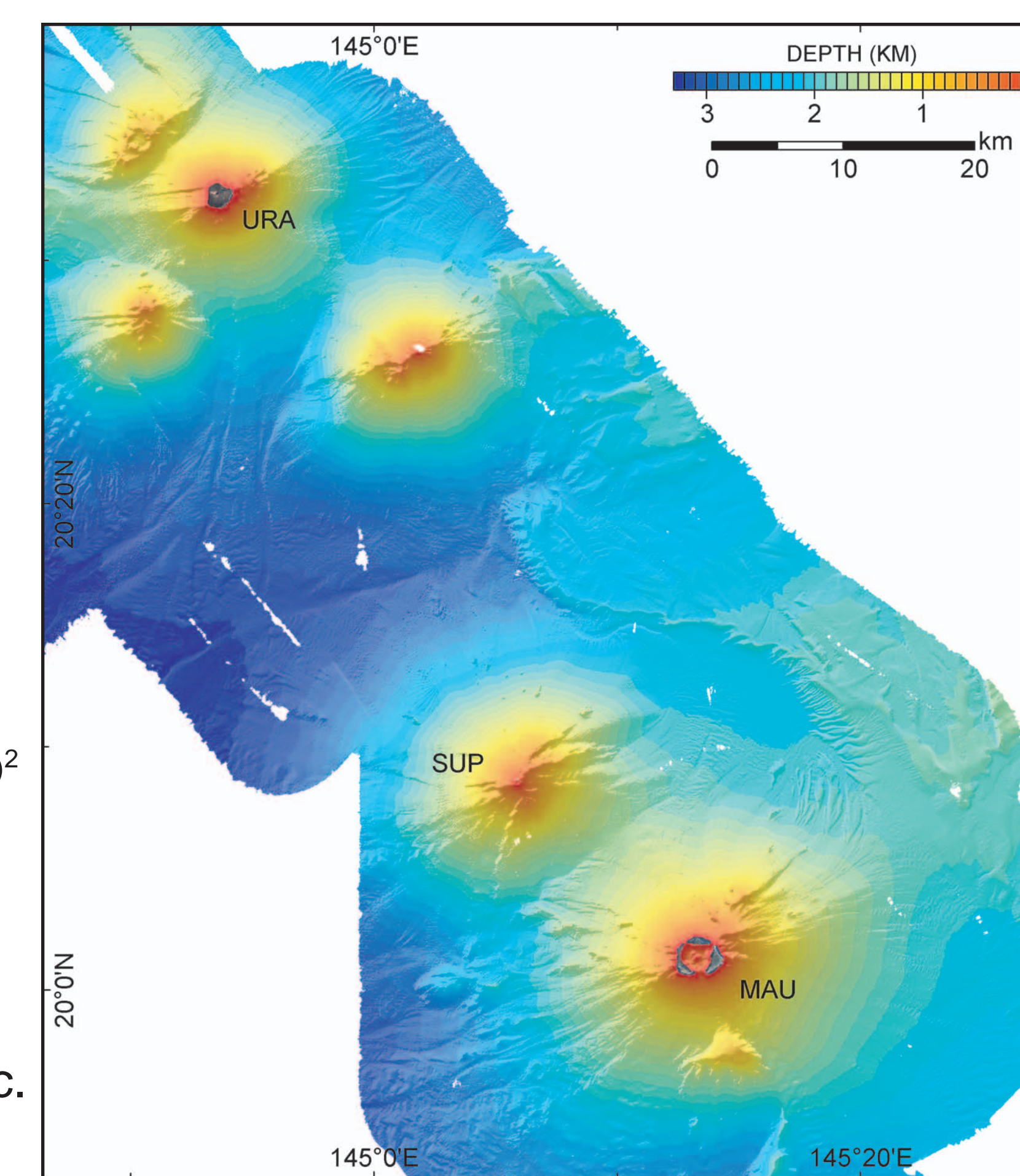
The map below shows color-coded bathymetry data collected during MARAMP cruises as of June 2007 and other data from the following sources:



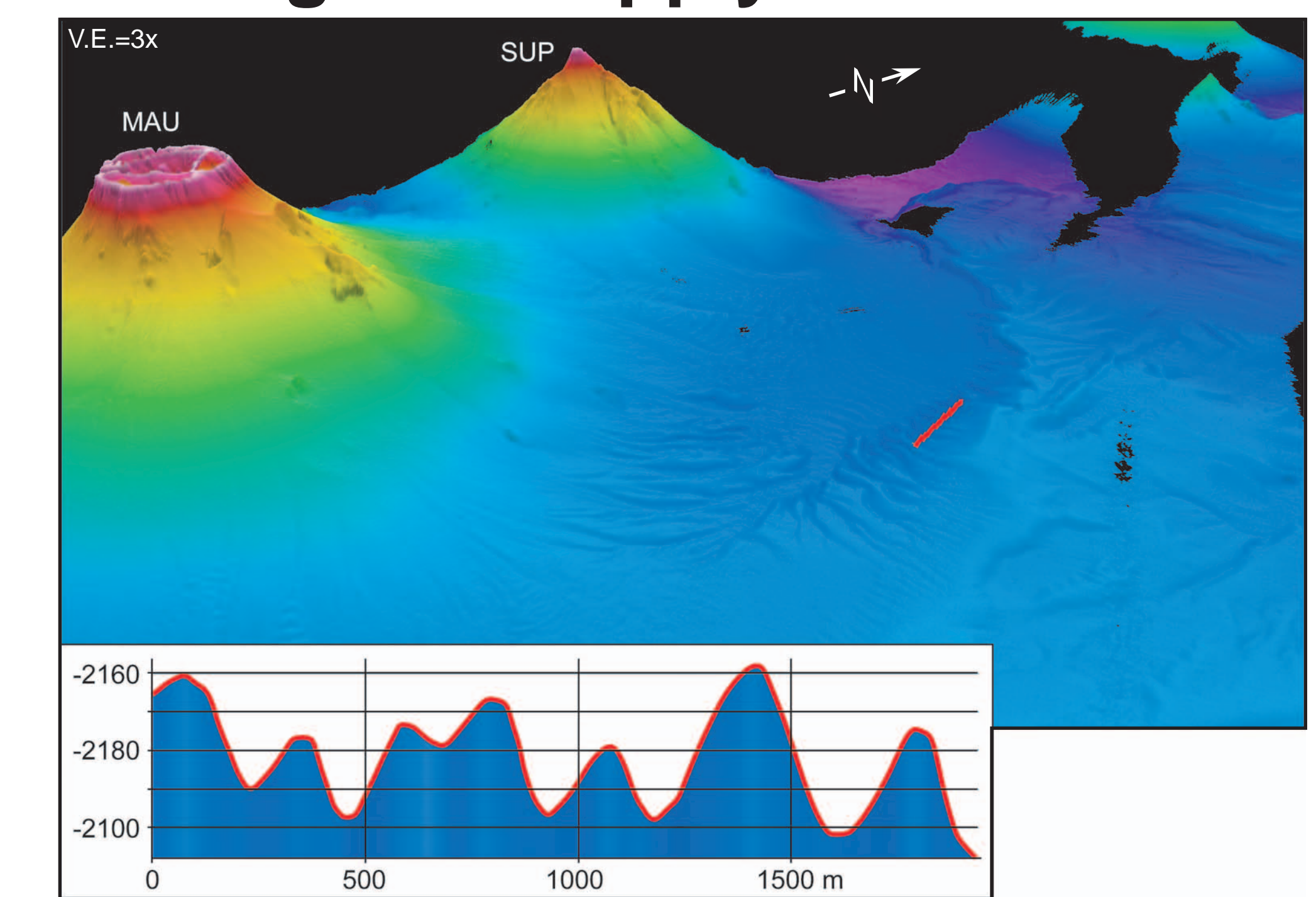
- Hawaii-MR1 phase bathymetry (COOK06/07MV)¹
- Hydrosweep DS2 multibeam bathymetry (EW0202/03)¹
- SEABEAM multibeam bathymetry (NOAA OE Ring of Fire)²
- EM300 multibeam bathymetry (NOAA OE Ring of Fire)²

1. MGDS www.marine-geo.org
2. NOAA Vents www.pmel.noaa.gov/vents and Ocean Exploration Programs www.oceanexplorer.noaa.gov

MARAMP data available for download in Dec. 2007 at: www.soest.hawaii.edu/pibhmc



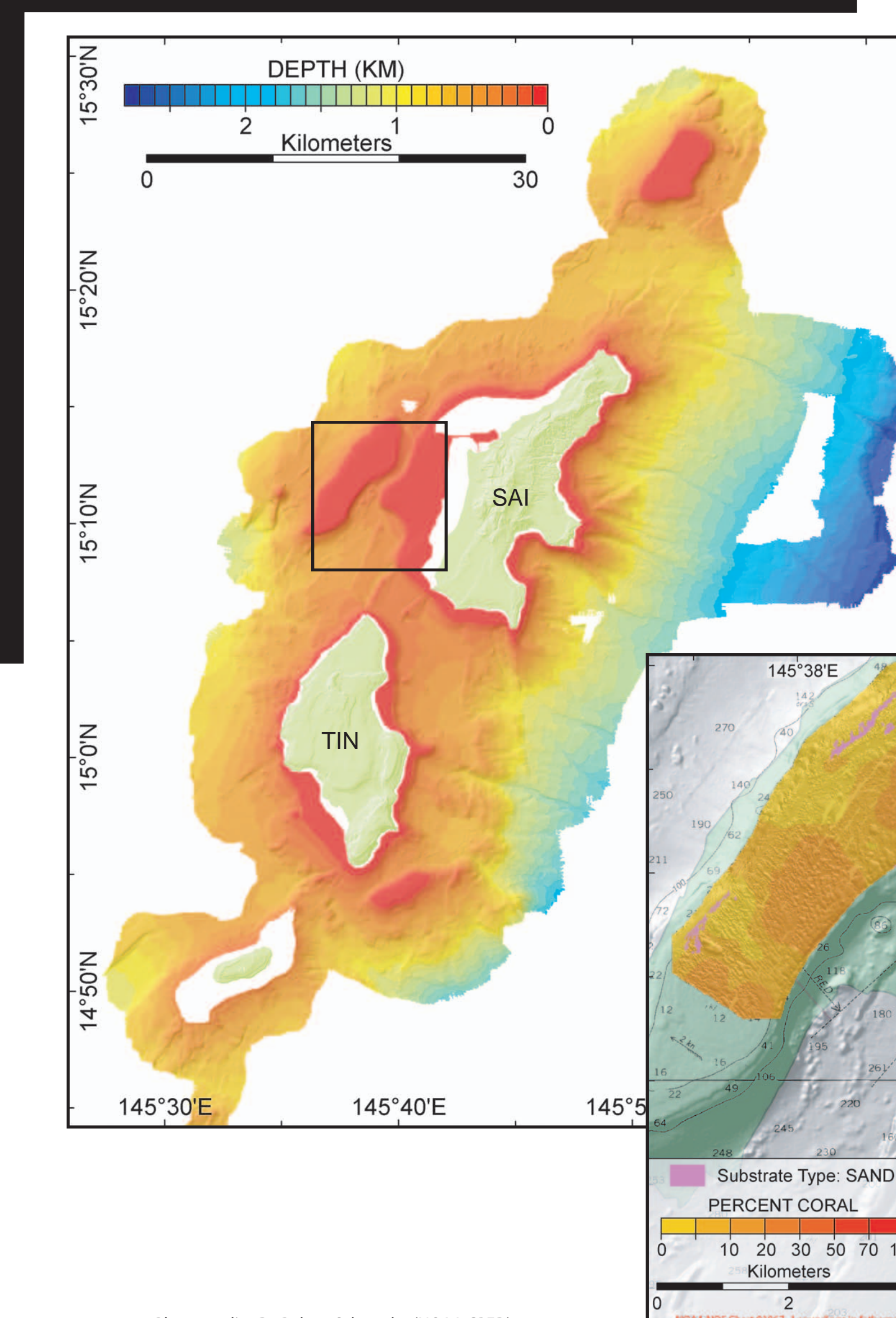
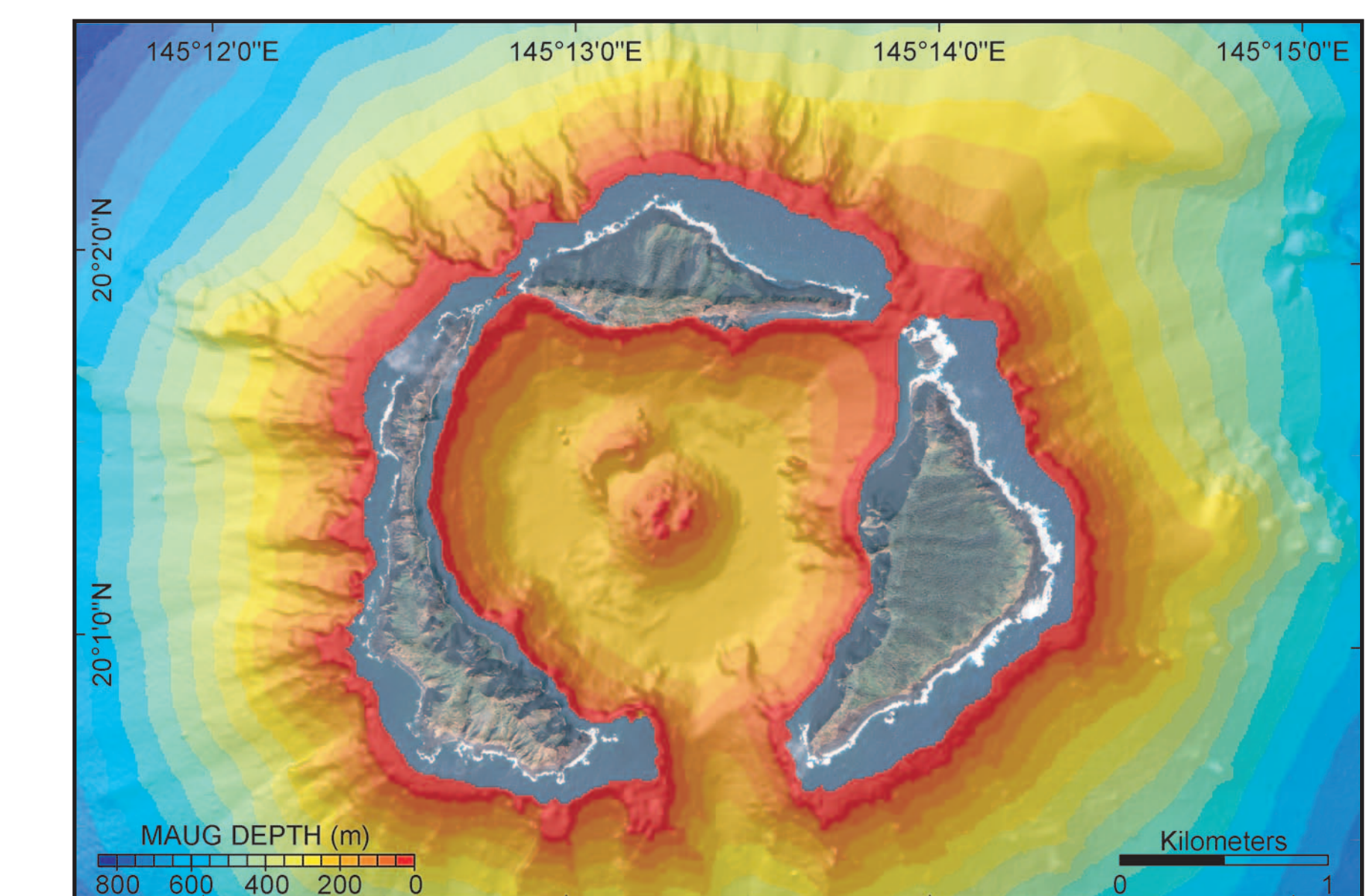
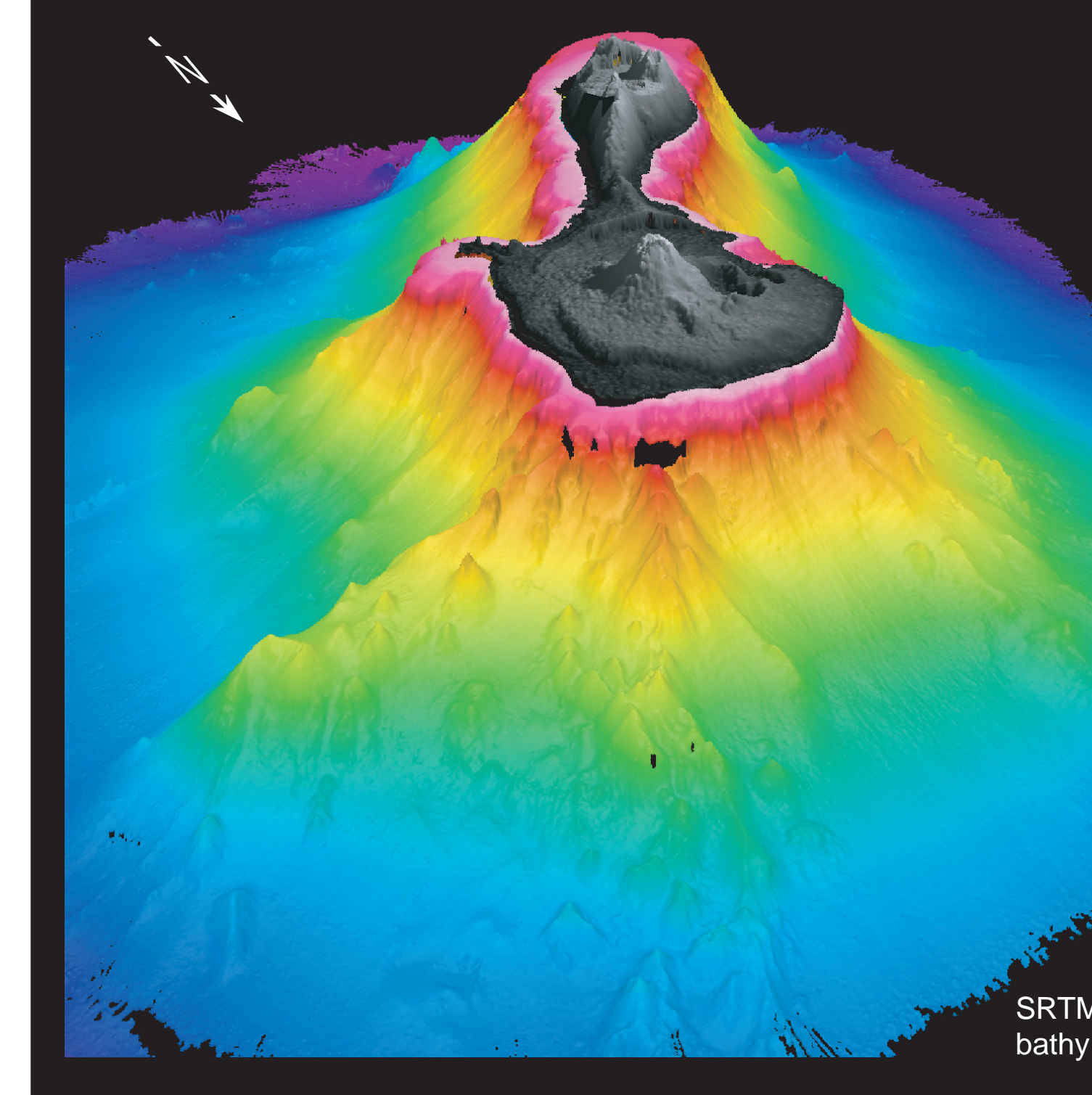
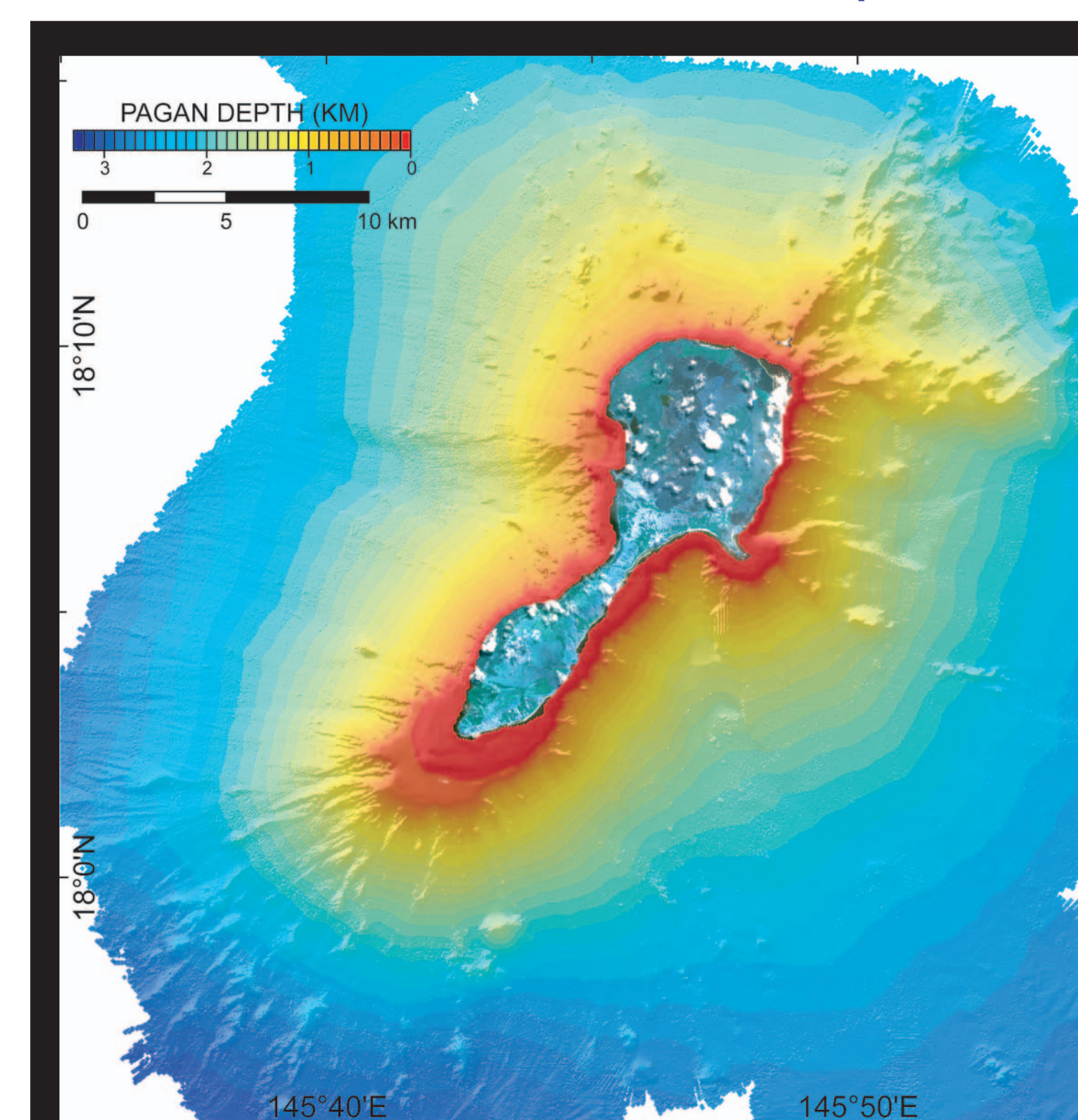
5 Maug and Supply Reef



The portion of the Mariana arc including Maug, Uracas, Supply Reef, additional submarine volcanoes and variably oriented channels, ridges, and scarps is shown in the two figures above. The perspective view highlights the region between and to the east of Maug and Supply Reef where channels on the volcanoes flanks terminate in a narrow basin. The eastern boundary of the basin is a sinuous ridge also incised by channels and canyons originating at the ridge crest. The SW-NE profile above gives a sense for the size of these features. The ridges and scarps east of the basin appear similar to fault-controlled structures mapped along the western boundary of the remnant arc further south and imaged in the MCS data from EW0202 & 03. A close-up view of the Maug caldera, post-collapse dome and shallow marine flanks is shown below.

4 Pagan

The two figures on the left show map and perspective views of bathymetry, IKONOS imagery (top), and the SRTM DEM (bottom) from Pagan. Pagan Island is composed of two strato-volcanoes joined by a narrow isthmus. Mount Pagan, the subaerial portion of the northern volcano, is 570 m high and last erupted in 2006. No eruptions have been documented from the southern volcano. Bathymetry collected during MARAMP 2007 reflect these differences. Submarine ridges radiate away from north Pagan and blocks of material litter the seafloor. Seafloor topography is far less irregular around south Pagan. A broad shelf with two prominent sea-level terraces at 40 and 115 m on the SW corner of Pagan is the largest shelf in the active volcanic arc.



6 Saipan

One quarter of the Mariana Archipelago's human population lives on Saipan and reefs there are subject to a range of anthropogenic affects. For instance, large vessels stocked with military supplies routinely anchor at the Garapan Anchorage outside of Saipan Harbor (see inset map below). CRED undertook a program of seafloor mapping and collected 123 km of seafloor videography in an attempt to identify areas where additional vessels could anchor without endangering coral communities. The inset map shows the percentage of seafloor covered by living coral on the Garapan Anchorage. Habitat maps such as these will guide local governments as they face resource management issues and proposals to expand infrastructure to the less populated islands.

7 Future Work

CRED will return to the Mariana Islands in early 2009 for the 4th MARAMP cruise. Much of the shallow mapping is completed and future work will focus on filling coverage gaps, exploring regions of interest, and collecting optical data. Backscatter from the 2007 work will be processed in early 2008, will aid in habitat mapping and geologic interpretations, and will be made available on the web. The four underwater photos shown here are examples of the splendid and varied shallow marine ecosystems that make the Mariana arc unique not only for its tectonic setting but for its coral reef ecosystems as well.

References
 Martinéz, F., and B. Taylor (2003). Controls on back-arc crustal accretion: insights from the Lau, Manus, and Mariana basins, in *Intra-oceanic subduction systems: tectonic and magmatic processes*, edited by R.D. Larter and P.T. Leat, pp. 19-54. Geological Society, London.

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