

1st Meeting of the Southern Indian Ocean Fisheries Agreement (SIOFA) Scientific Committee

21-14 March 2015, Esplanade Hotel, Fremantle

SC-01-INFO-17

Seabed Mapping in the SIOFA Area

Relates to agenda item: 7

Working paper info paper

Delegation of Cook Islands

Abstract

In 1996 the seafood company Sealord Group developed a proposal to investigate prospects for a new deep-water fishery in the Southern Indian Ocean. As part of the exploratory program, a full sidescan sonar survey was planned for Ninety-East and Broken Ridges, and the Southwest Indian Ridge and Walter's Shoal prior to the commencement of fishing operations, to map the habitat. The data from these surveys subsequently provided information for the development of Benthic Protected Areas in the Indian by the Southern Indian Ocean Deepsea Fisher's Association (SIODFA) Shotton 2006) to maintain and protect biodiversity. In total 11 areas were protected with a combined area of 309 150 km². The areas were jointly declared as protected areas with the International Union for the Conservation of Nature in 2006 (SIODFA & IUCN 2006a, 2006b).

The Cook Island government was the first flag state to incorporate these closed areas in vessel fishing regulations, and noted this requirement at the signing of the SIOFA agreement in July 2006.

This report presents details of habitat data in the SIOFA region.

Benthic Habitat Mapping of the SIOFA Area

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Introduction

In 1996 the seafood company Sealord Group developed a proposal to investigate prospects for a new deep-water fishery in the Southern Indian Ocean. As part of the exploratory program, a full sidescan sonar survey was planned for Ninety-East and Broken Ridges, and the Southwest Indian Ridge and Walter's Shoal prior to the commencement of fishing operations, to map the habitat. The data from these surveys subsequently provided information for the development of Benthic Protected Areas in the Indian by the Southern Indian Ocean Deepsea Fisher's Association (SIODFA) Shotton 2006) to maintain and protect biodiversity. In total 11 areas were protected with a combined area of 309 150 km². The areas were jointly declared as protected areas with the International Union for the Conservation of Nature in 2006 (SIODFA & IUCN 2006a, 2006b).

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This report presents details of habitat mapping data in the SIOFA region.

Methods

The first survey was undertaken on the Swire Pacific Offshore vessel *Wira Keris*, towing the University of Hawaii Mapping Research Group MR1 survey system. The survey was undertaken by Seabed Mapping Technologies Limited in November 1997.

MR1 (Figure 1) is a portable side-scanning seafloor imaging system that simultaneously acquires digital bathymetry (swath width ~ 3.4 times water depth) and sidescan sonar imagery (swath width ~ 7.5 times water depth). The system's sonar transducers are housed in a 4.5-m-long vehicle that is towed beneath the surface mixed layer (60 to 100 m) at ship speeds of 8 to 10 knots. A 1600 kg depressor weight is towed about 50 m in front of the towfish, thus mostly decoupling it from ship motion. The MR1 towfish is extremely stable due to its multi-body towing configuration and its large righting moment. As a result, MR1 has successfully operated in rough sea conditions (up to sea state 6) that typically cause performance degradation in hull-mounted systems due to bubble masking and violent ship motion.

During a 25 day cruise into the region, 2,891 miles were covered, mapping both Ninety East Ridge and Broken Ridge. However, vessel safety issues and a tropical cyclone in the region prevented the survey continuing to the Southwest Indian Ridge. In January 2000 the Sealord fishing vessel *Cheung Shing (Will Watch)* undertook a full habitat mapping survey of both Walter's Shoal and the Southwest Indian Rige using MR1 again, to complete the regional survey.

All sidescan and bathymetry data were processed by the University of Hawaii Mapping Research Group, and provided to Sealord Group in digital format at 16 metre resolution. Vessel trackline bathymetric data were also gathered from fishing vessels operating in the area. The 2000 survey focused on habitat areas outside those for which reasonable bathymetric data had already been gathered.

Habitat mapping data were also collected from 2008-2015 using underwater camera systems attached to trawl nets. Both the SeaCorder net camera from Tritech (Figure 2), and the Sealord Acoustical Optical System (S-AOS), (Figure 3) developed by CSIRO Australia have provided substantial video footage of any net habitat impact on trawl paths (Figure 4) and cross validation with sidescan imagery.

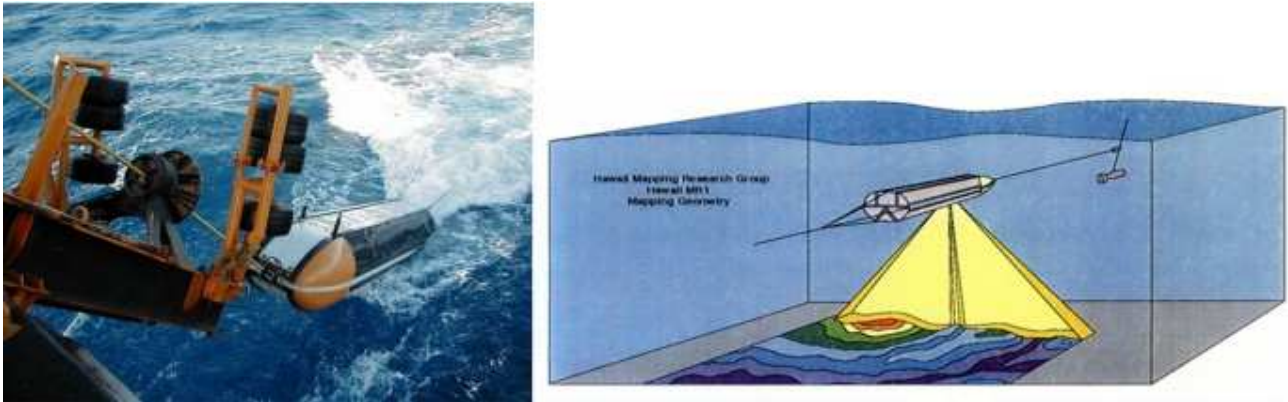


Figure 1 Hawaii Mapping Research Group MR1



Figure 2 SeaCorder Net Camera

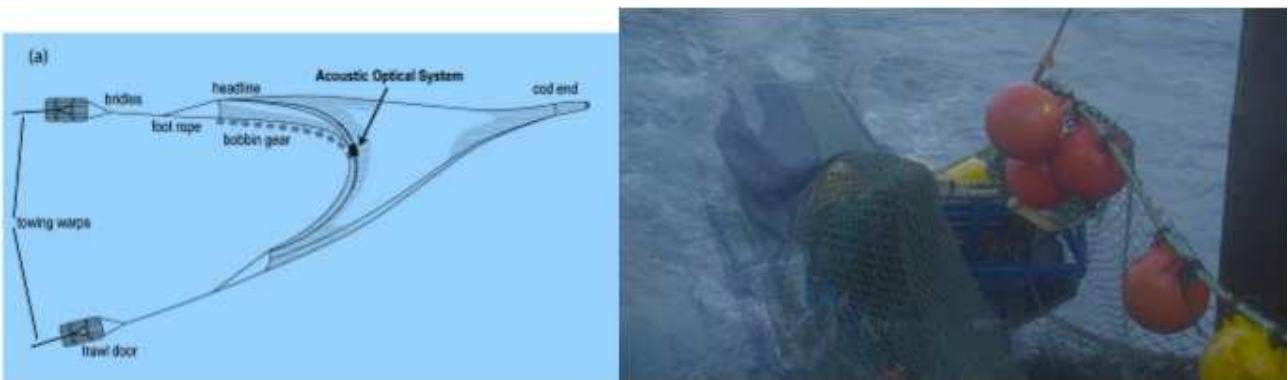


Figure 3 S-AOS (CSIRO MkIV AOS)



Figure 4 S-AOS Bottom Habitat on trawl path

RESULTS

Bathymetric data and sidescan imagery were compiled into 91 charts of the region. The grayscale sidescan images show hard (dark), and soft (light) bottom habitat. In addition, vessel acoustic data in some areas identified coral habitat, which enabled cross calibration of sidescan imagery (Figure 5).

In total over 160,000 km² of habitat were mapped during the surveys, and it was noted that in many areas the predicted bathymetry model from satellite data was very inaccurate. In addition, the use of 3D mapping software (Piscatus™, and Seaplot Pro™), enabled combination of swath mapping and vessel data to produce detailed 3D profiles (Figure 6) of all habitat from 20 metres to over 4000 metres in areas covered by SIOFA. These detailed data sets were installed on all Sealord controlled vessels operating in the Indian Ocean. In total by 2015 the compiled bathymetric database held 135 million depth points. The deepest depth recorded on the Southwest Indian Ridge was 6288 metres.

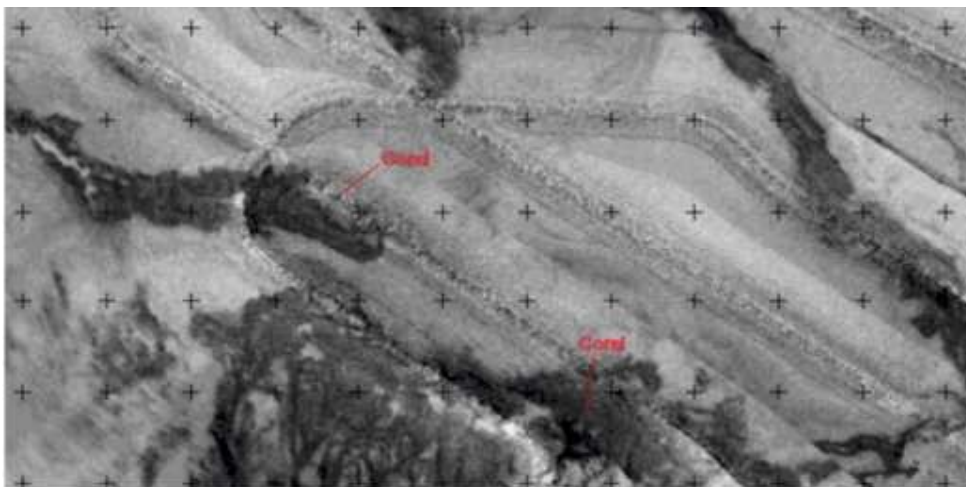


Figure 5 Sidescan Imagery of Fool's Flat

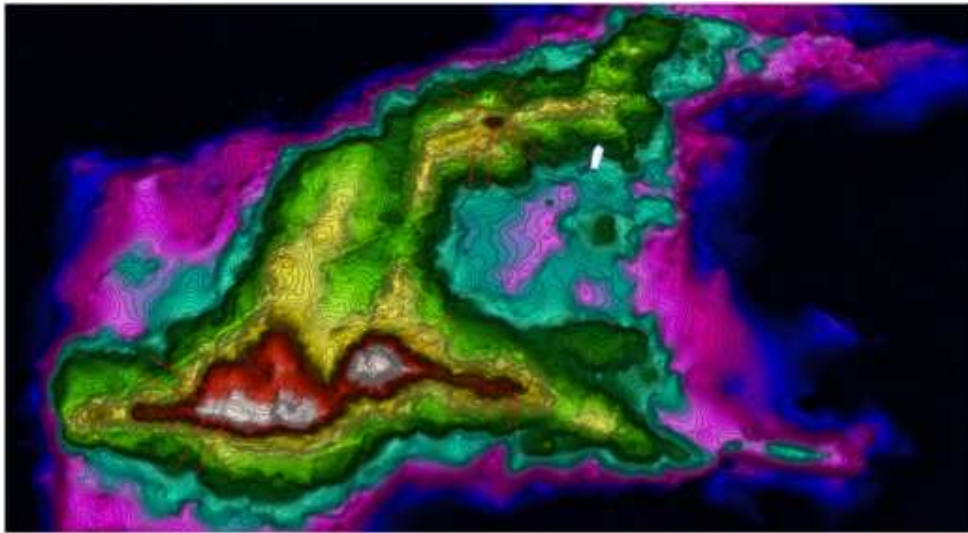
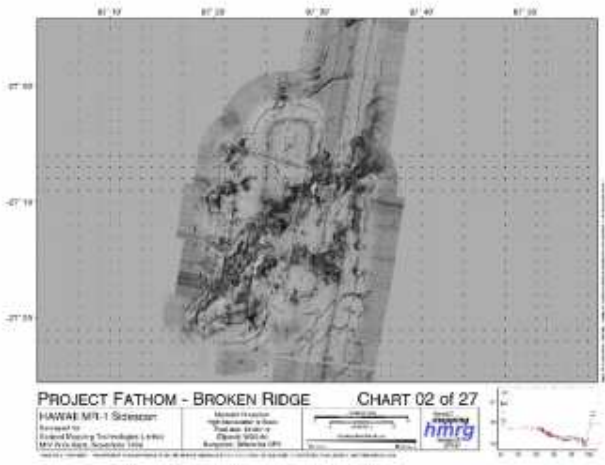
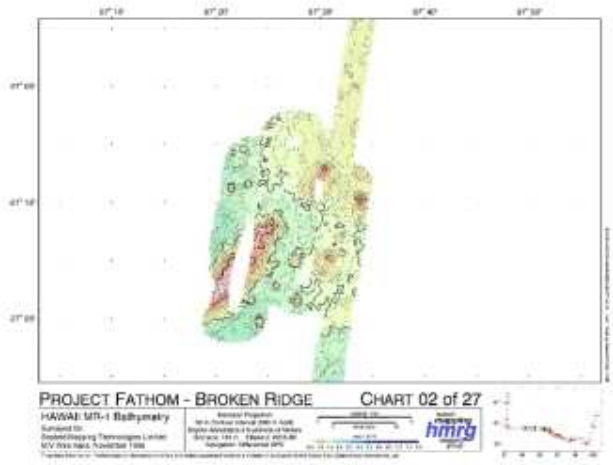
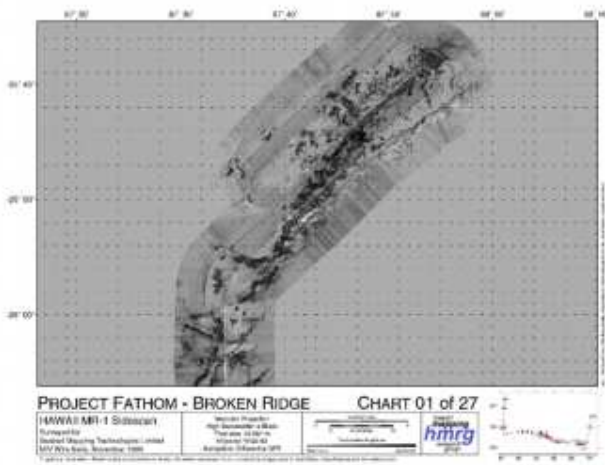
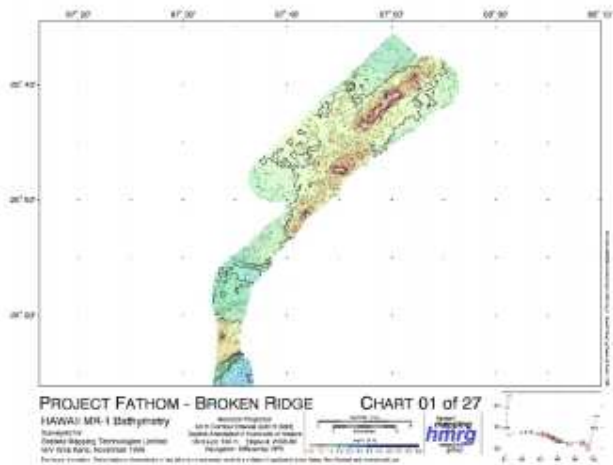
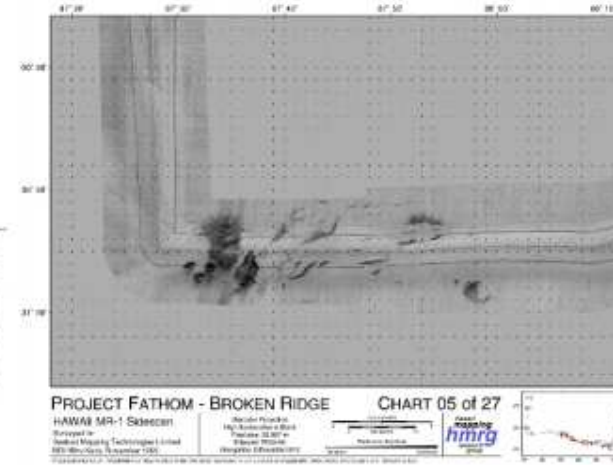
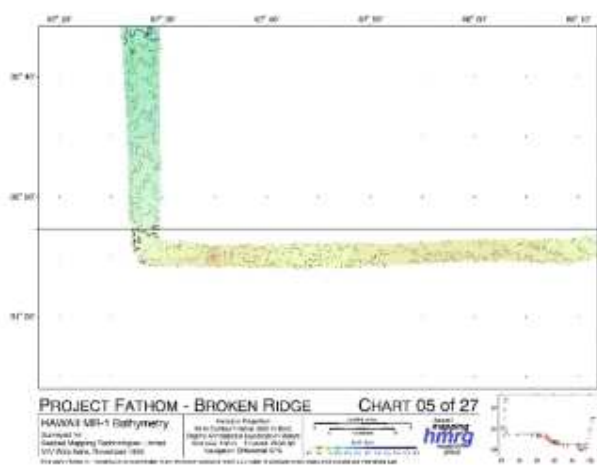
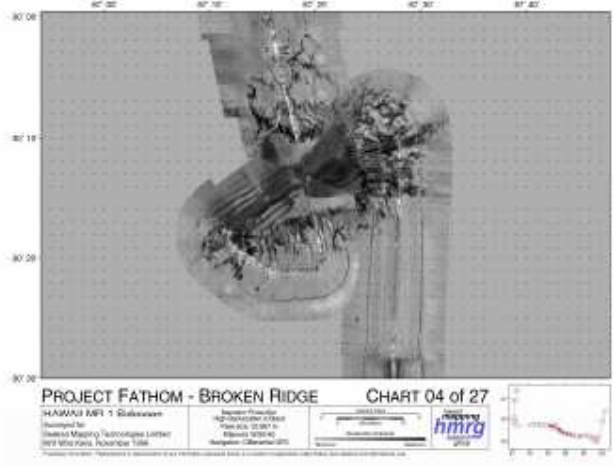
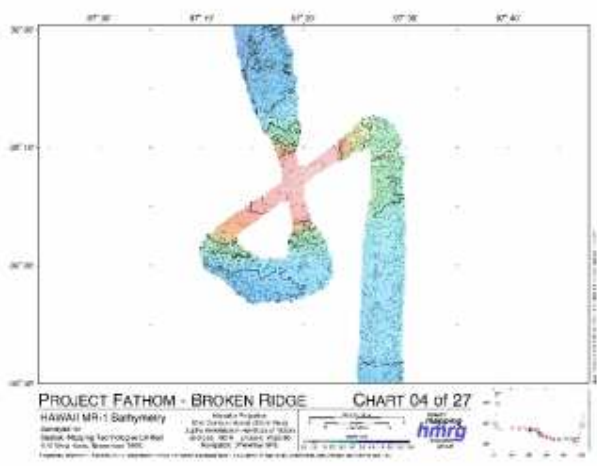
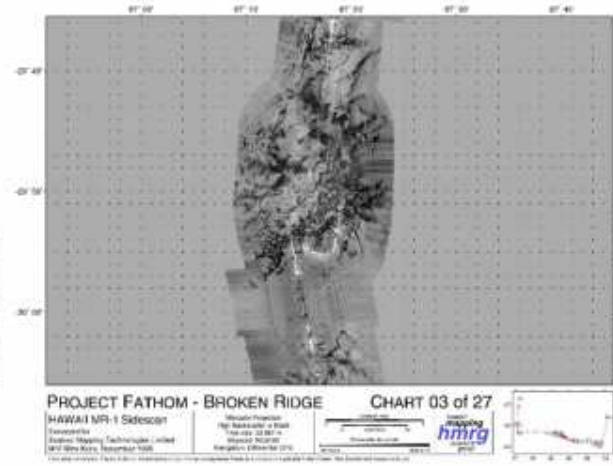
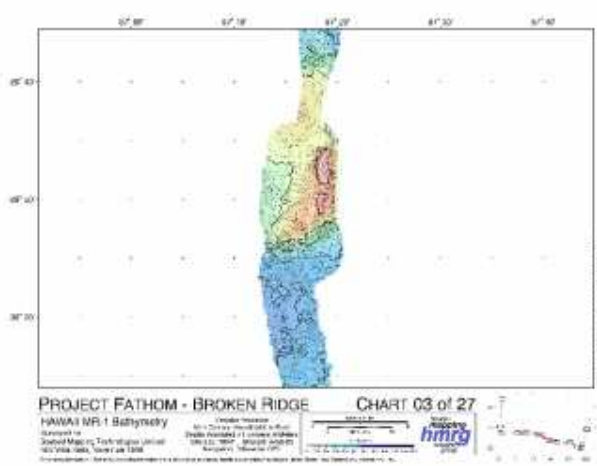
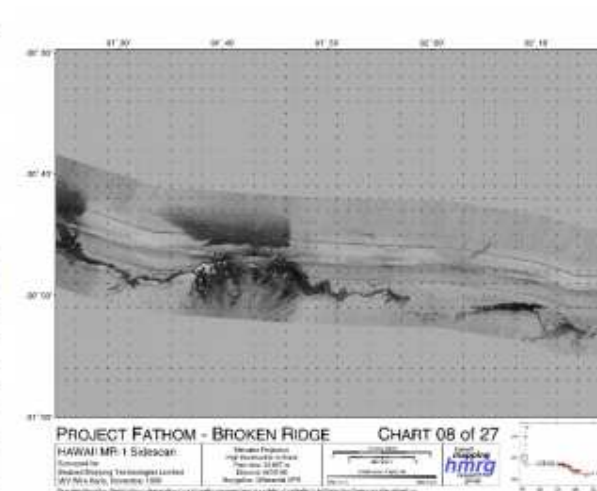
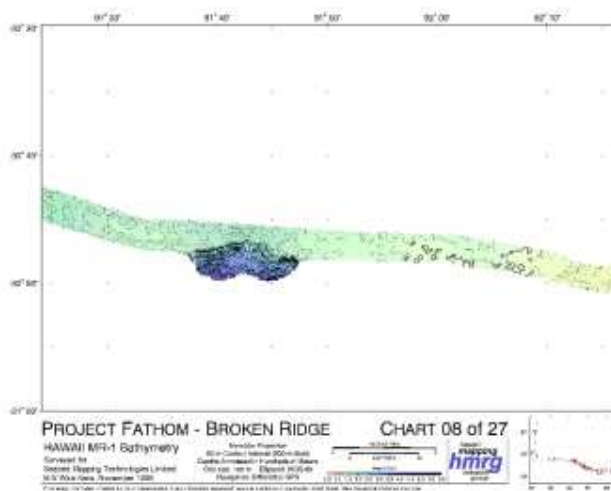
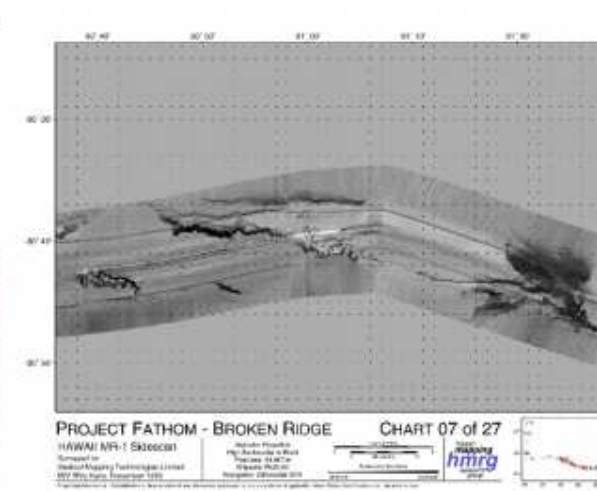
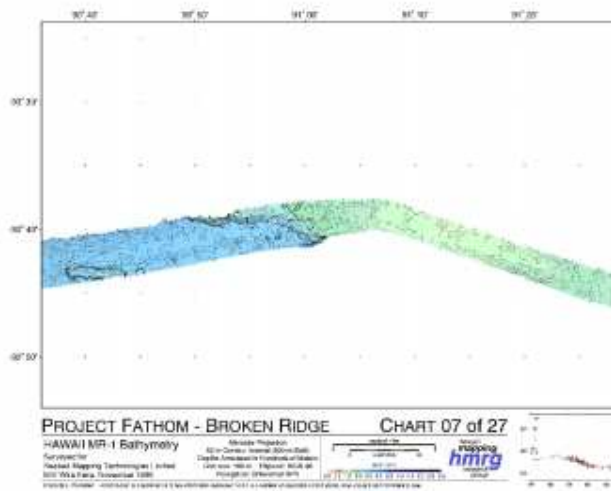
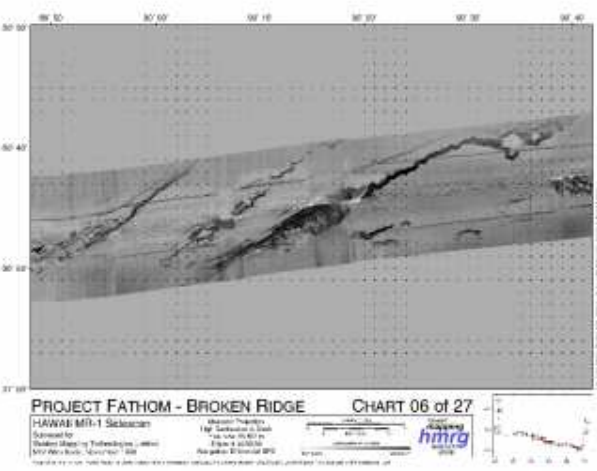
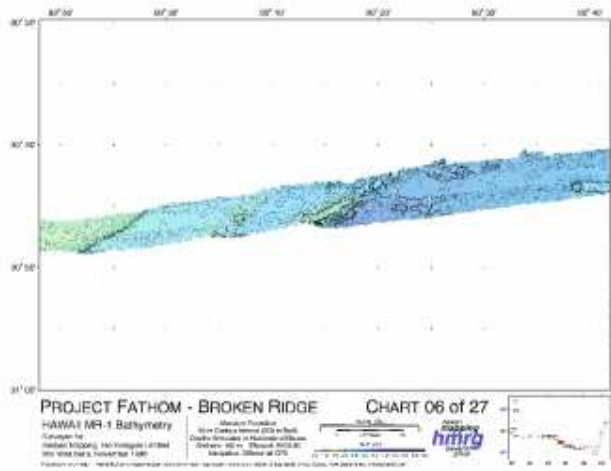


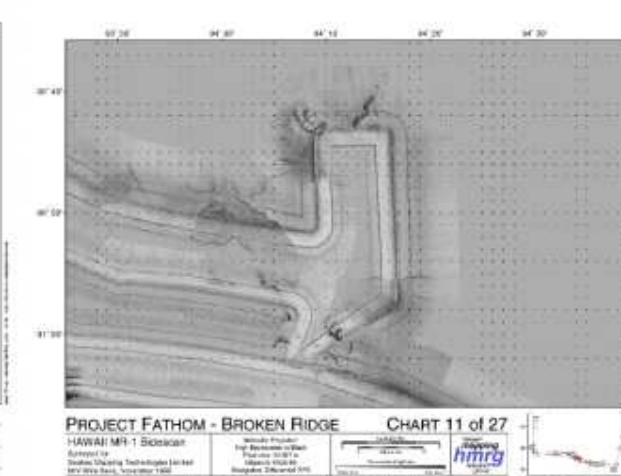
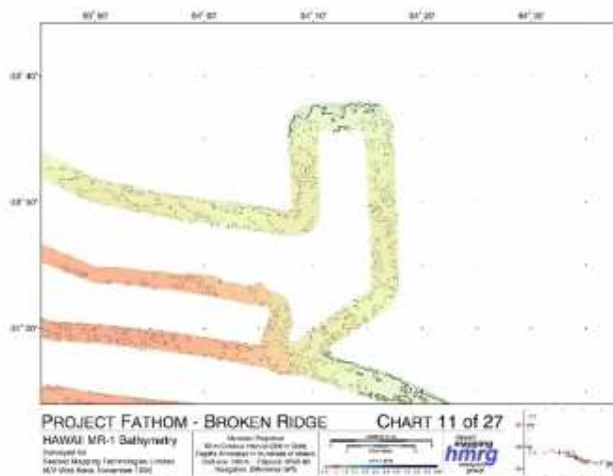
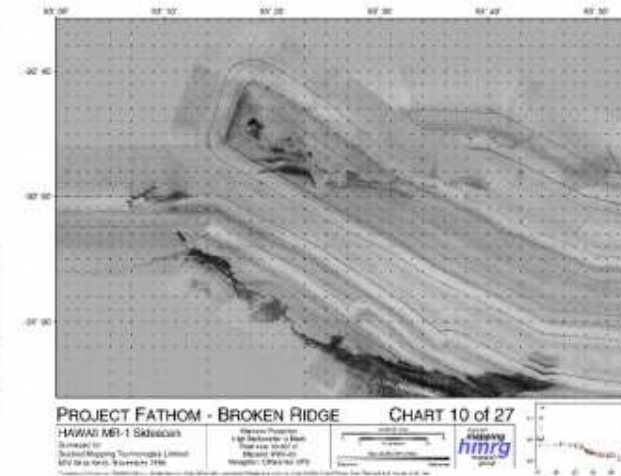
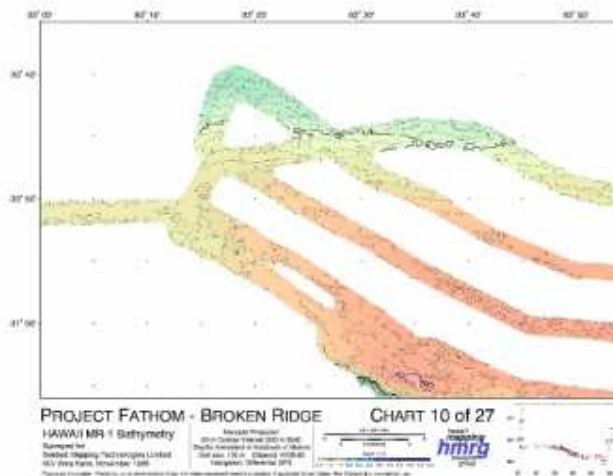
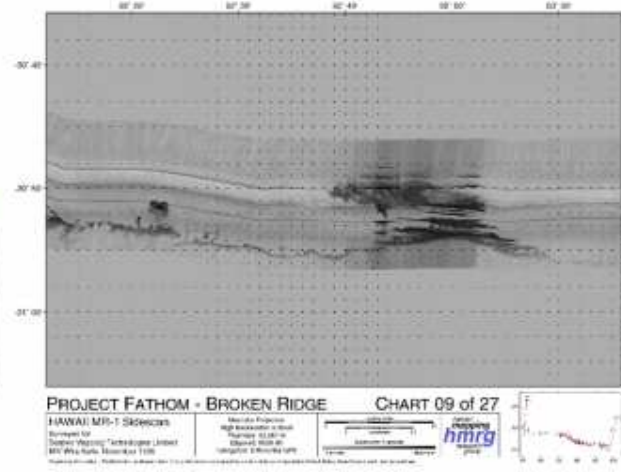
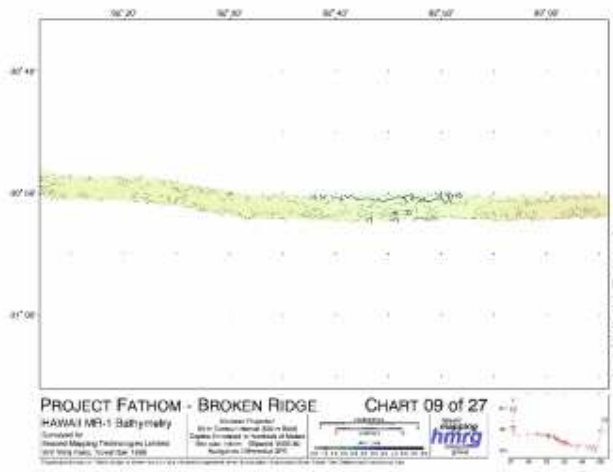
Figure 6 Vessel data 3D image of Seamount, showing trawlable tracks in red

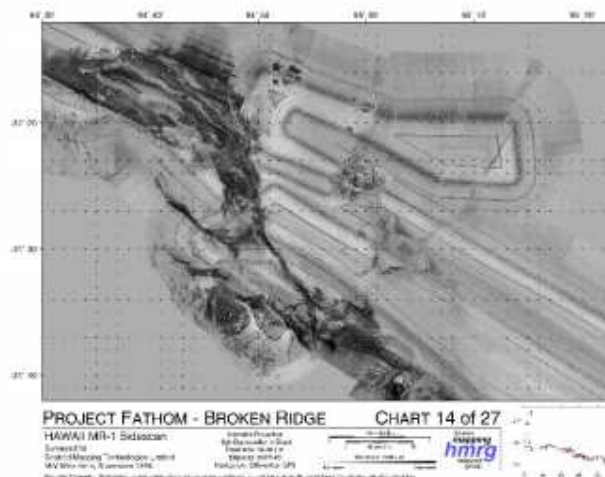
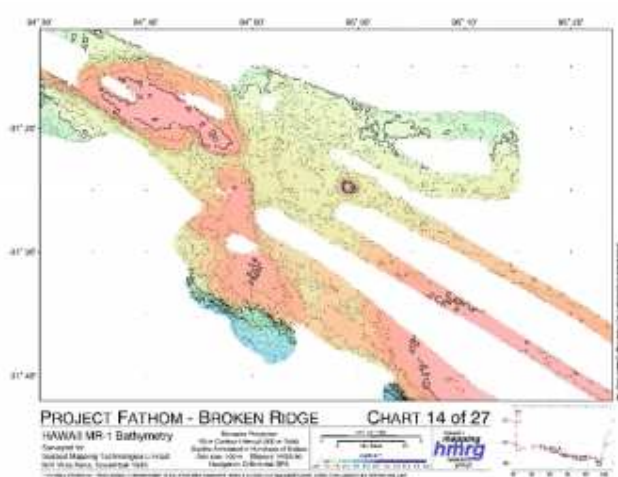
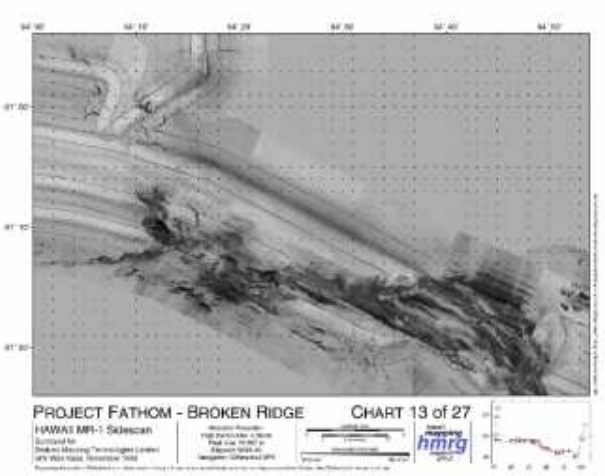
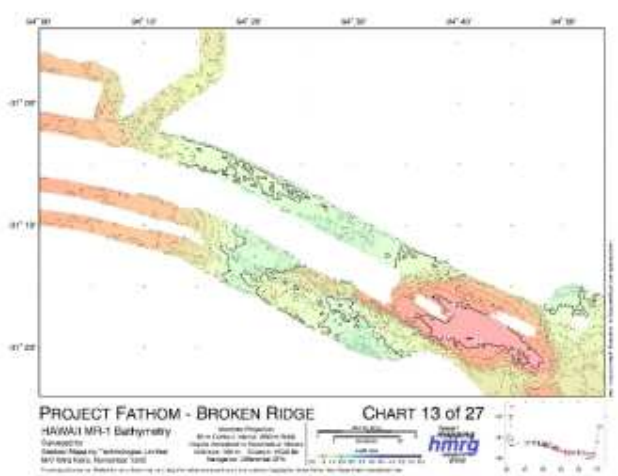
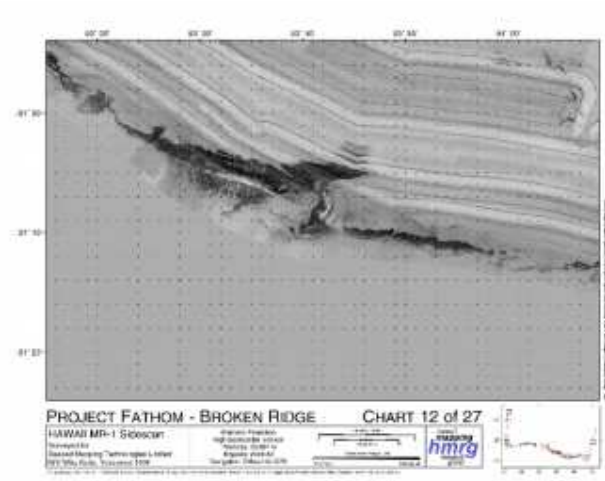
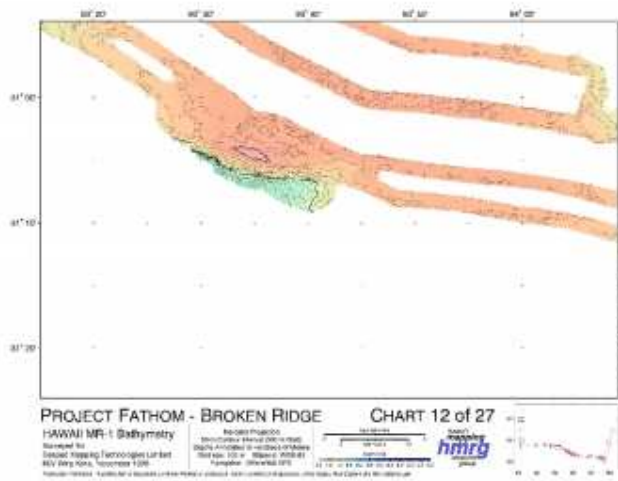
Following are the bathymetric charts with corresponding sidescan image for areas 1-27 on Broken Ridge and Ninety-east Ridge.

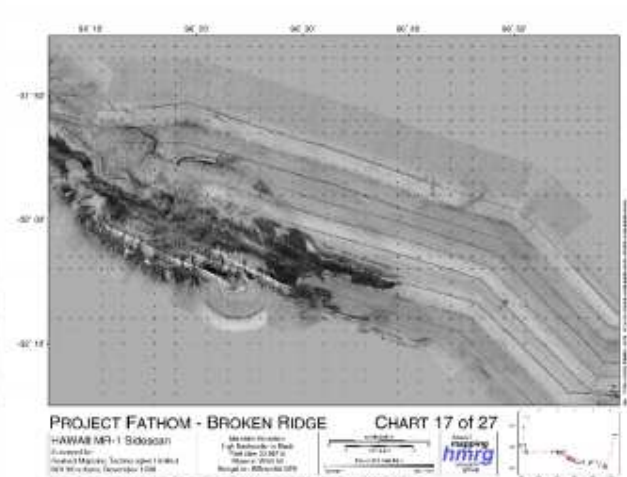
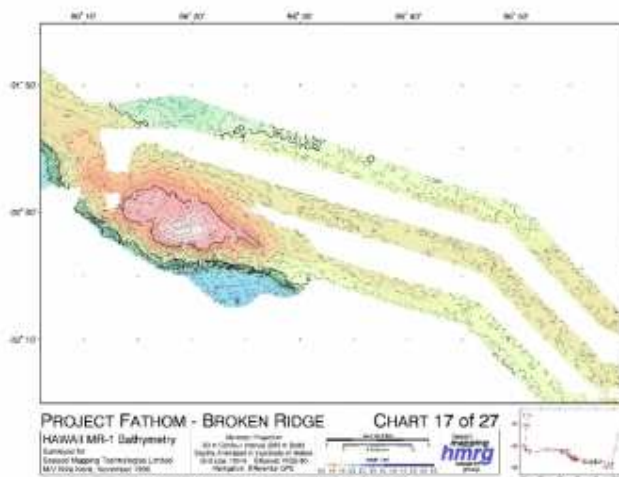
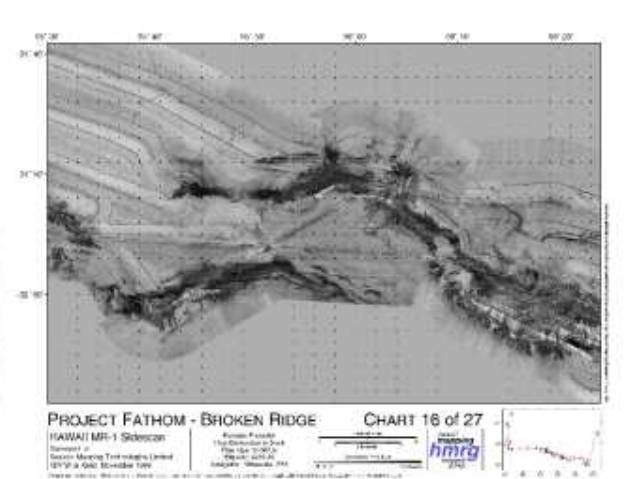
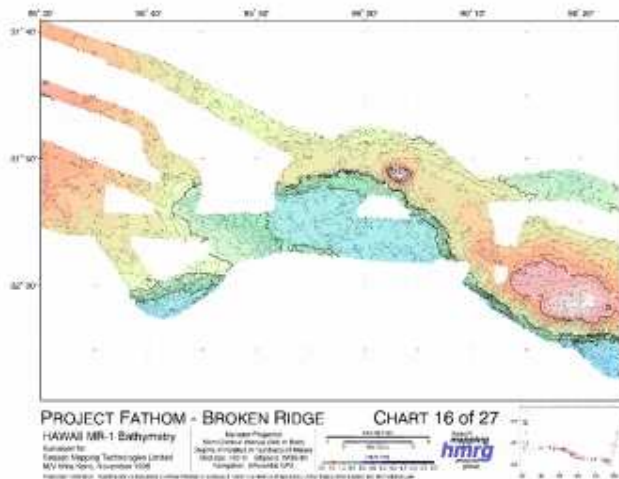
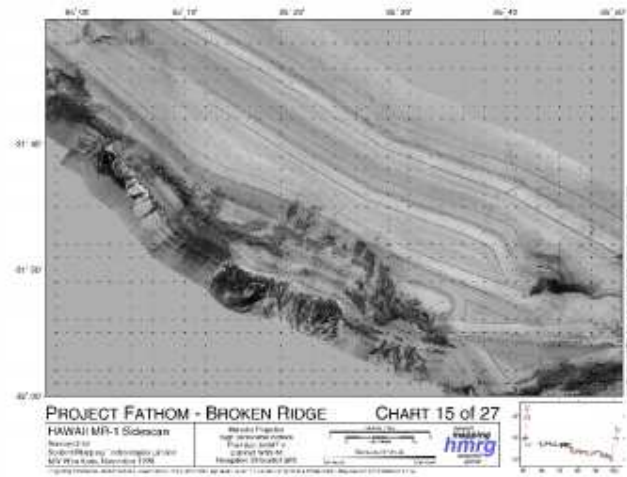
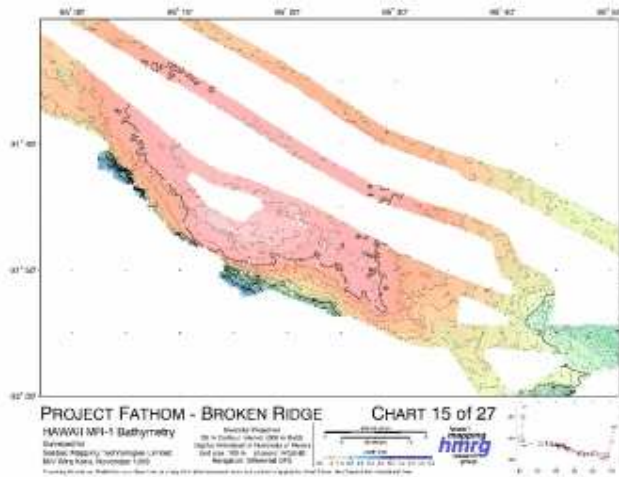


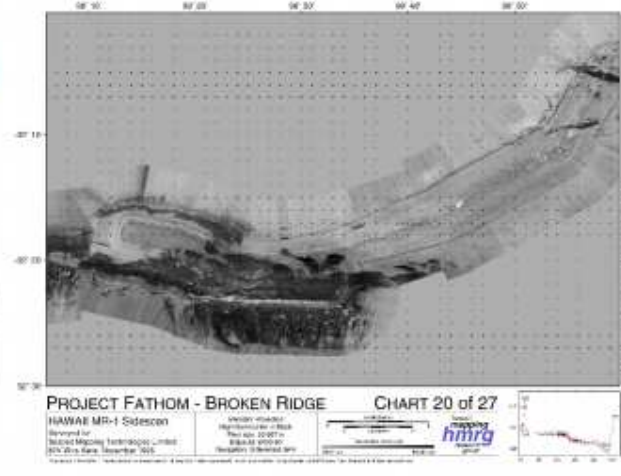
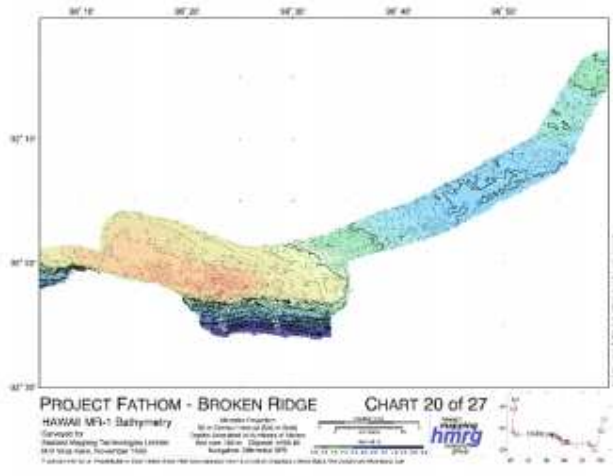
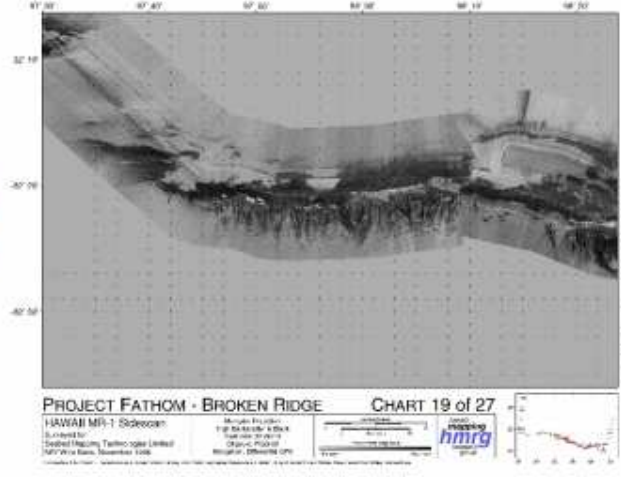
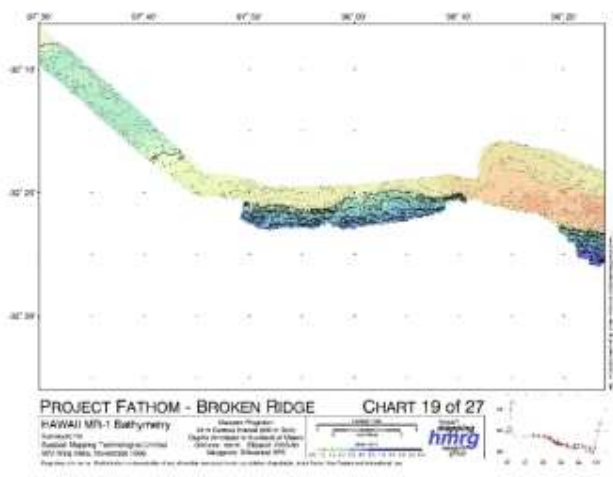
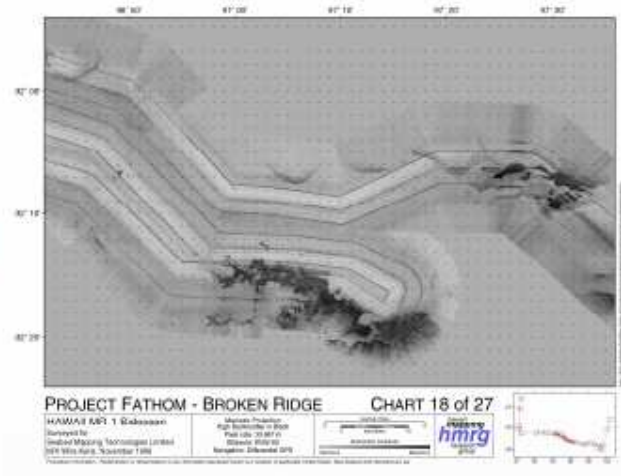
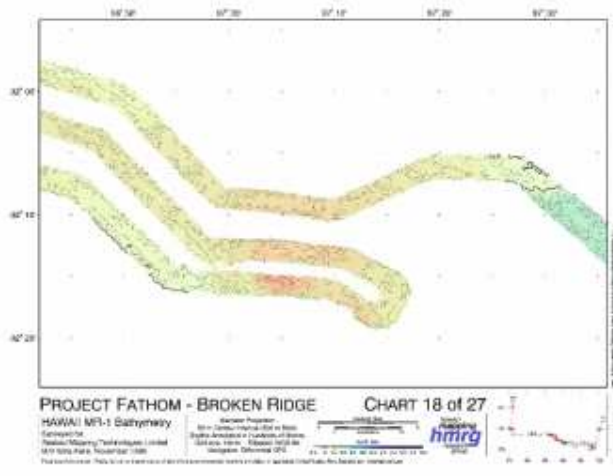


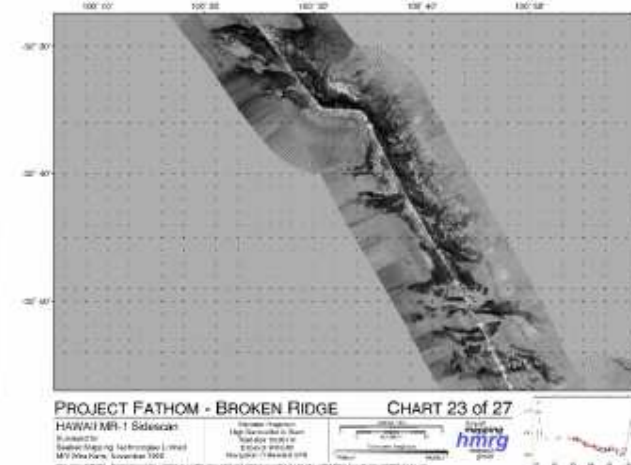
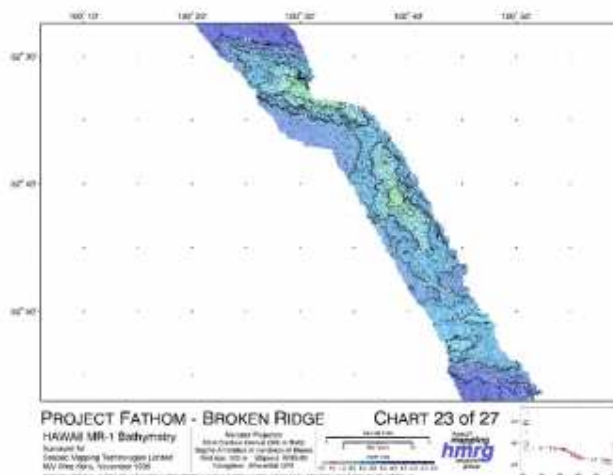
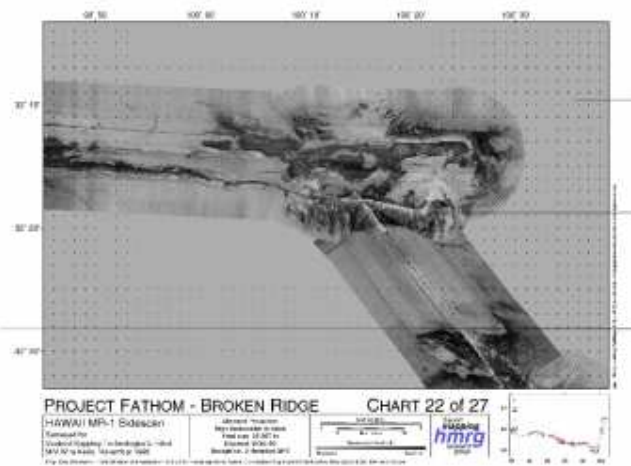
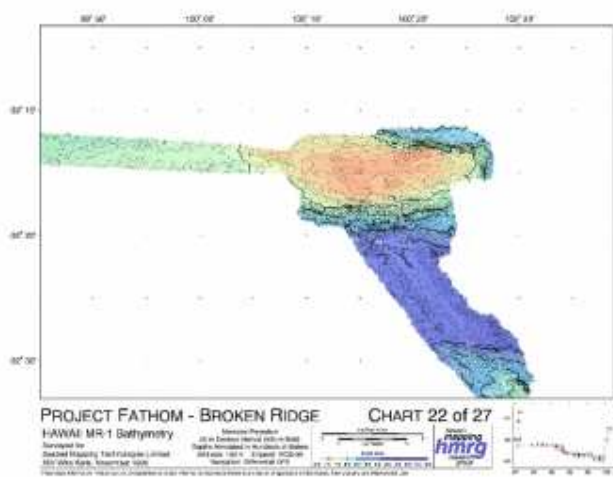
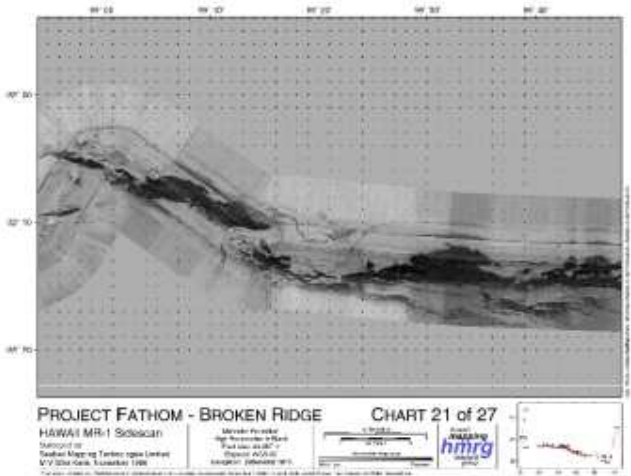
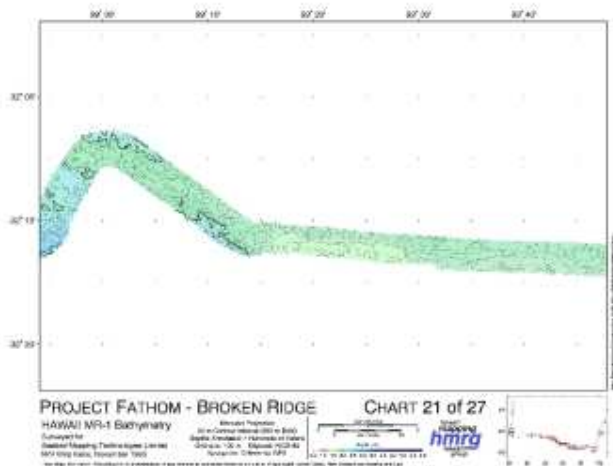


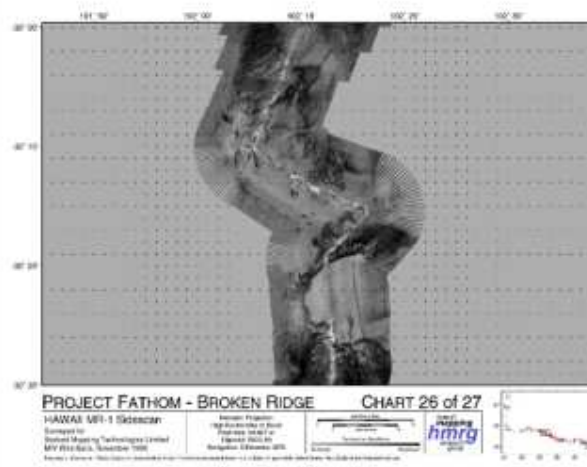
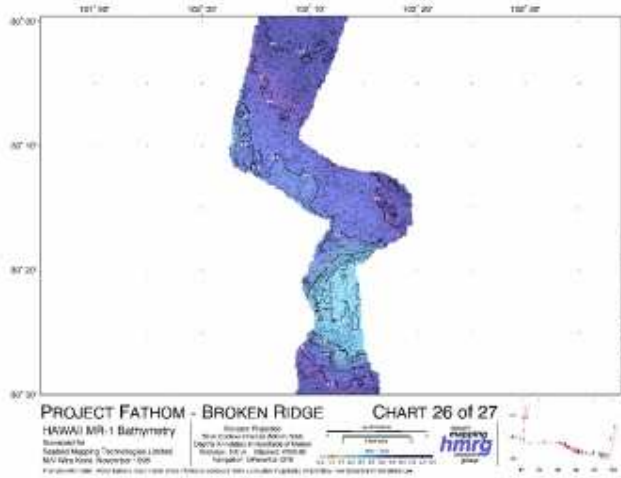
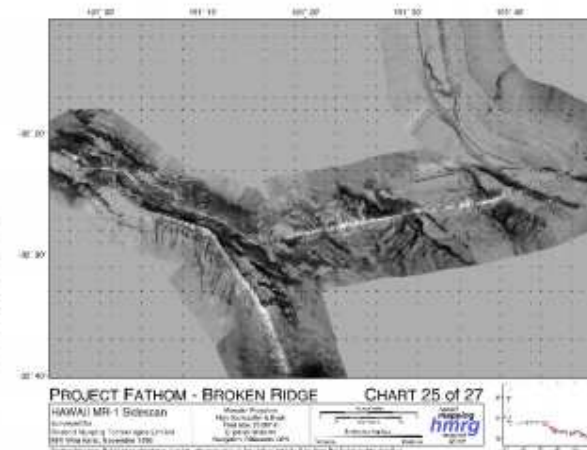
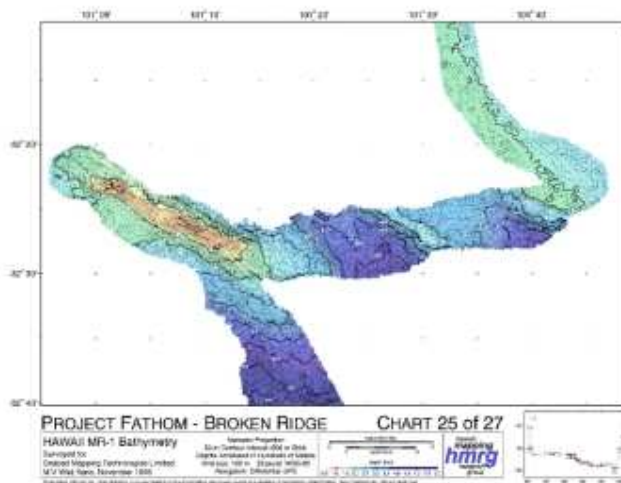
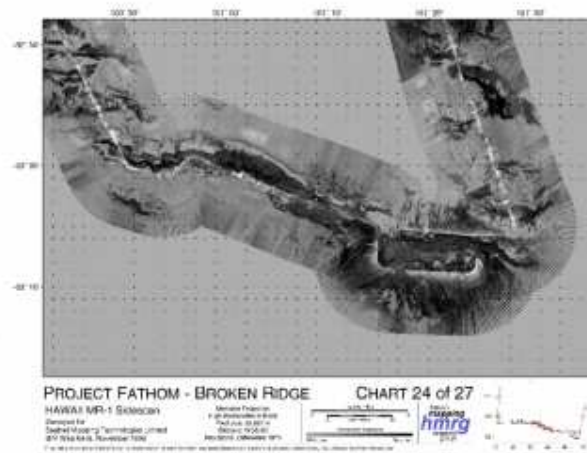
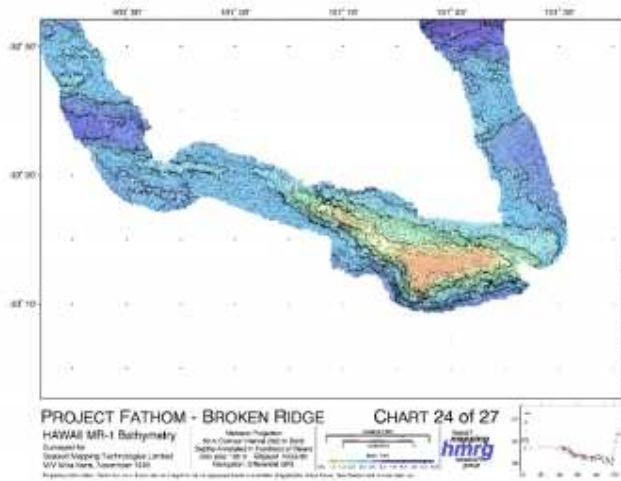


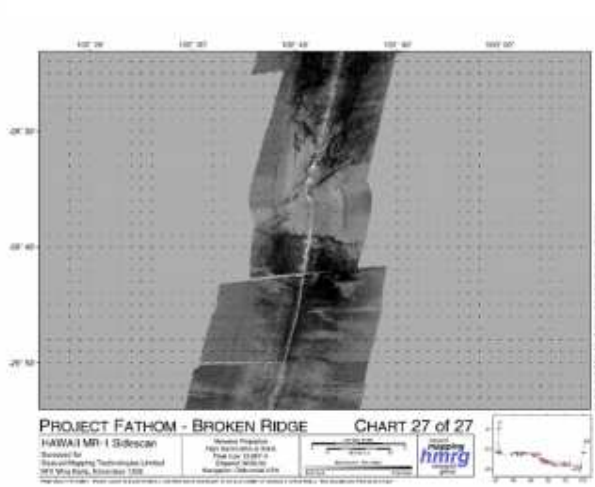
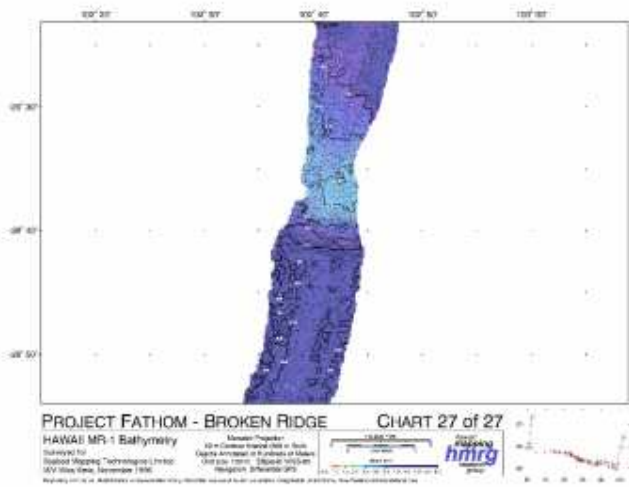












Southwest Indian Ocean and Walter's Shoals Bathymetry

Following are the 64 bathymetric and sidescan imagery charts for the Southwest Indian Ocean Ridge that were mapped with MR1 (Figure 7).

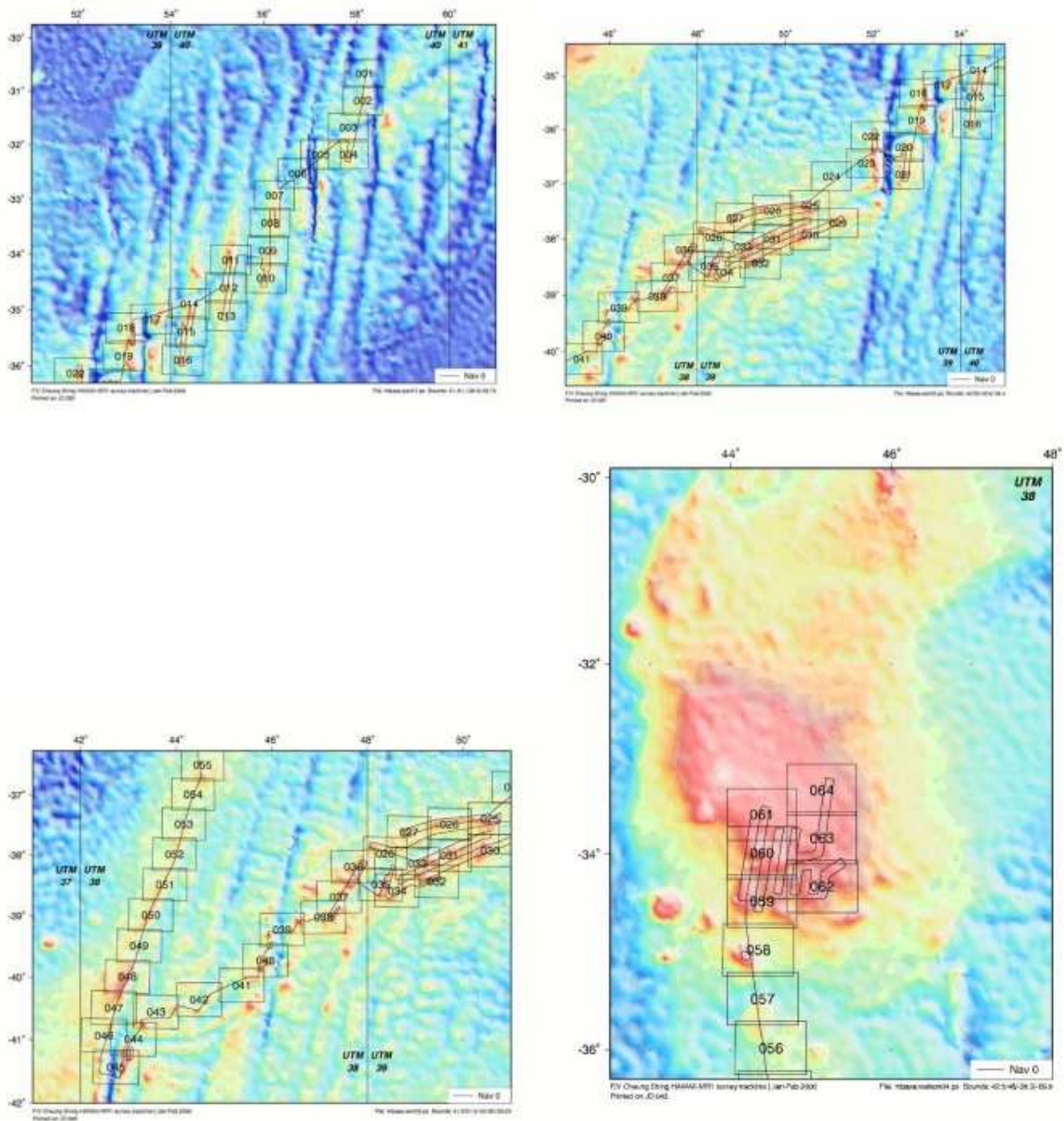
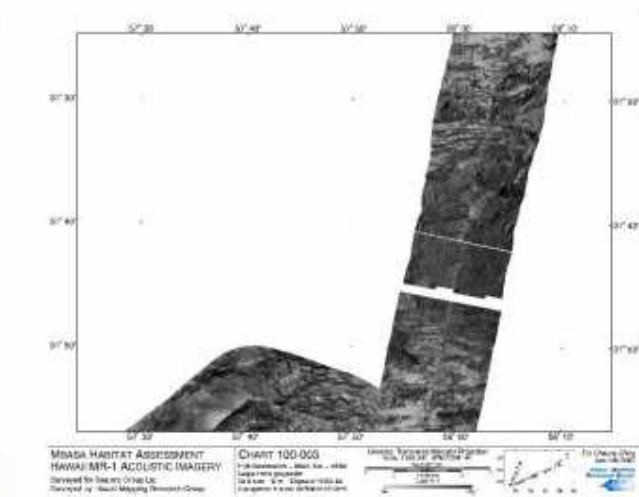
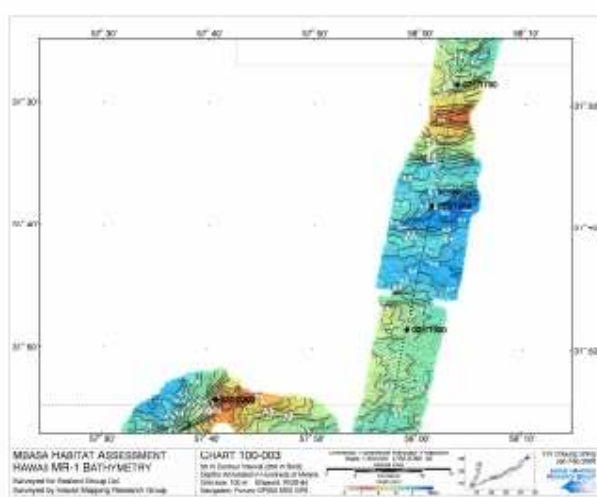
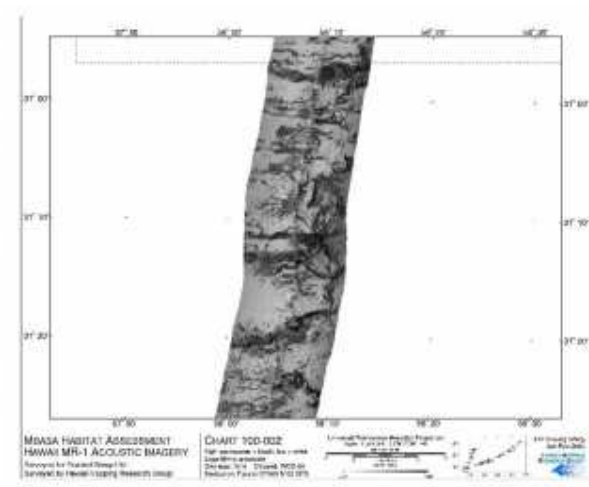
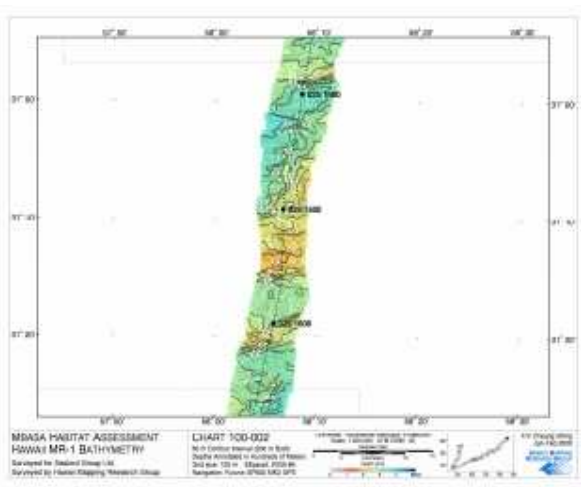
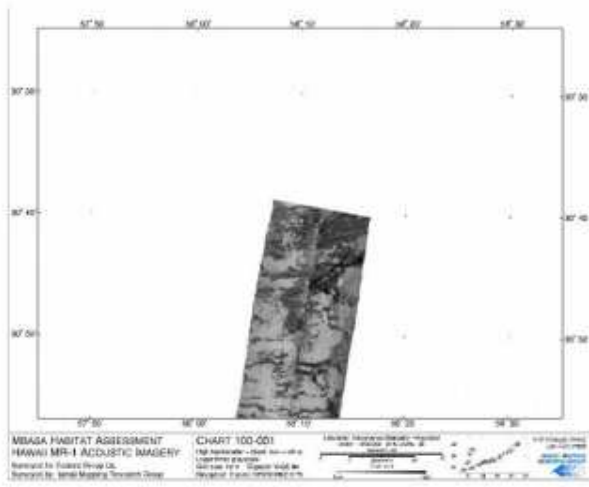
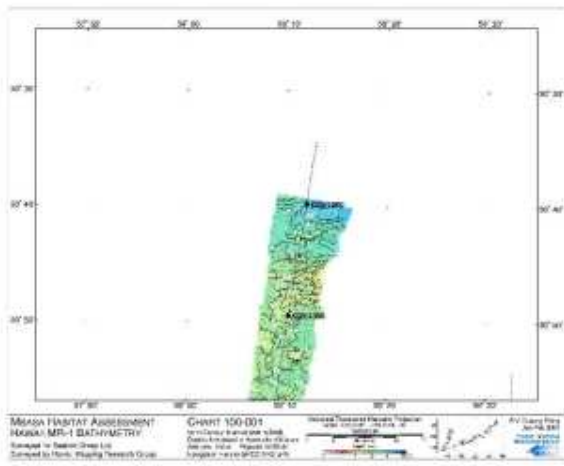
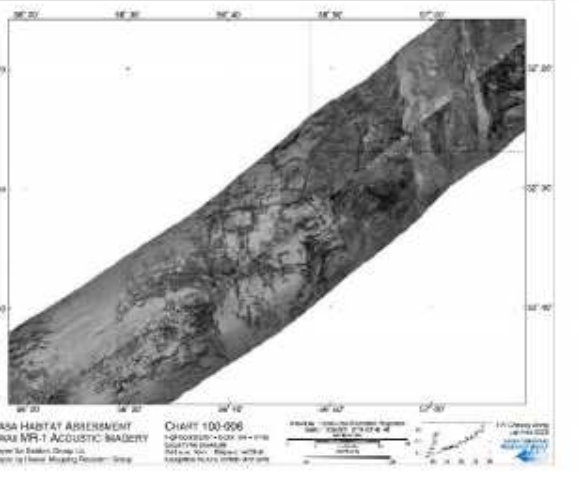
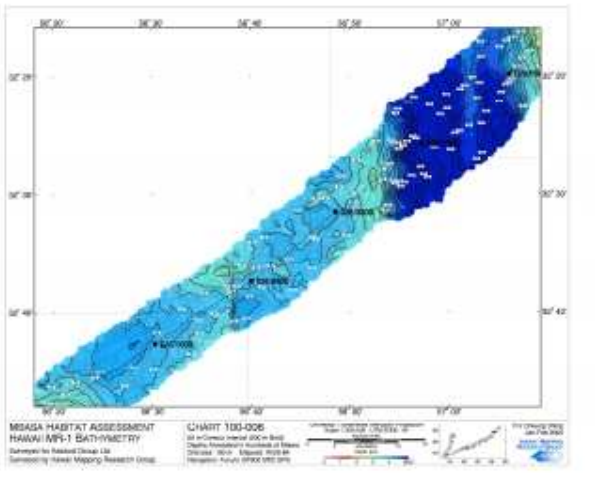
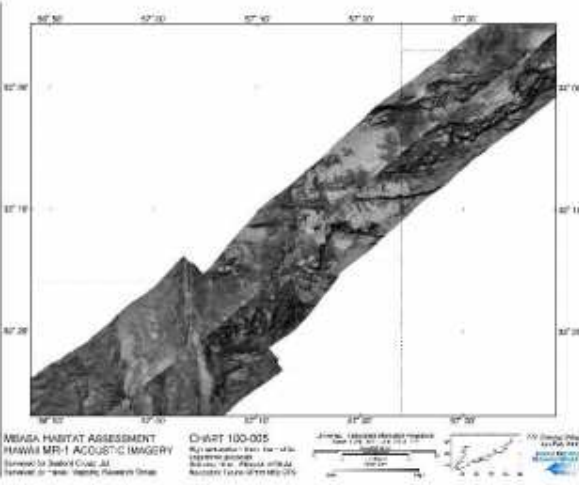
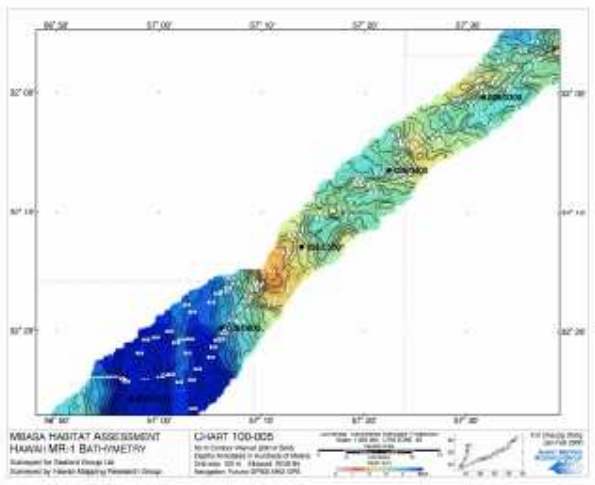
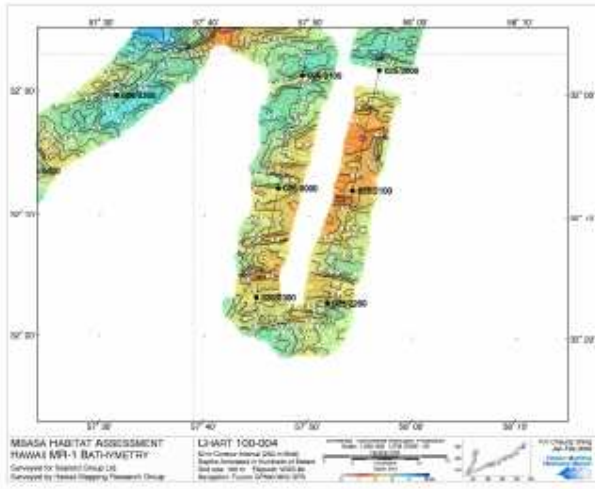
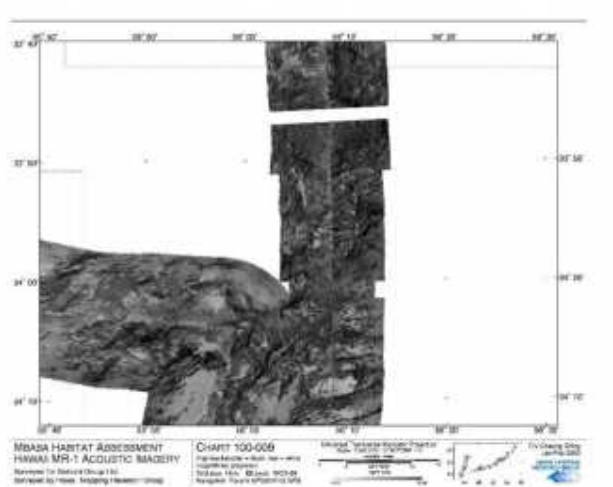
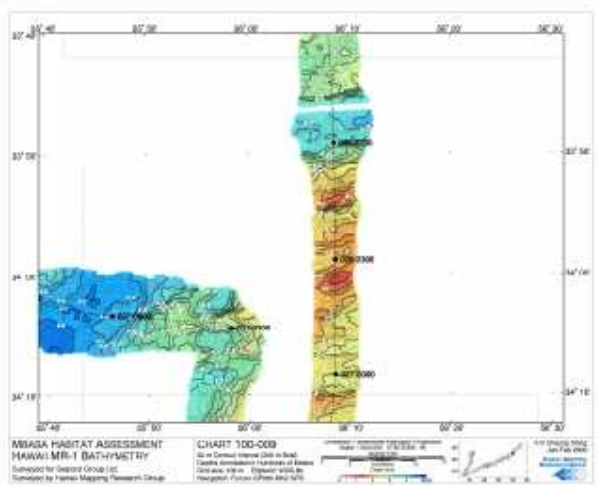
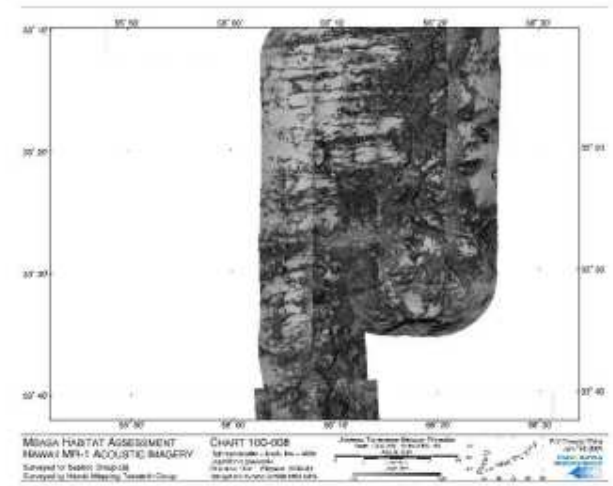
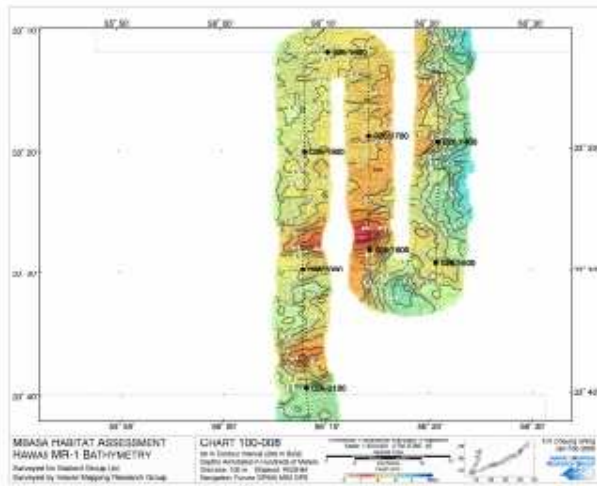
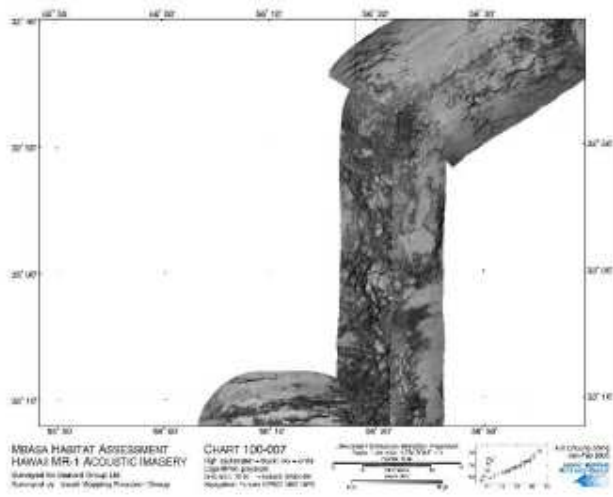
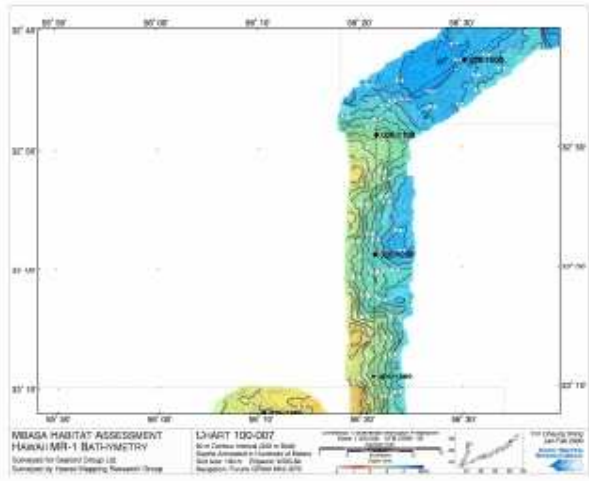
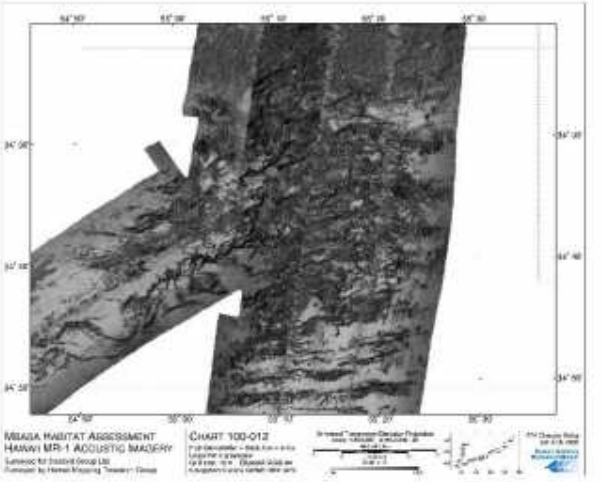
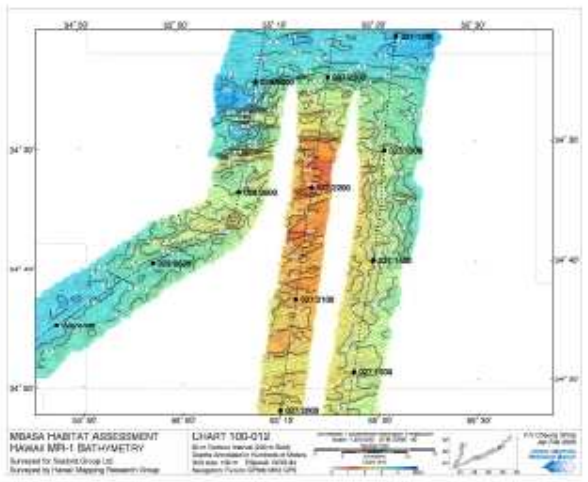
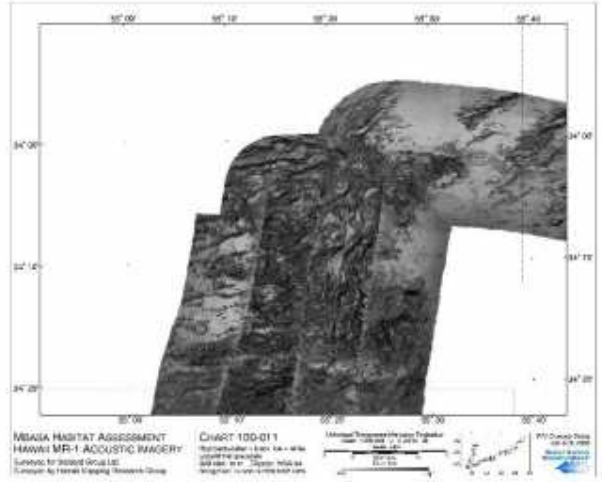
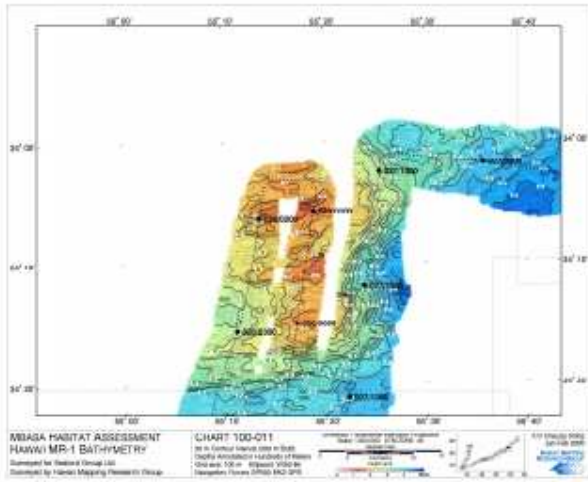
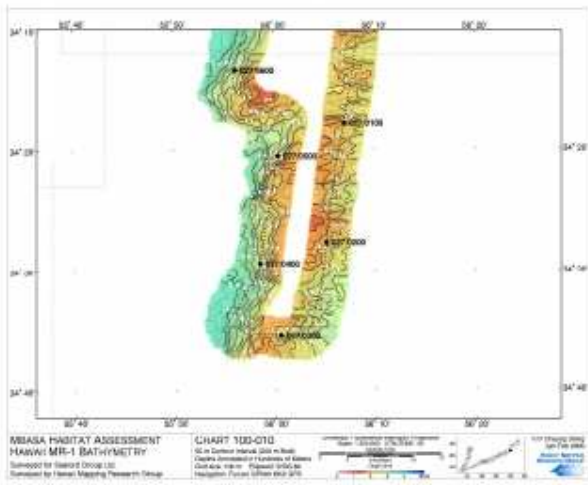


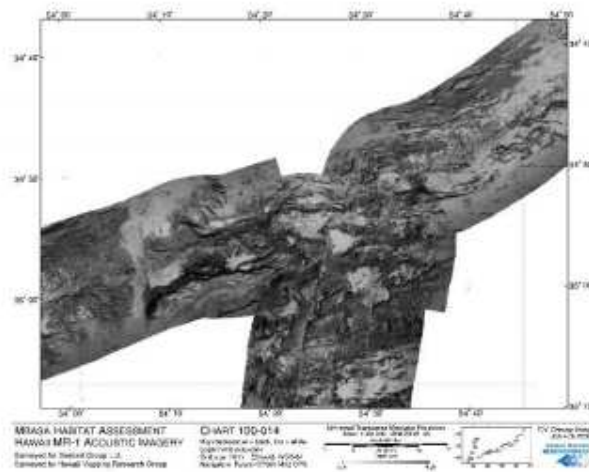
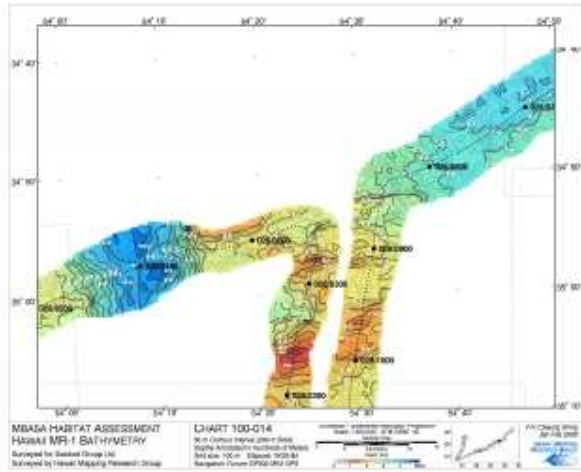
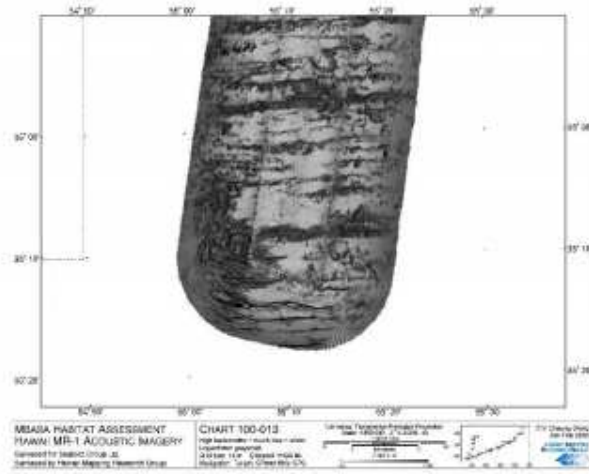
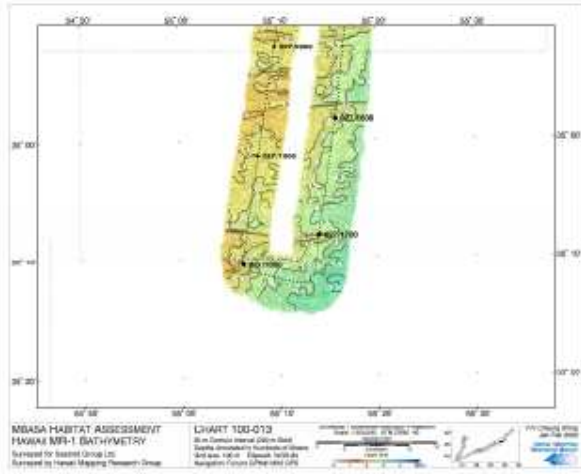
Figure 7 Southwest Indian Ocean and Walters Shoal MR1 Survey coverage

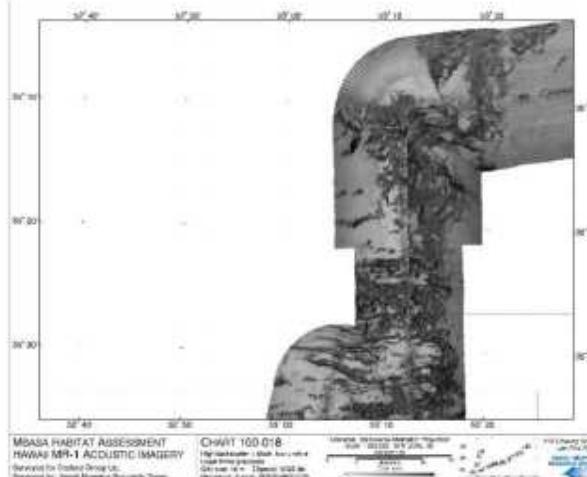
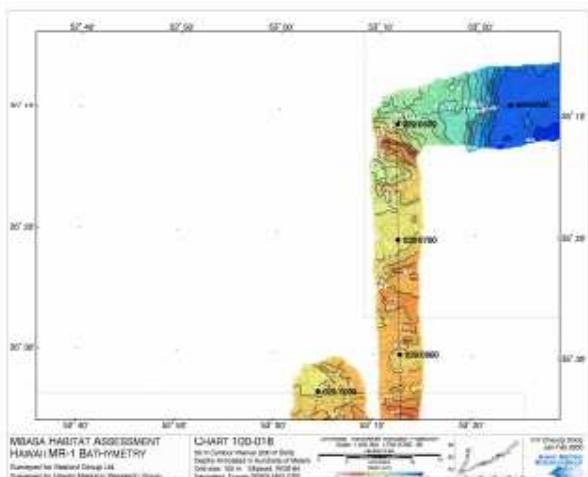
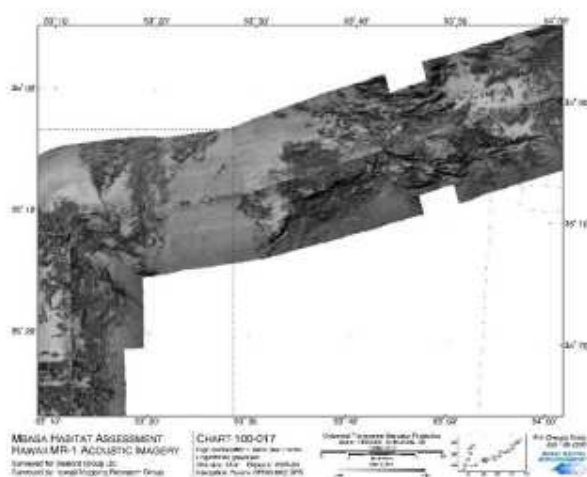
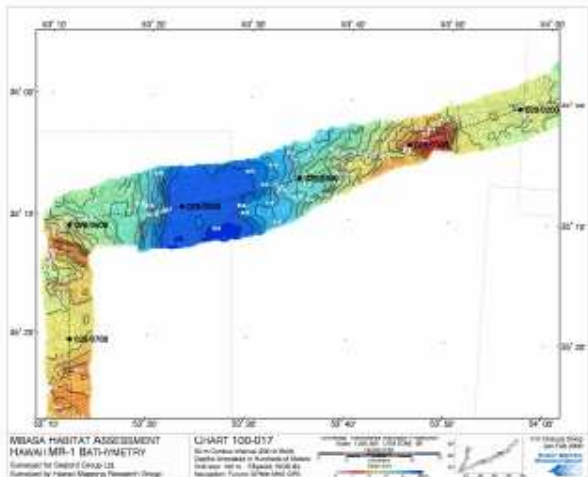
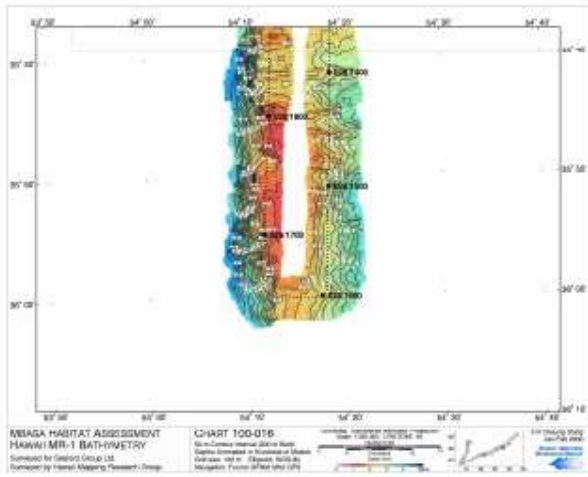


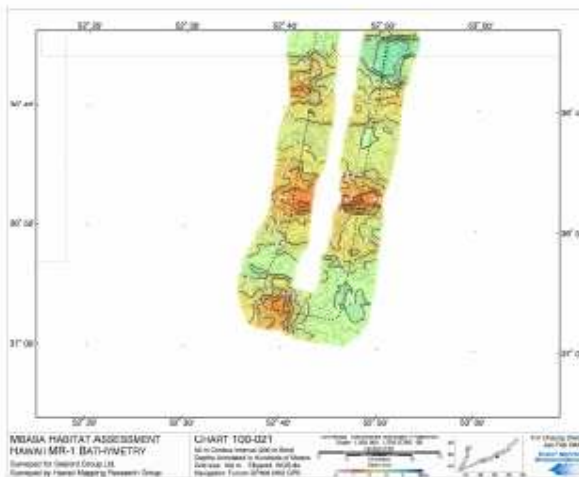
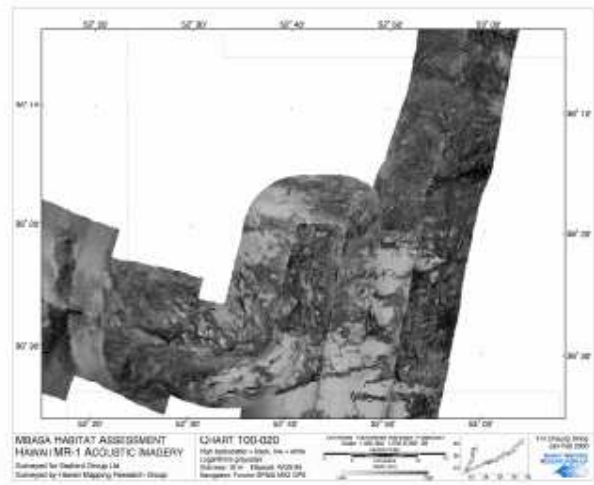
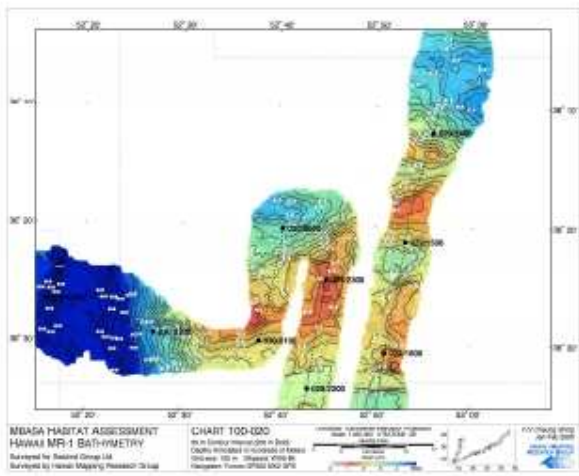
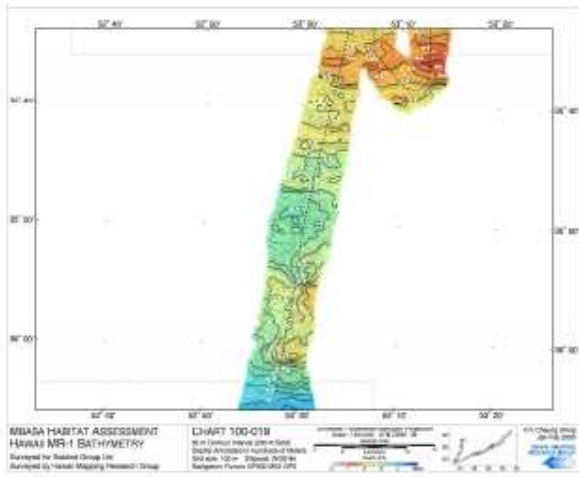


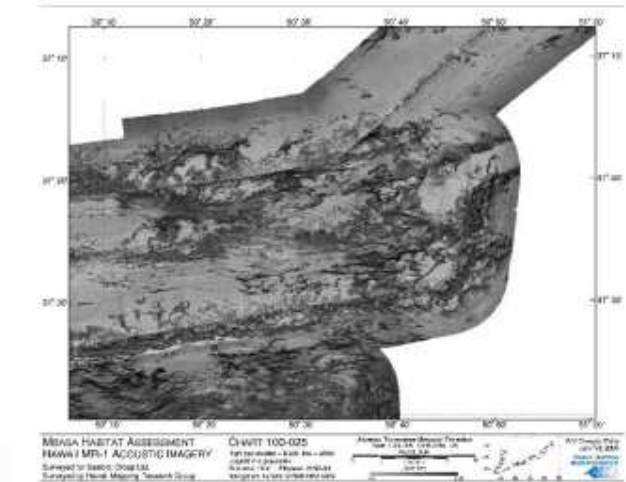
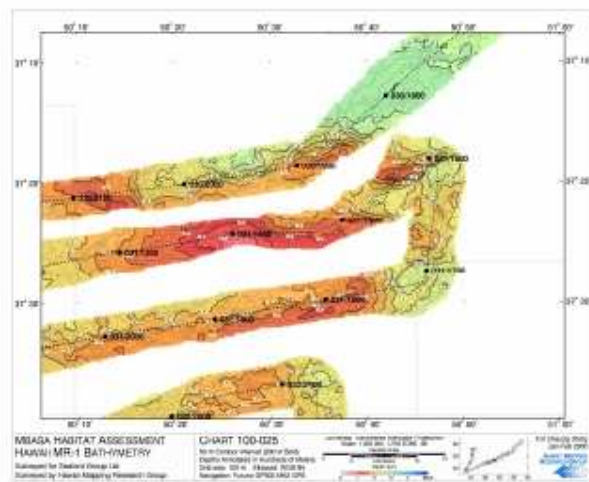
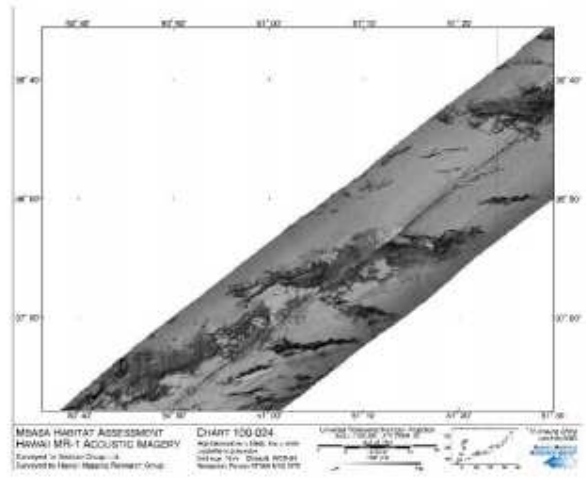
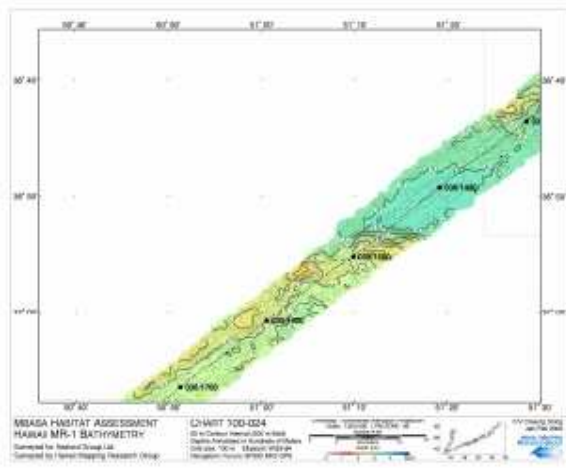
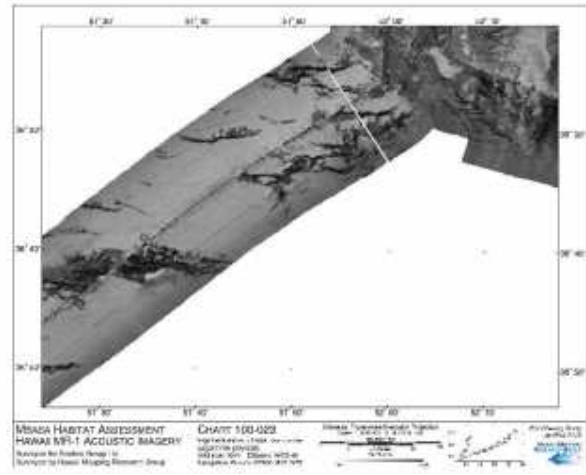
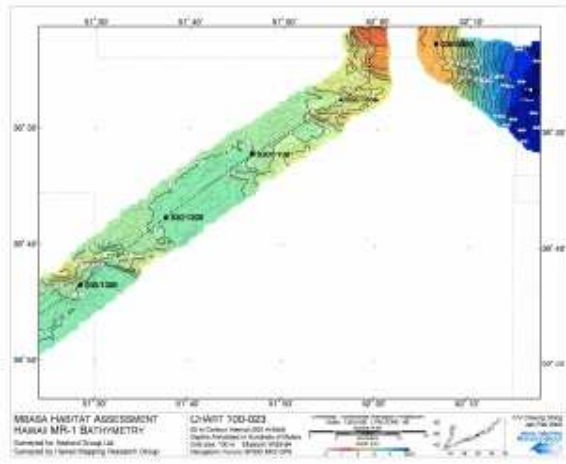


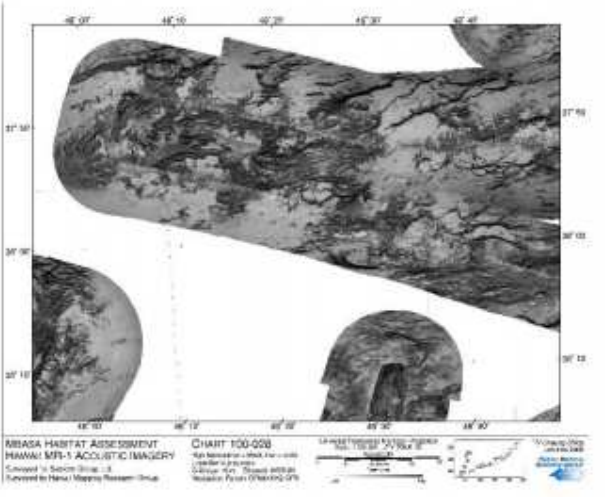
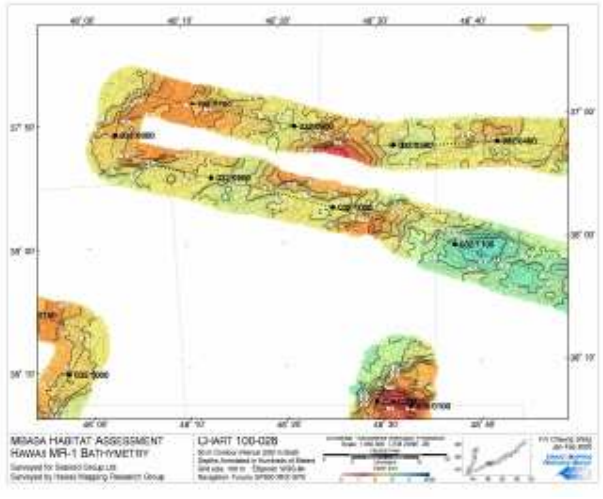
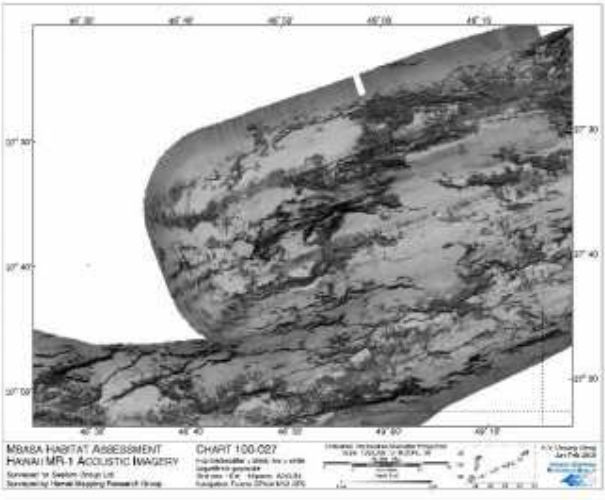
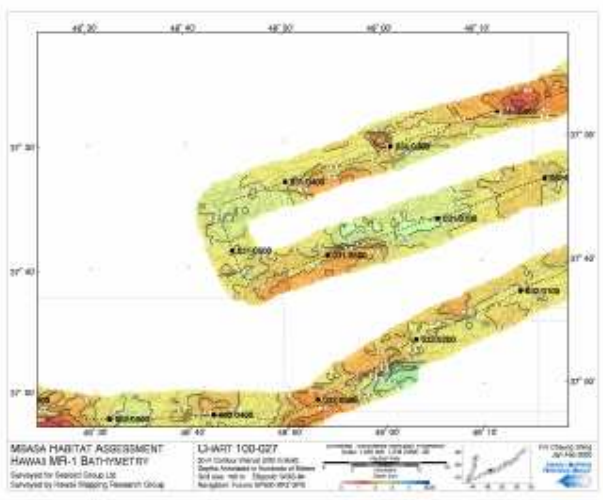
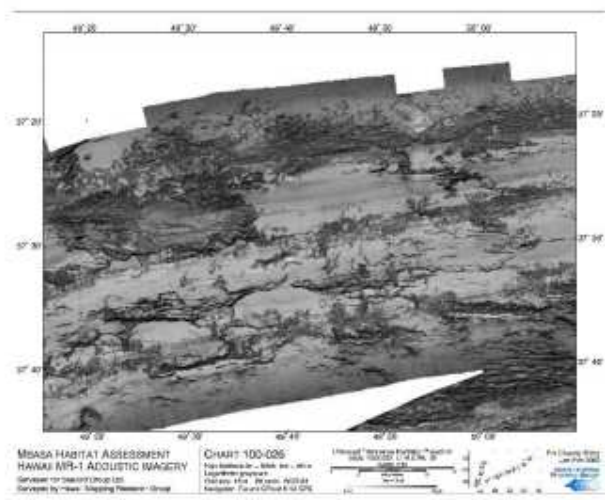
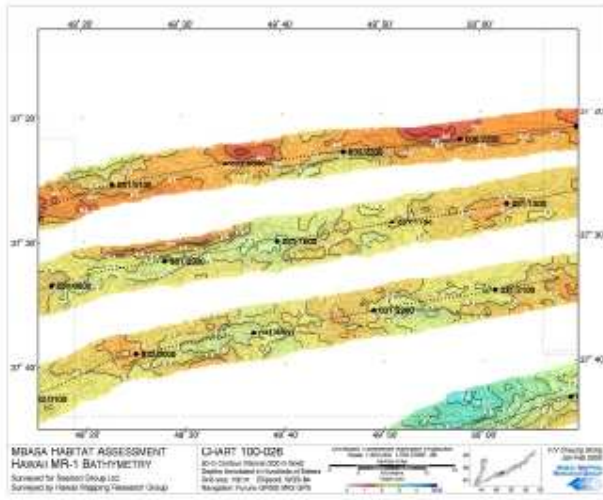


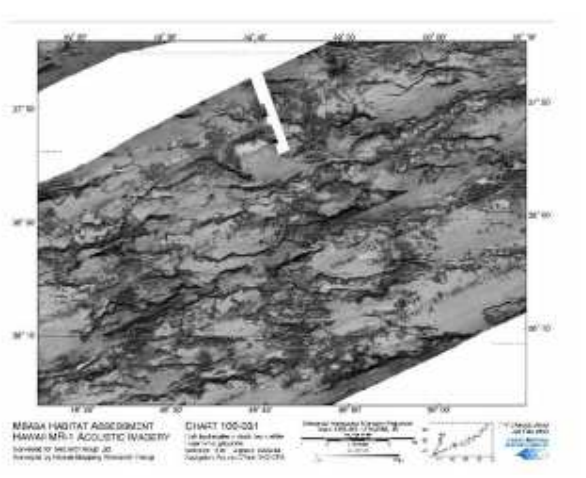
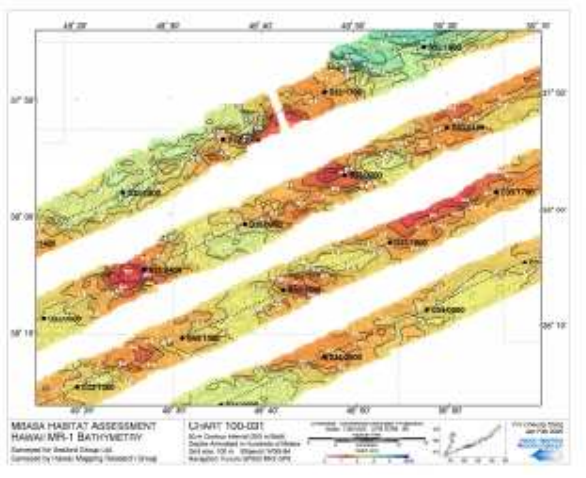
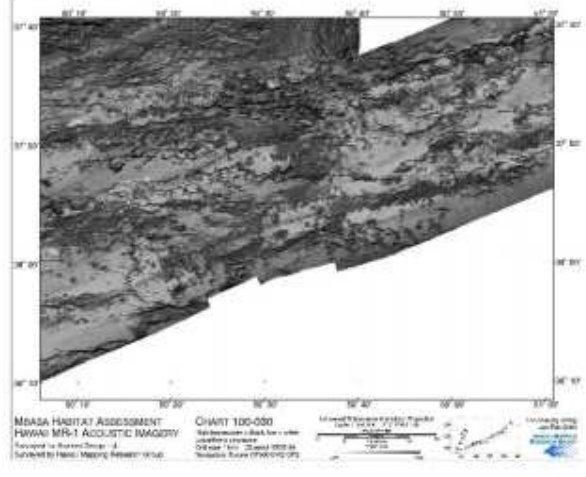
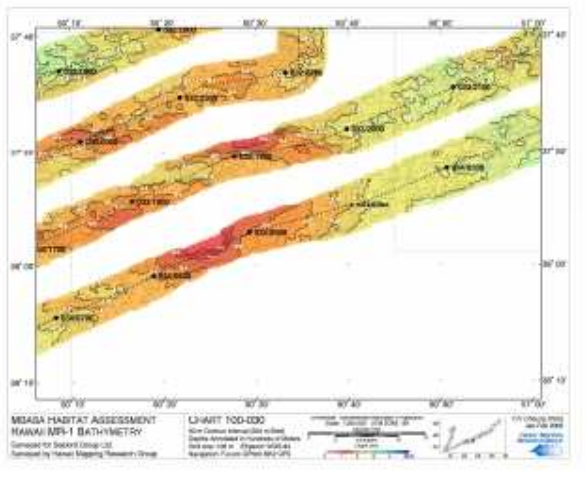
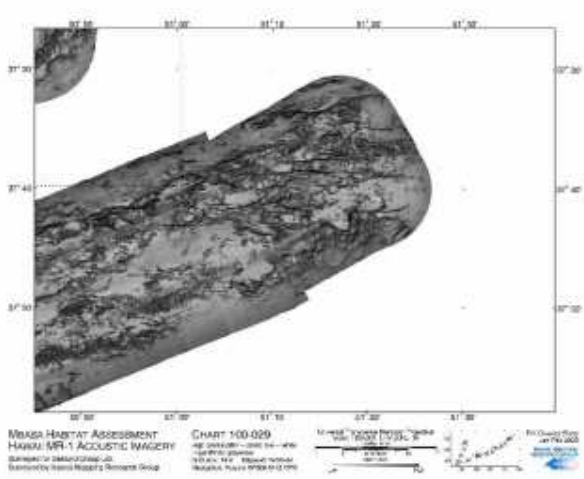
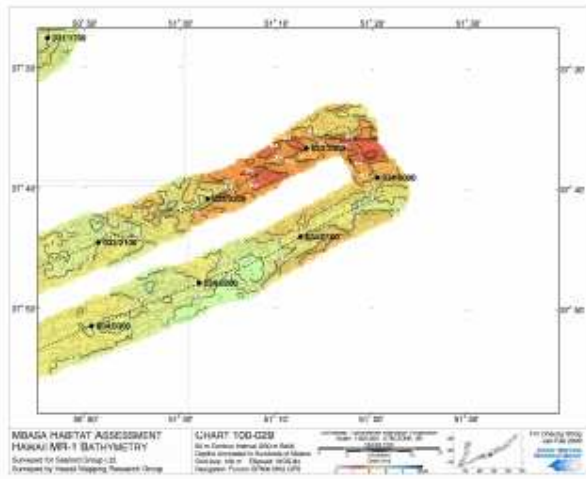


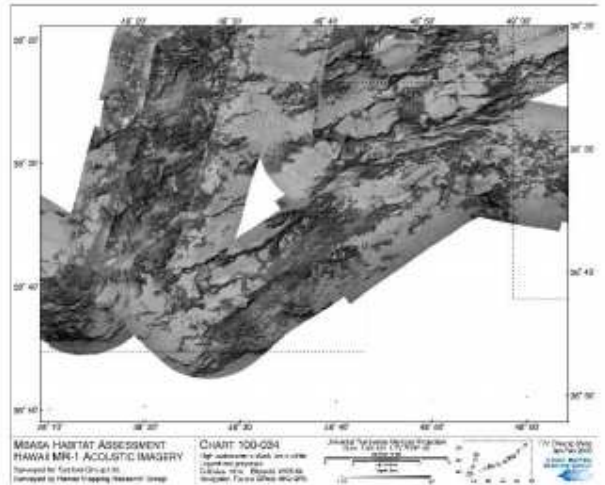
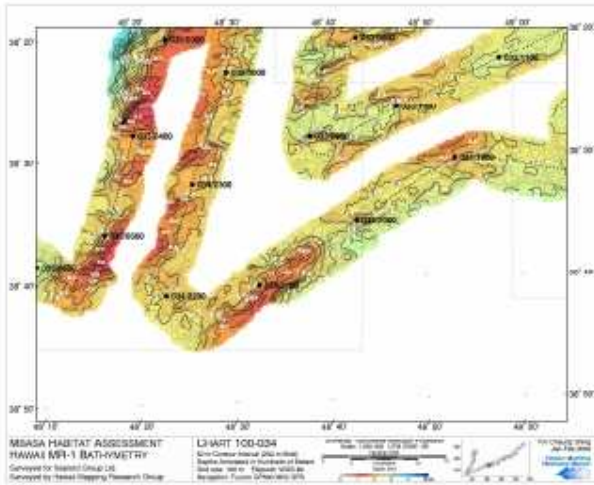
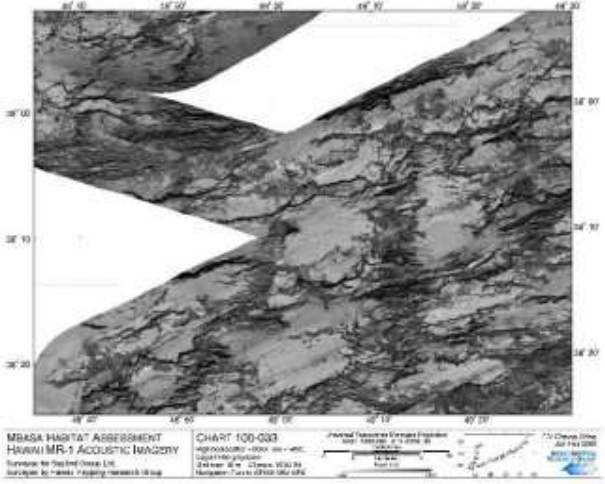
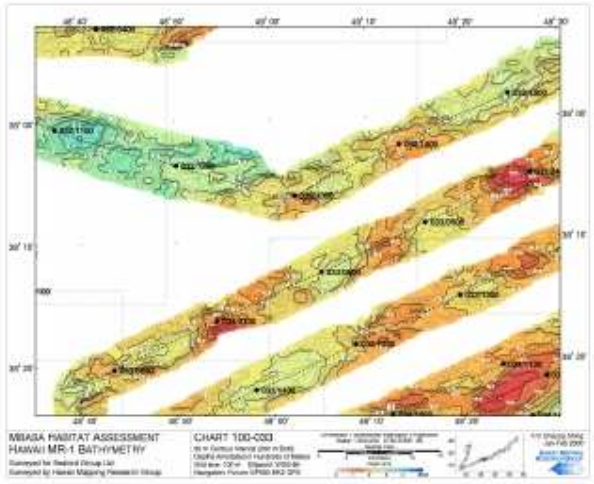
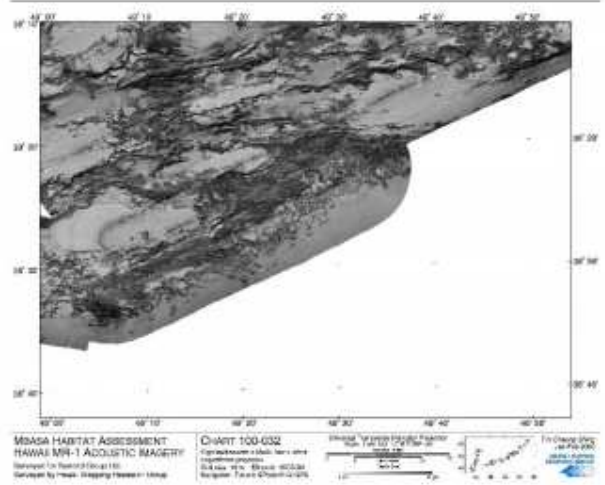
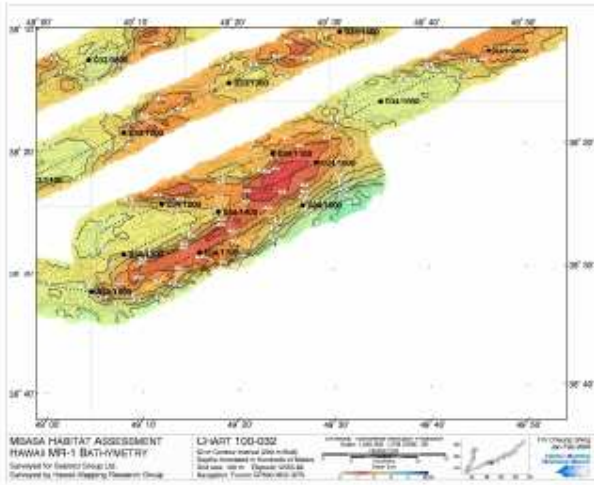


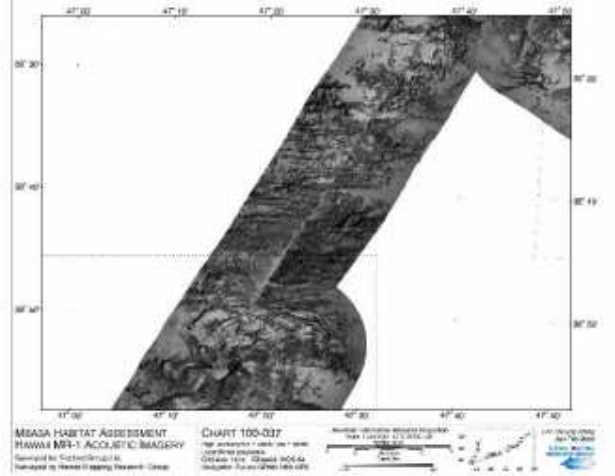
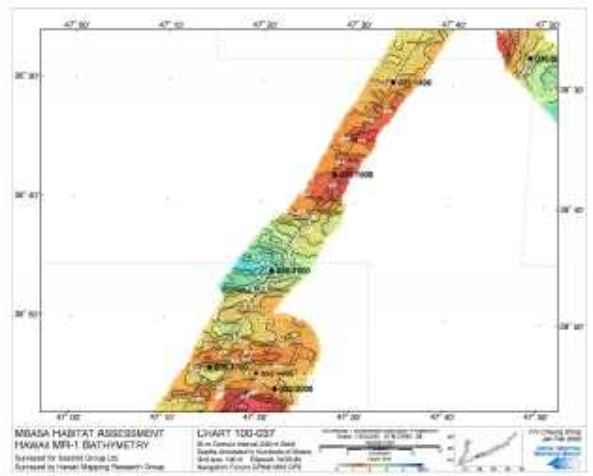
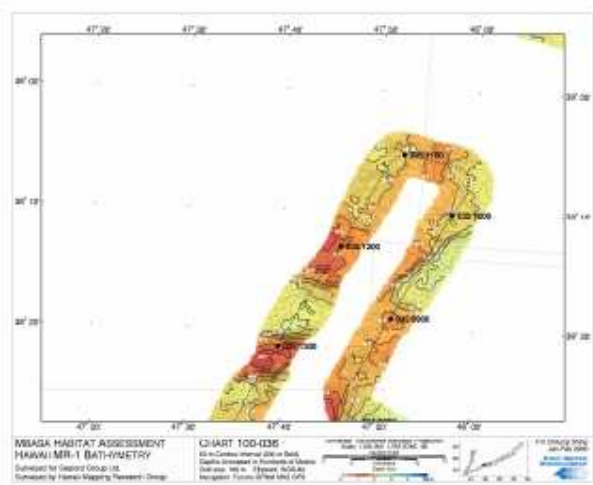
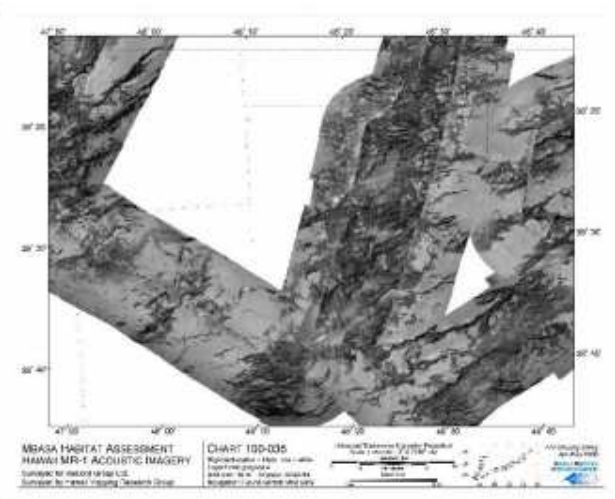
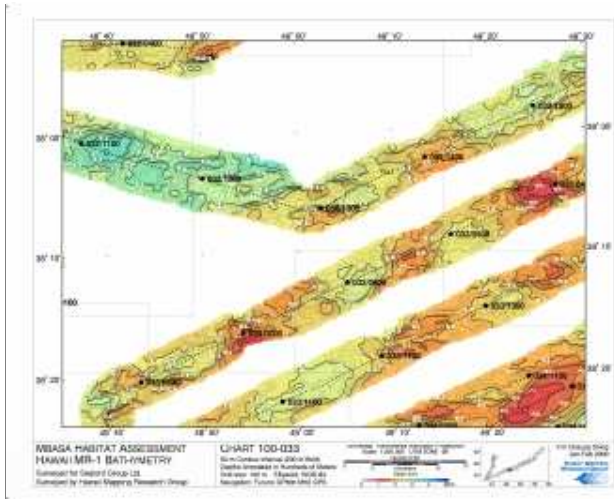


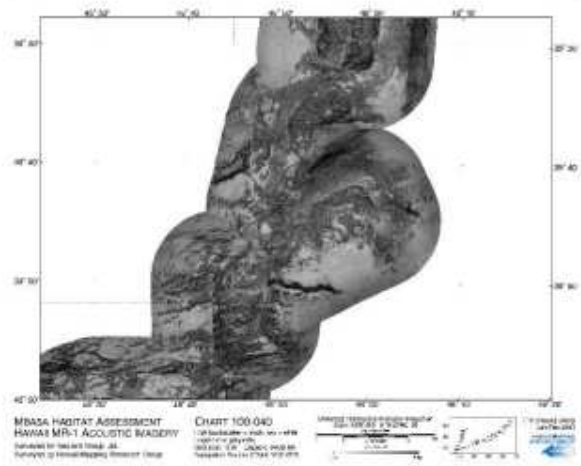
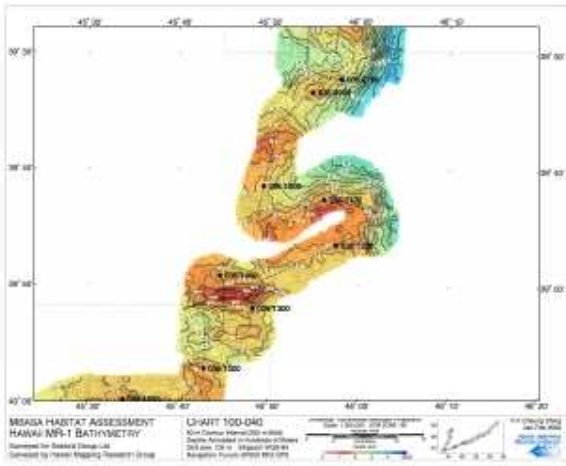
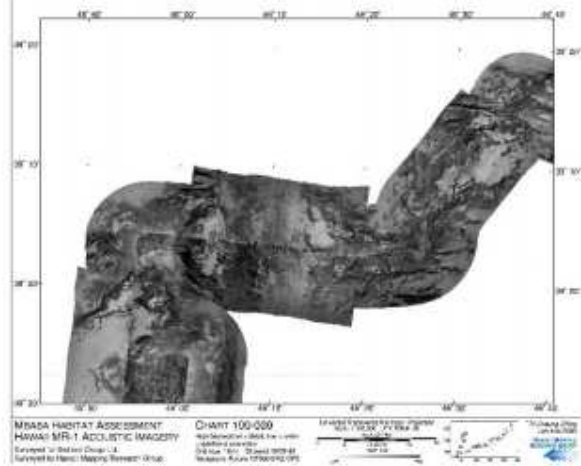
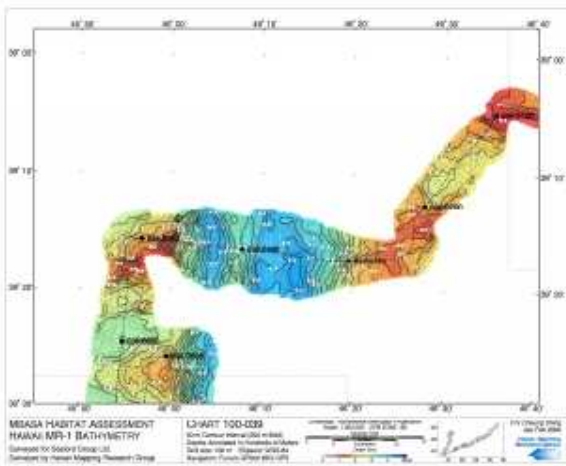
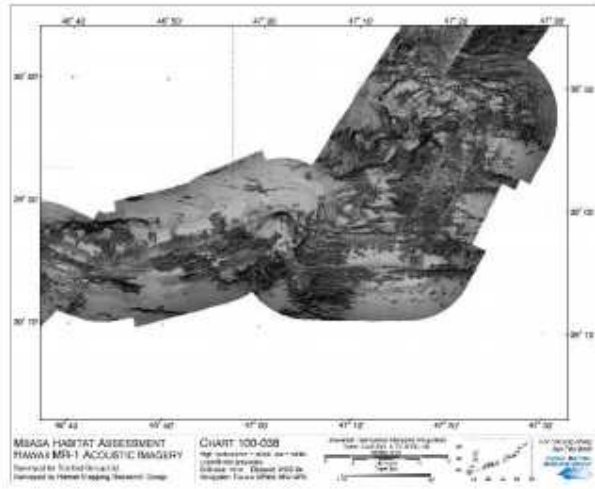
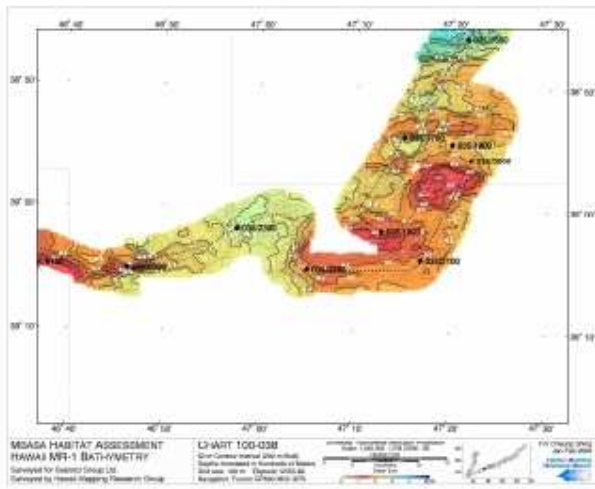


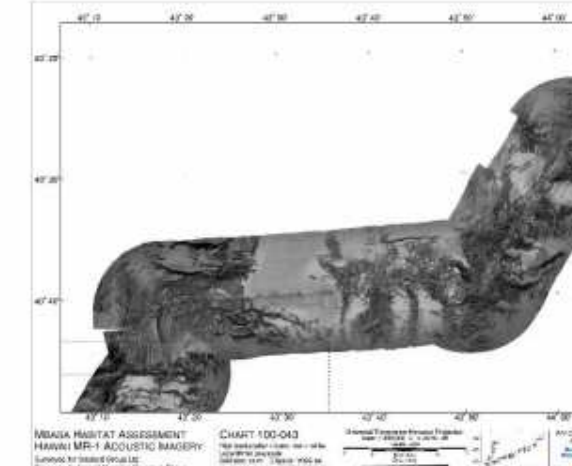
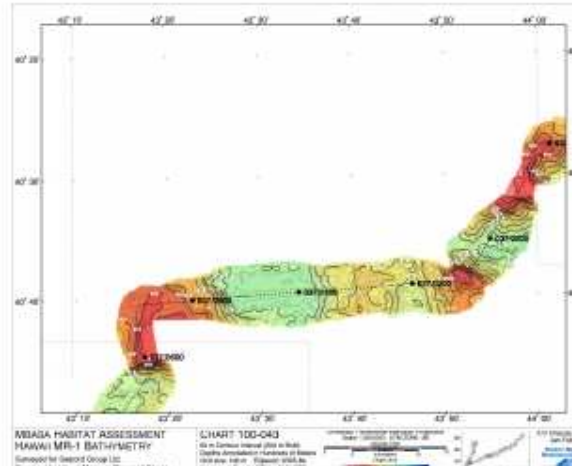
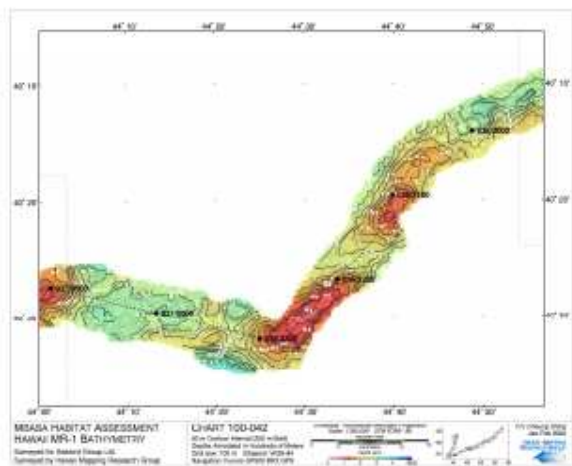
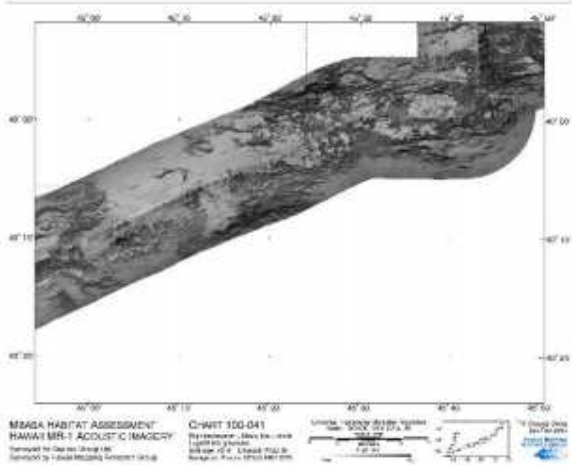
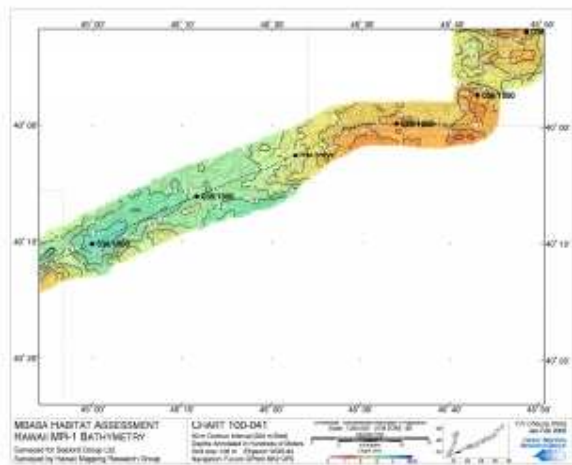


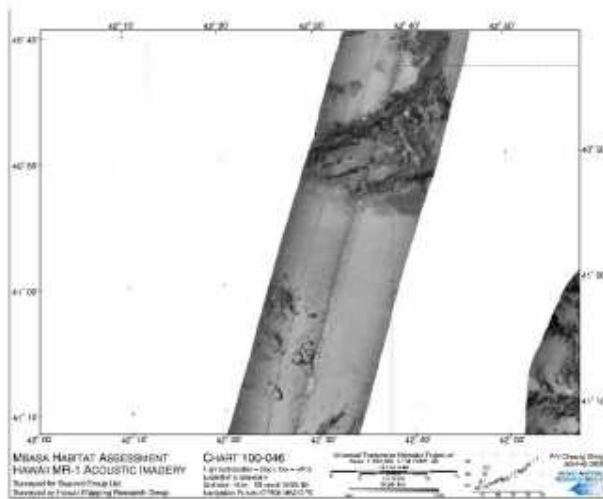
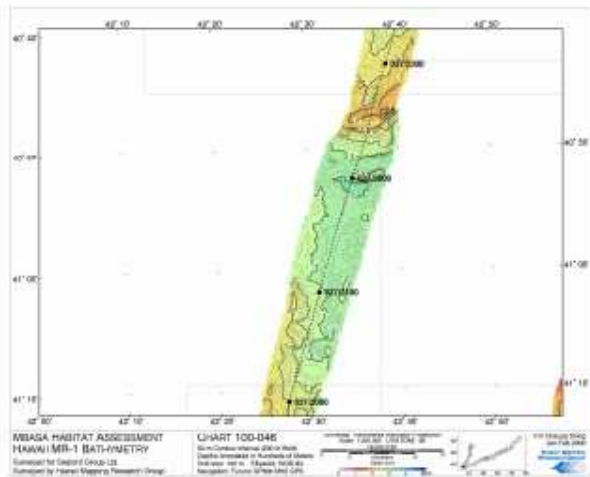
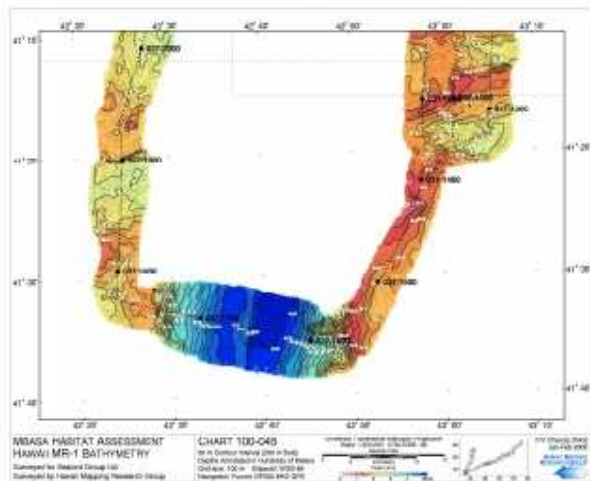
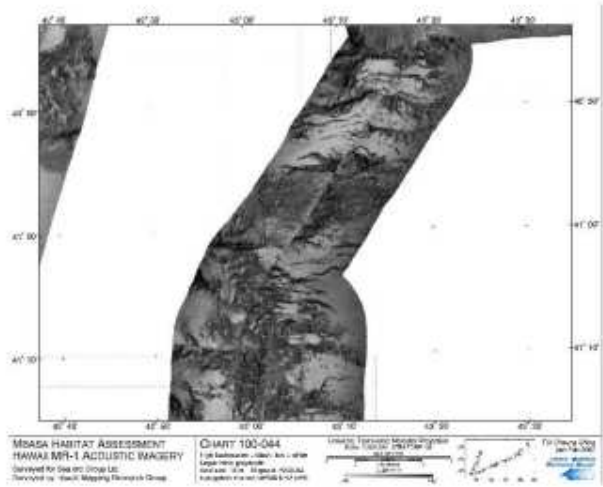
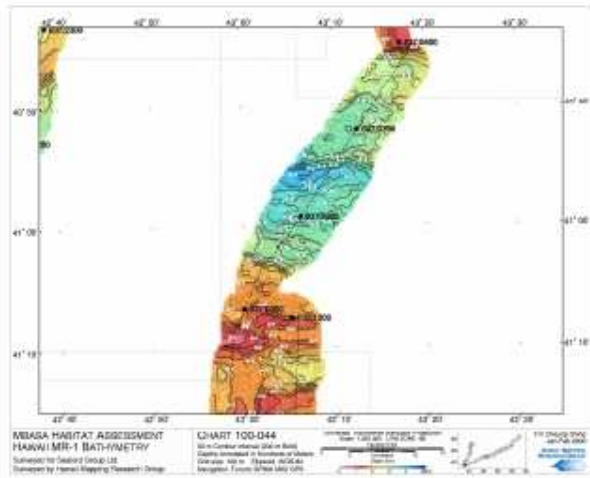


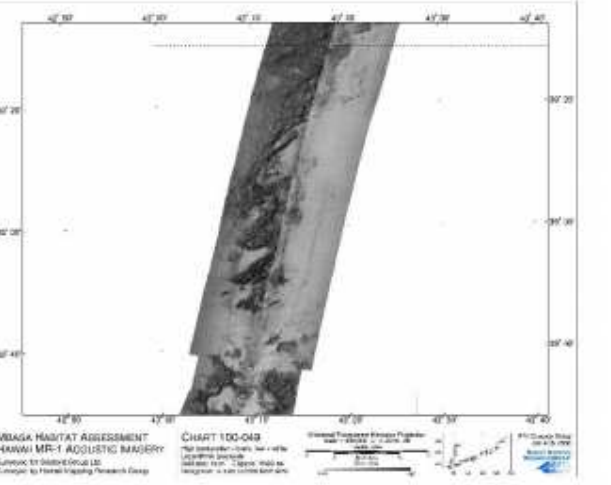
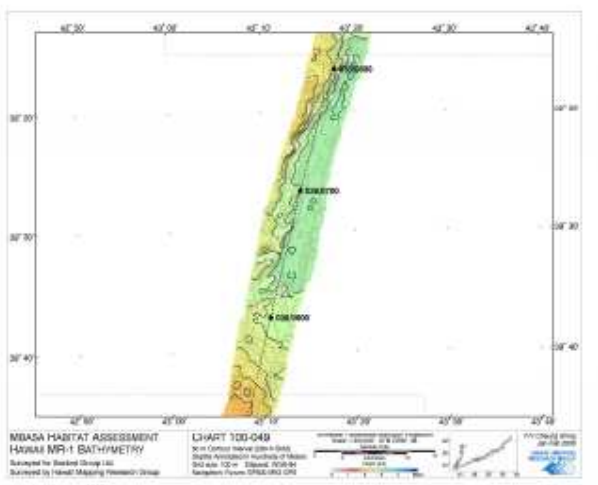
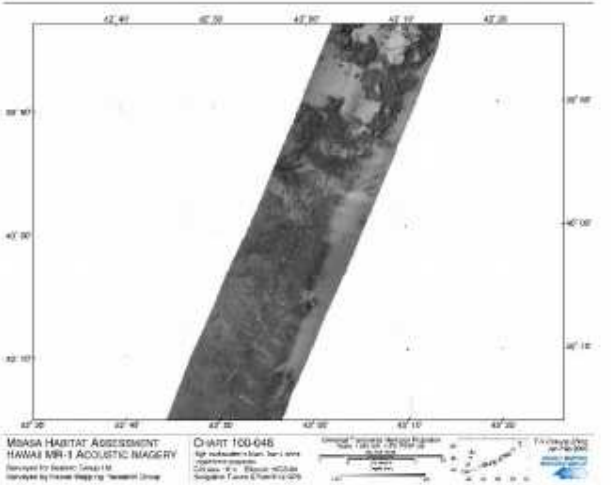
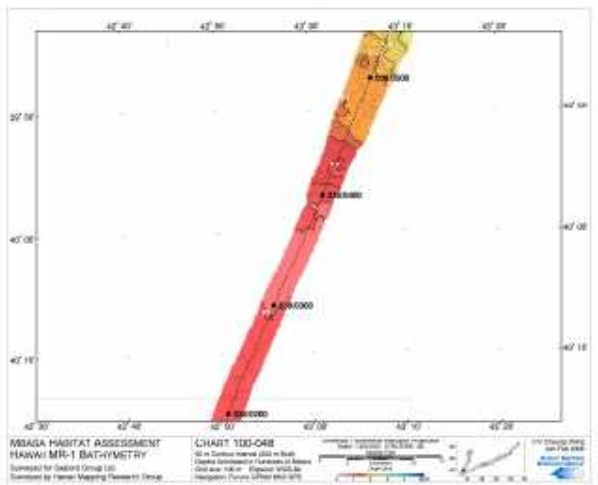
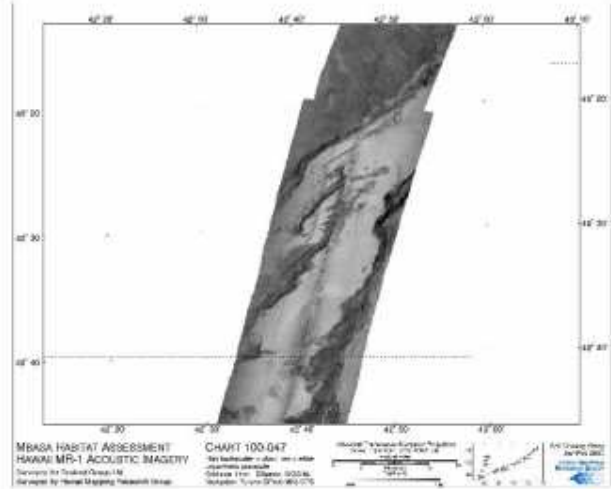
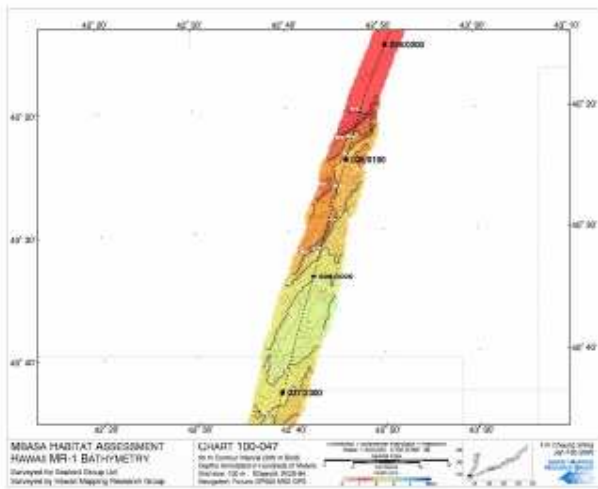


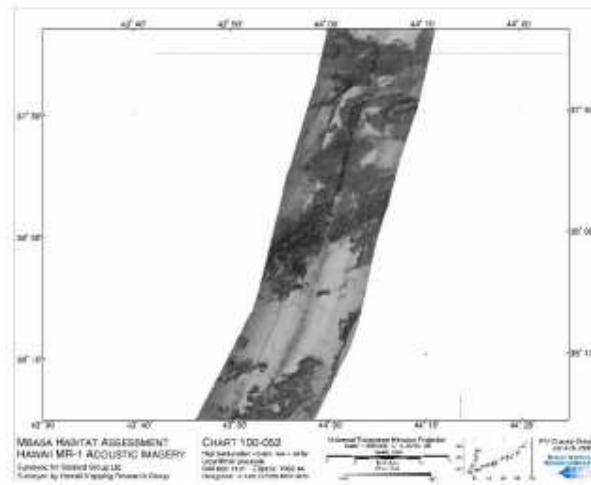
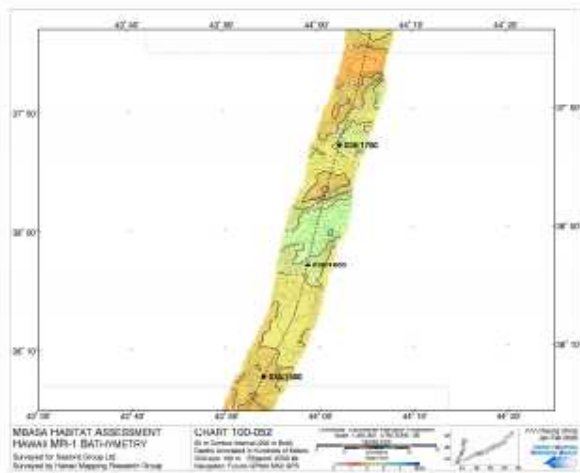
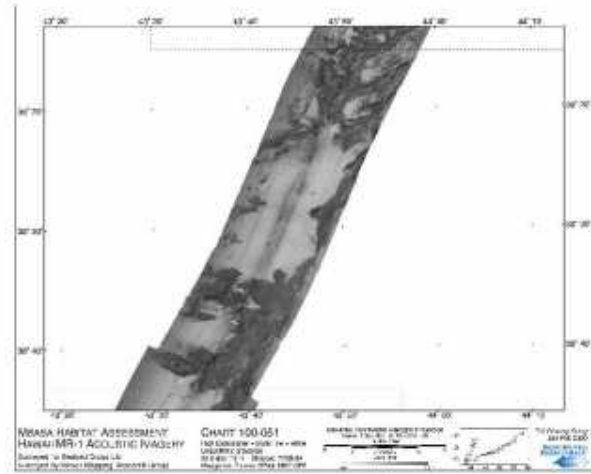
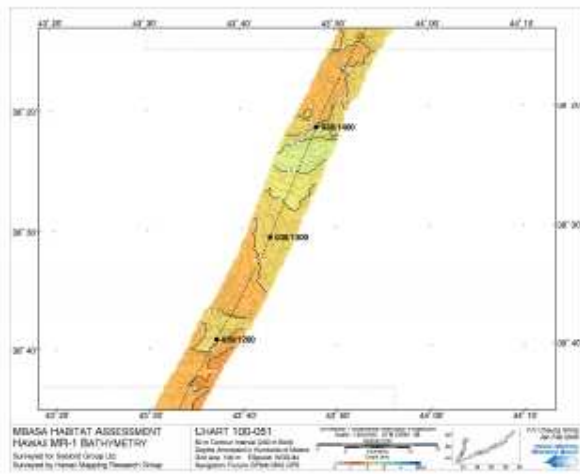
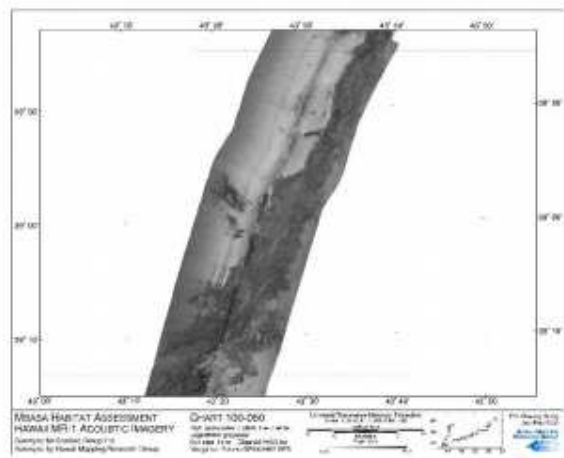
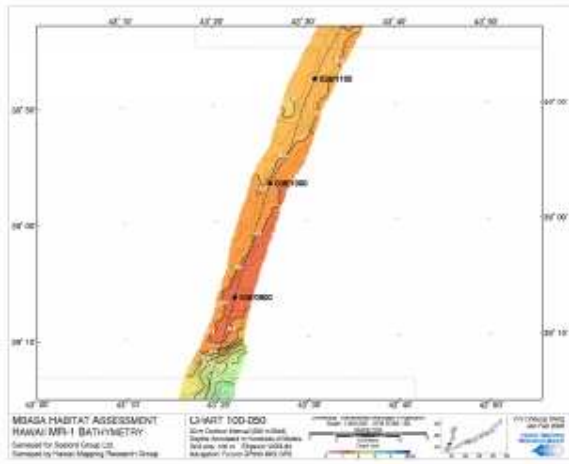


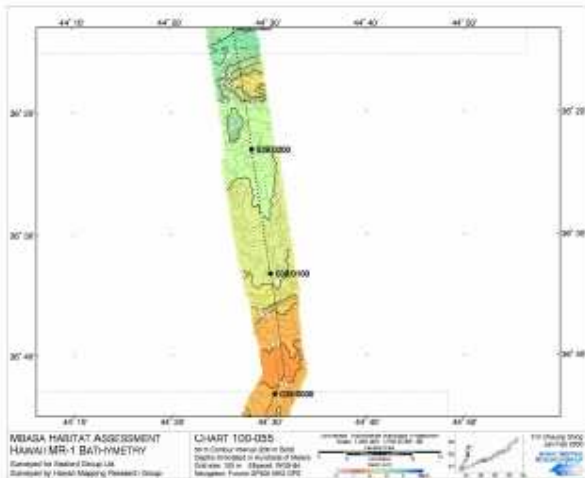
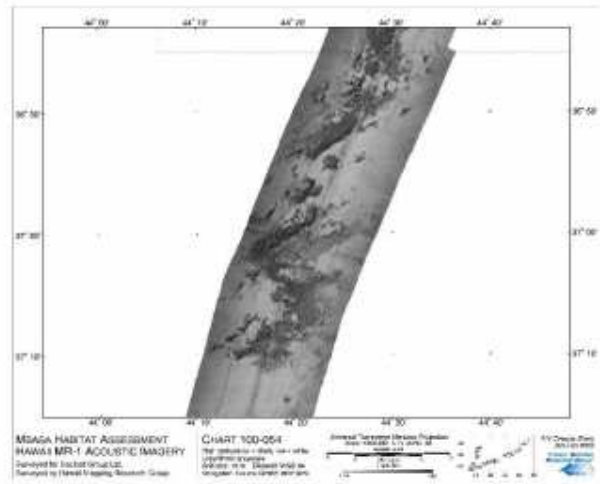
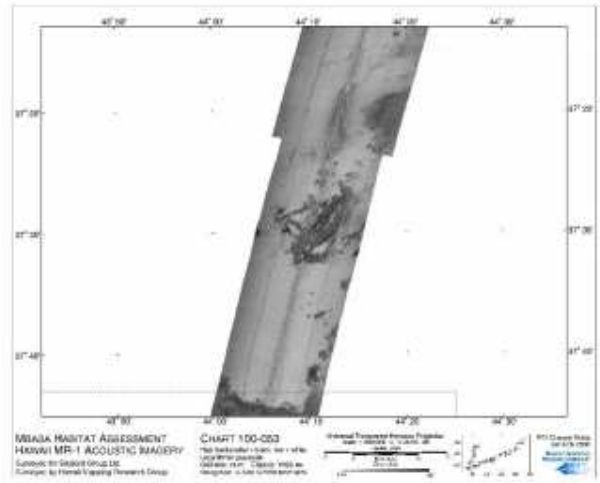
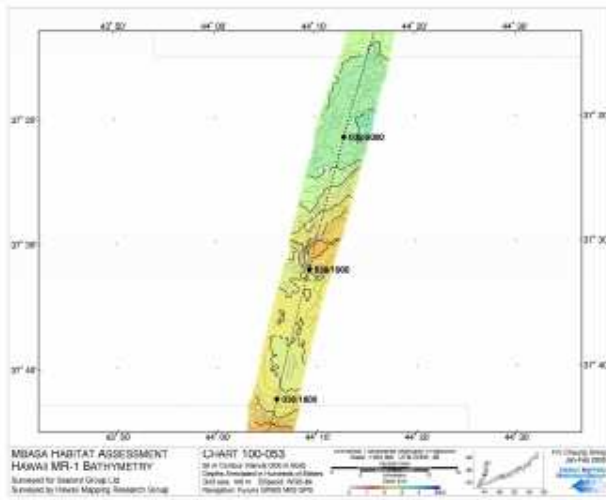


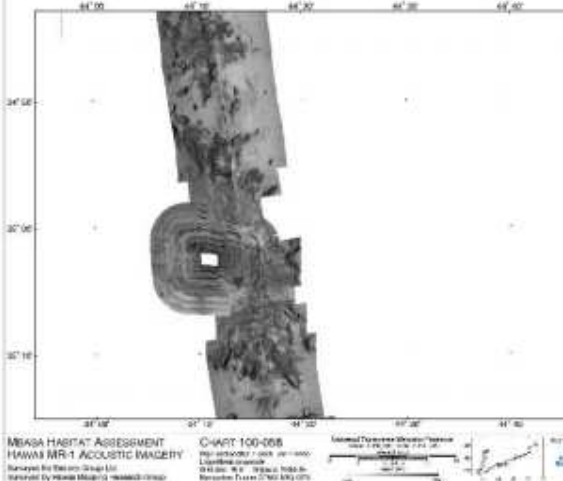
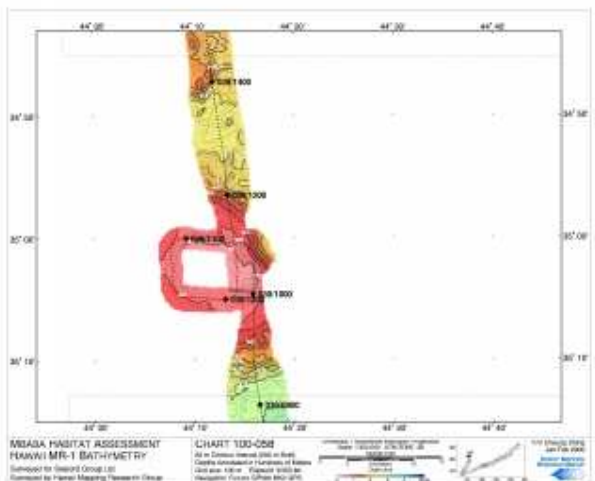
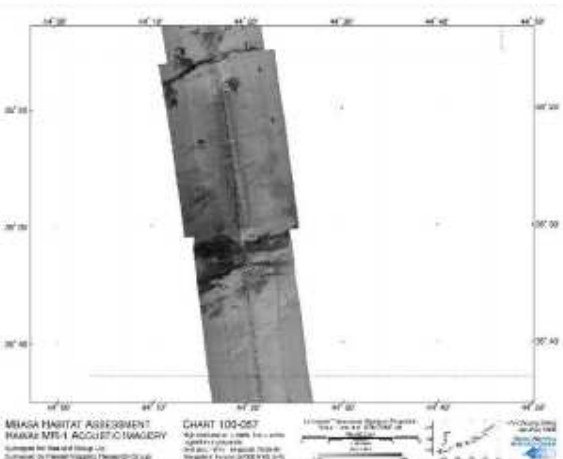
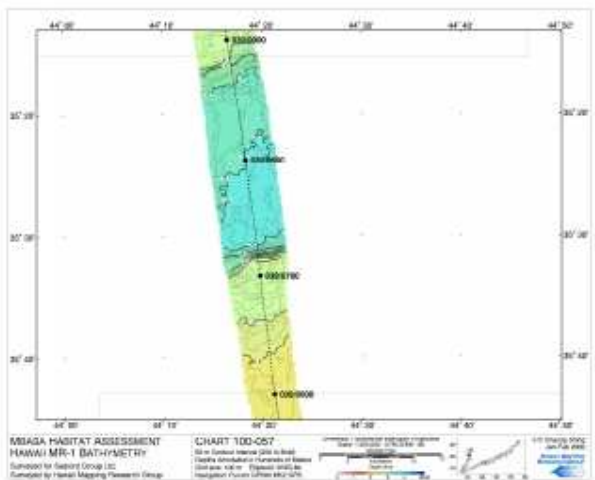
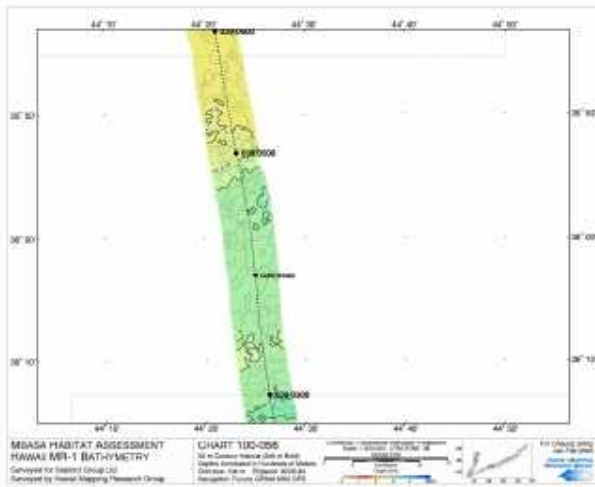


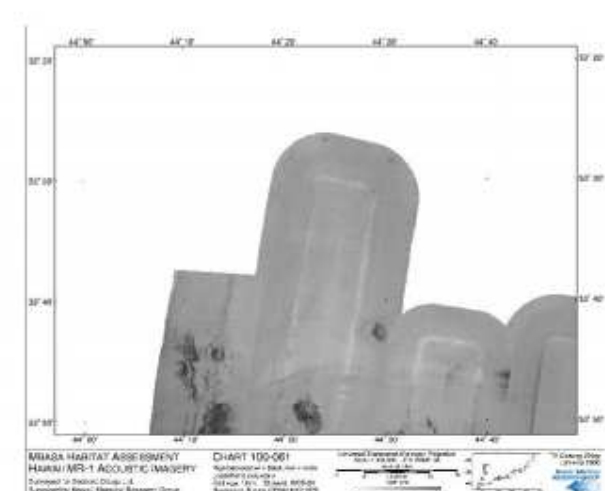
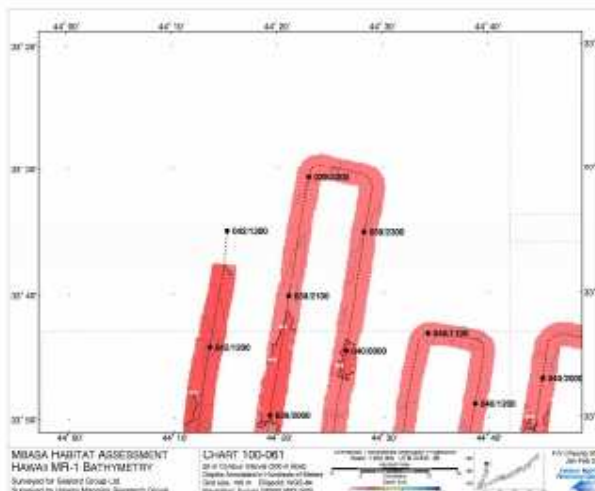
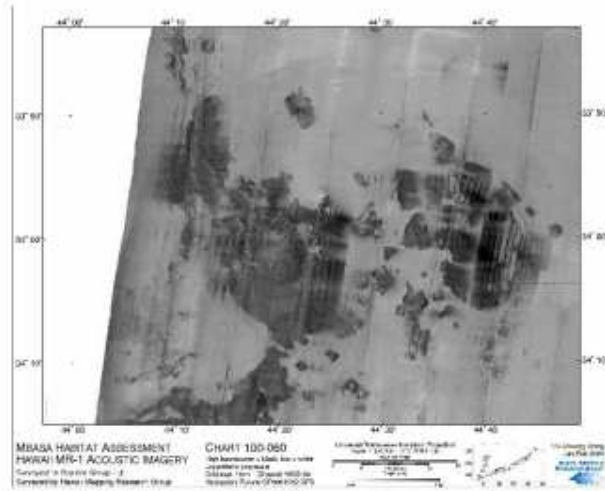
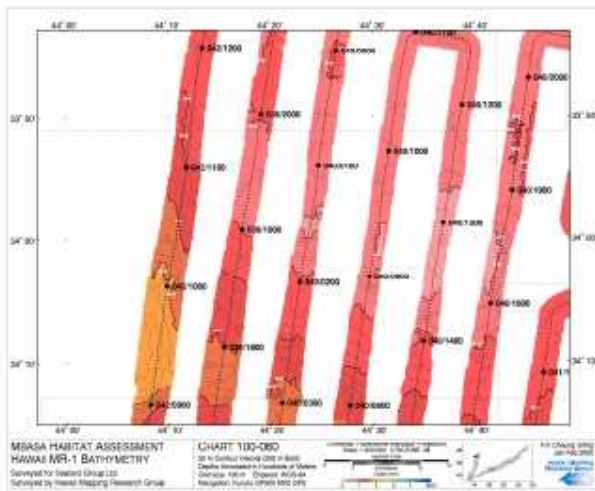
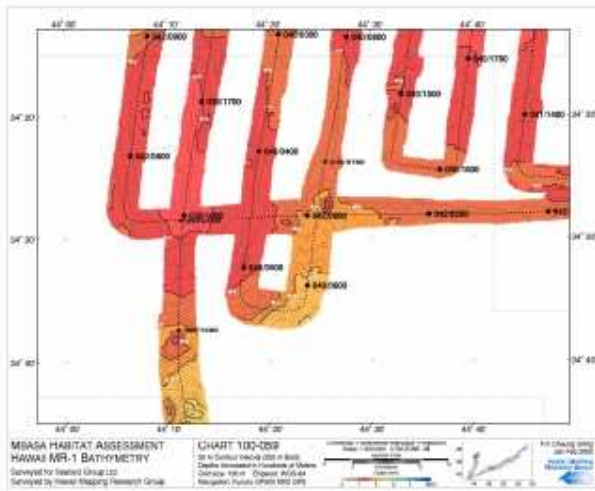


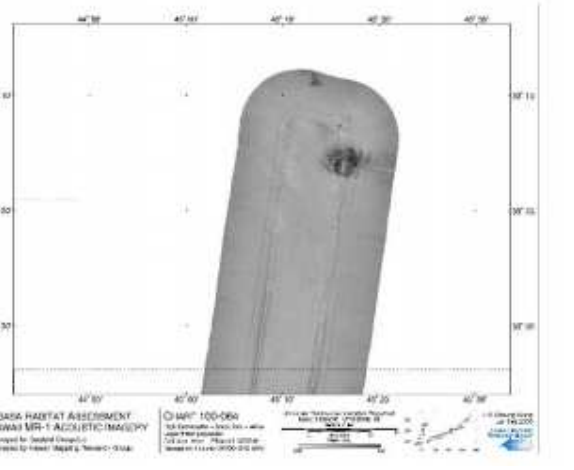
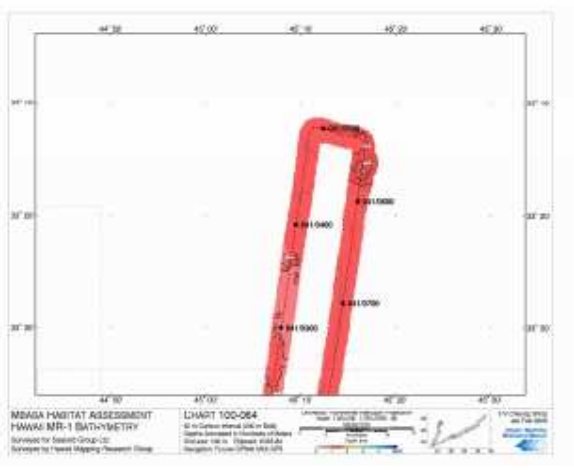
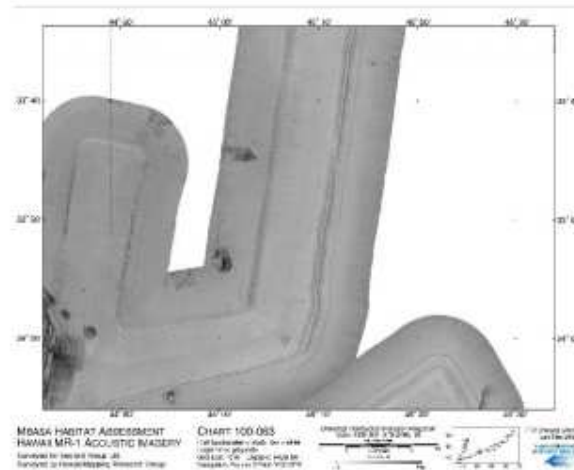
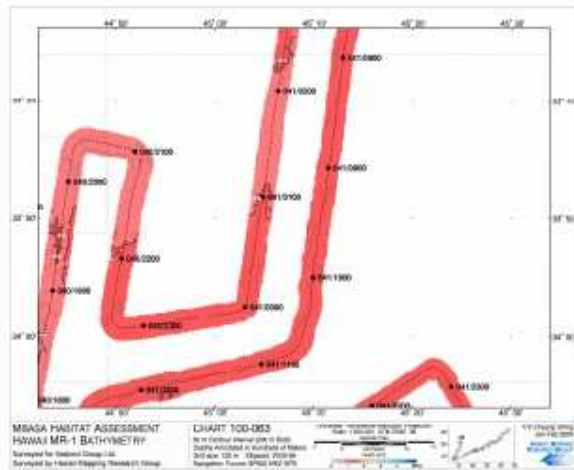
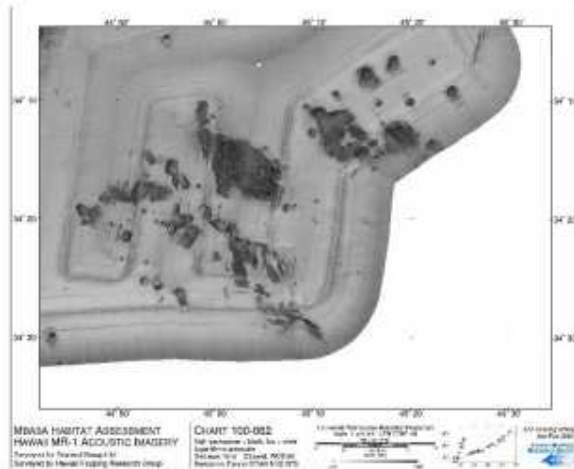
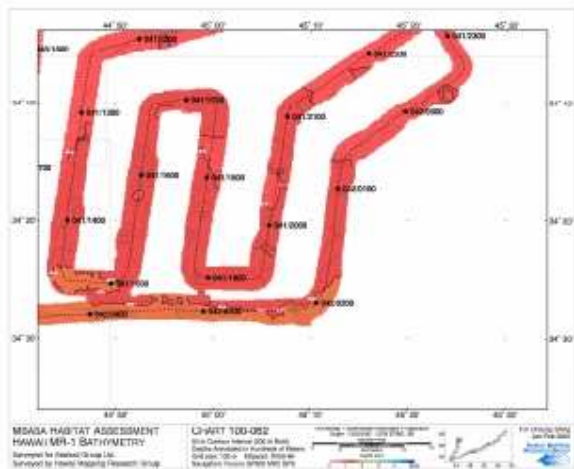












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