



Reaching further

# THE USE OF MULTIPLE AUV'S FOR EFFICIENT SEABED MAPPING

31<sup>st</sup> January 2019

PUBLIC

# AGENDA

- Introduction to Swire Seabed and the concept
- Why AUV's and why multiple AUV's
- Concept setup
- Challenges
- Project experience – The search for MH370

# SWIRE SEABED

- Seabed AS founded in 2008 and acquired by Swire Pacific Offshore in 2012
- Headquartered in Bergen, operating globally
- Maintains and operates two multi-purpose support vessels and two light construction vessels
- Owns a fleet of 11 ROVs; maximum depth rating 6000 meters
- One Hugin AUV on order (delivery 2020)
- Over 300 employees
  - 60 Shore based (Bergen & Singapore)
  - 75 Offshore Project Personnel
  - 168 Marine Crew

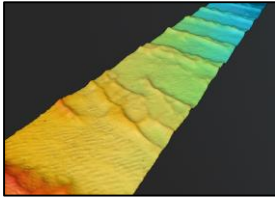
# SWIRE SEABED PROJECT SERVICES

A proven portfolio of **integrated** subsea project services

Deep Water Salvage



Survey and Mapping



Inspection  
Maintenance &  
Repair



Light Construction  
Support



Subsea Excavating  
& Dredging



Decommissioning



Customers



# SWIRE SEABED & OCEAN INFINITY

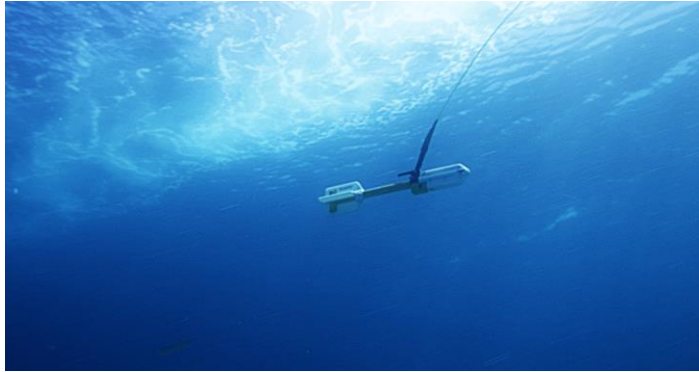
Swire Seabed and Ocean infinity proving and providing a comprehensive seabed exploration system for water depth down to 6000 meter consisting of up to 8 AUV's and up to 8 USV's from one host vessel.

Ocean Infinity contracted Swire Seabed as a technical partner and this initiated the start of the concept Multiple AUV Seabed Mapping.



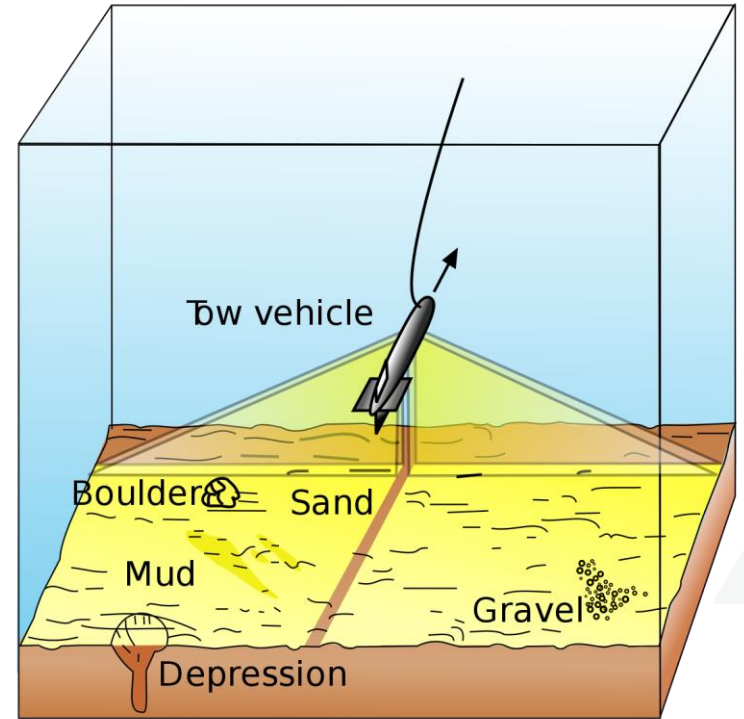
# WHY USE MULTIPLE AUVS

## Towed Sensor Surveys



## Deep Water Surveys

Increase Depth = Decrease in Survey Speed  
Decreased Positional Accuracy



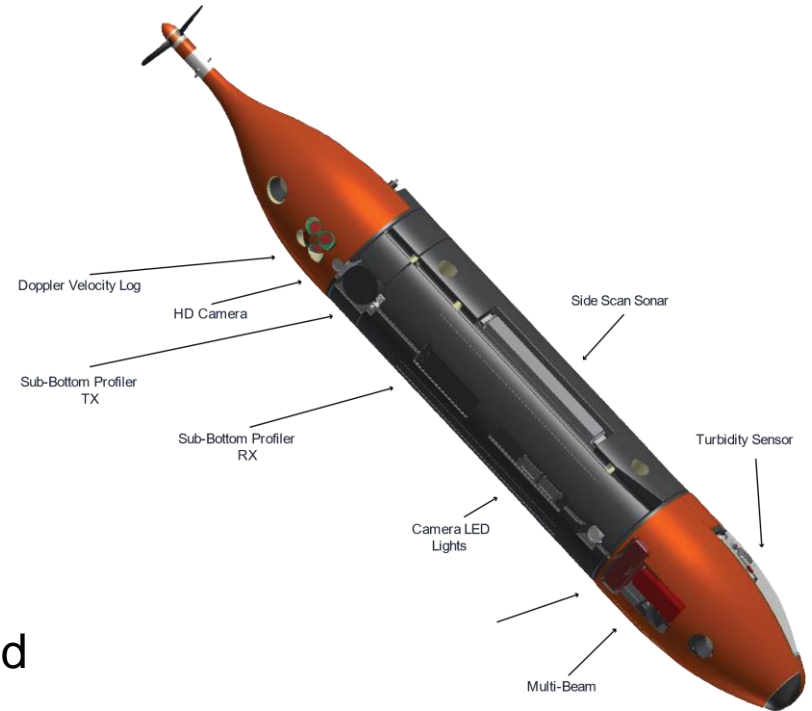
# WHY USE MULTIPLE AUVS

## AUV Surveys



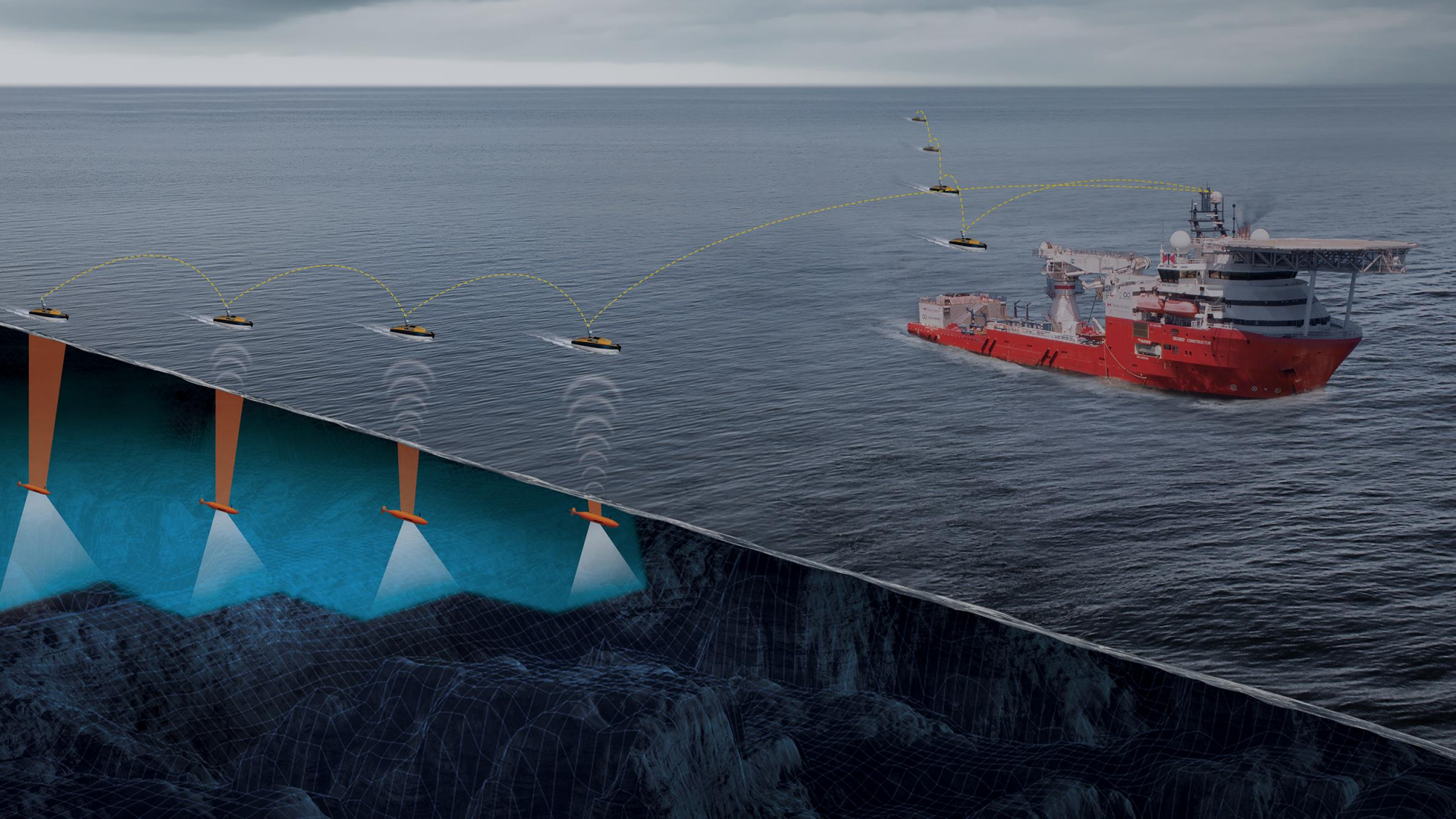
### Deep Water Surveys

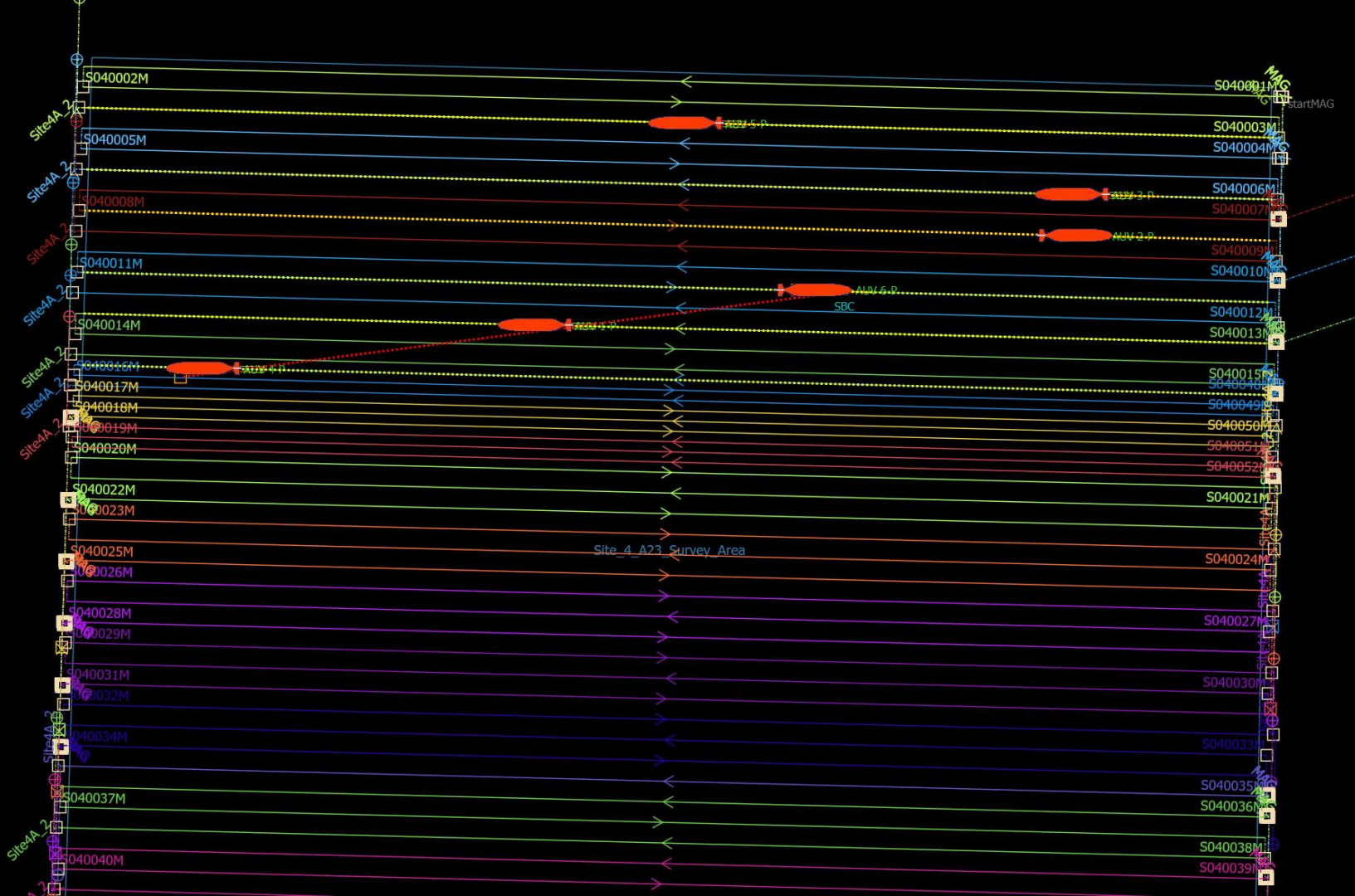
Increase Depth = Maintain Survey Speed  
Maintain positional Accuracy





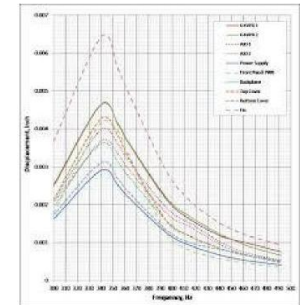
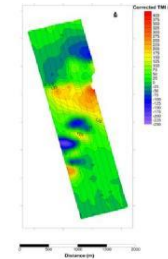
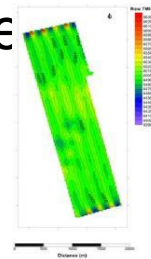
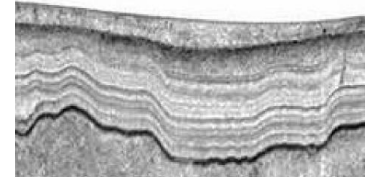






# SENSORS

- EM2040 Multi-Beam Echosounder
- Edgetech Sidescan Sonar
- Edgetech Sub-bottom profiler
- Cathx Color Camera
- SAIV Conductivity/ Temperature/ Depth
- OFG Self Compensating Magnetometer



# UNMANNED SURFACE VESSELS



## Telemetry

Radio Mesh

Acoustic HiPAP 502

## Collision Avoidance

Radar

AIS

Warning / Stop Systems

Daylight Camera

Thermal Camera

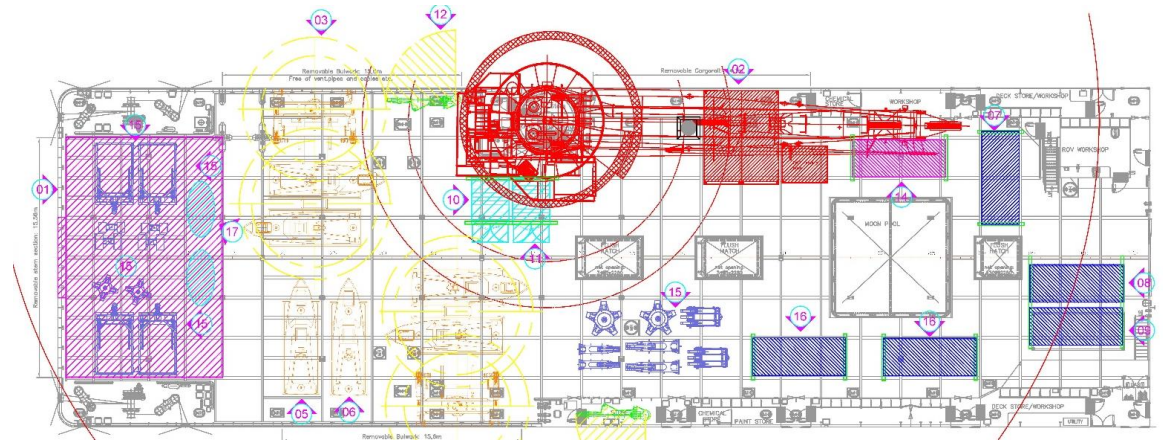
# TRADITIONAL SETUP FOR THE AUVS





Traditional container deck layout

Custom hangar solution





SWIRE SEABED  
OCEAN INFINITY





OCEAN INFINITY

KONGSBERG

OCEAN INFINITY

# HANGAR INSTALLATION



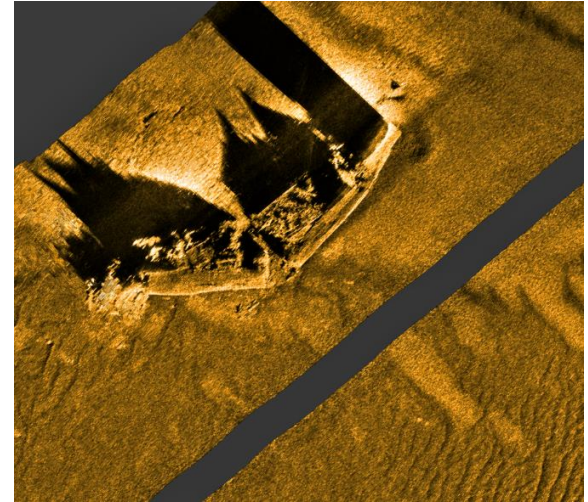
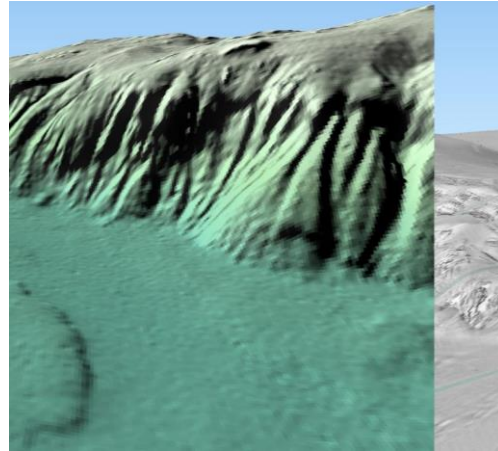
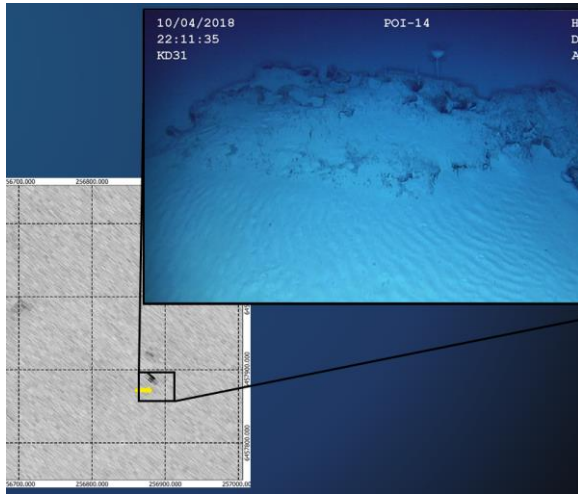


# CONTROL ROOM



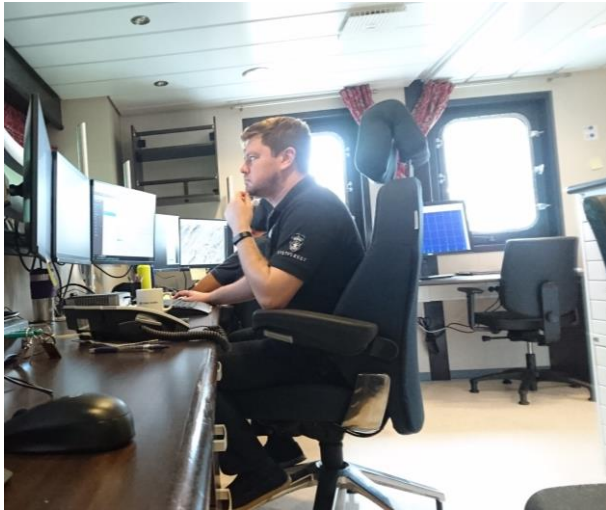
# BIG DATA

- Terabytes of seabed data and images have been collected and processed within a 24 hour period



# AUTOMATED DATA PROCESSING

- X8 AUVs – not X8 Data Processor Teams



**iXblue**

**CATHX**  
OCEAN

**EIVA**  
MARINE SURVEY SOLUTIONS

 **esri**

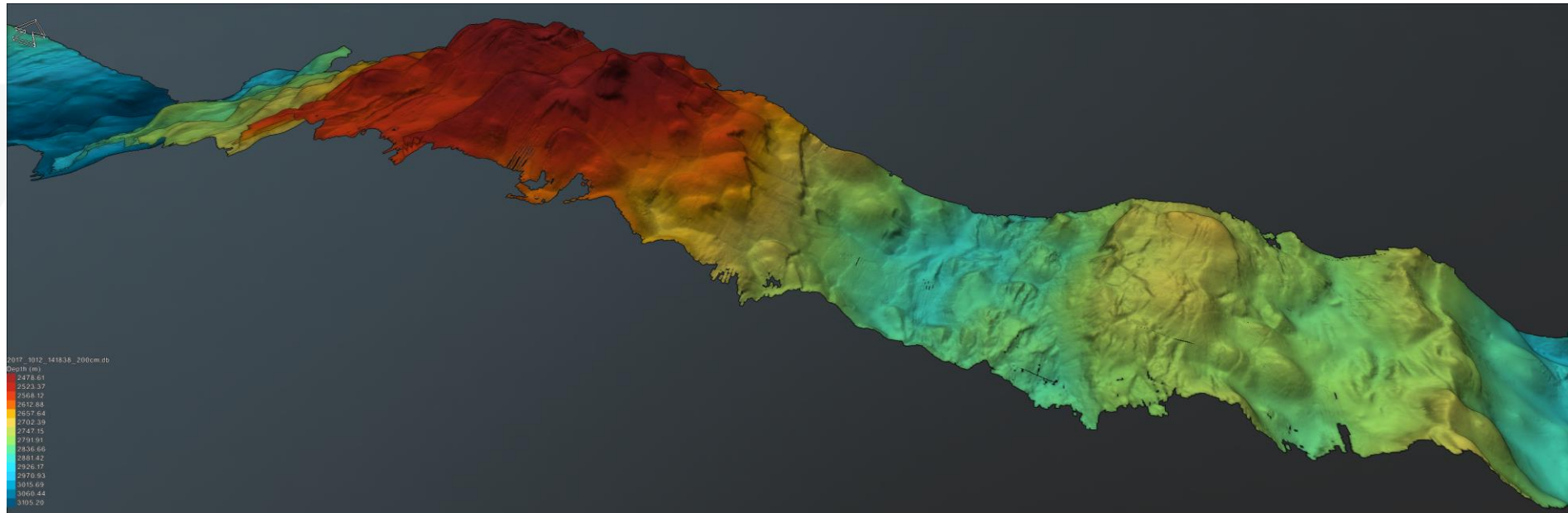
 **GEO DATA**

# AUTOMATED DATA PROCESSING

The screenshot displays the Workflow Manager interface. On the left, a 'Data Tree' shows a workflow structure with 'Process \*All Files' selected. Below it, the 'Properties' panel shows details for the selected process, including 'Inherit Properties' and 'Local Properties'. The main area is a workflow execution table with columns for various processing steps and a list of files on the left.

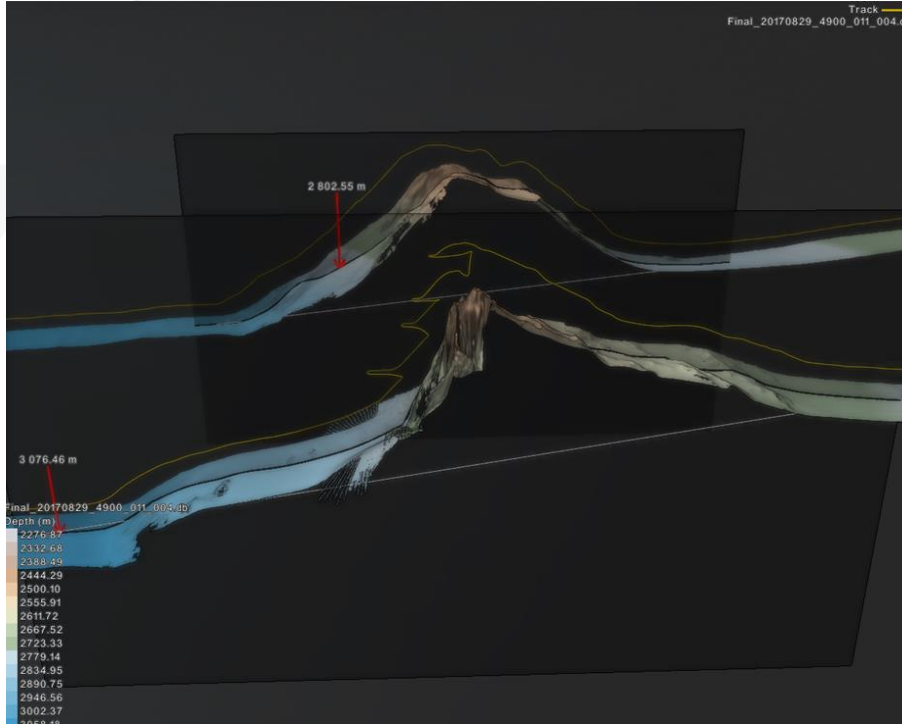
Name	All Import	Set Property	NavLab Pos - Alt	NavLab Pressure	Link Title	Link SVP	Link Pressure	Recalc Duty	Create CTM	Call Stats before Cleaning	Write before stats to file	Copy File	ScanScore	Call Stats after Cleaning	Write after stats to file	Whitback	Reject Fraction
em2040-0019-ofg1-20170301-093228.all	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
em2040-0020-ofg2-20170301-093441.all	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
em2040-0027-ofg3-20170118-095729.all	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
em2040-0028-ofg4-20170118-095943.all	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
em2040-0050-cam3-20170118-104749.all	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
em2040-0051-cam4-20170118-104922.all	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
em2040-0052-cam5-20170118-105003.all	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
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em2040-0056-cam9-20170118-105623.all	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
em2040-0057-cam10-20170118-105738.all	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
em2040-0058-cam11-20170118-105828.all	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
em2040-0059-cam12-20170118-105911.all	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
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em2040-0067-cam20-20170118-110840.all	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

# AUTOMATED DATA PROCESSING





# AUTONOMOUS MODE



# WORKCLASS ROVS

- Schilling HD
  - Heavy Duty Work Class
  - 150 shaft horse power (shp)
  - 5000 meter depth rating
  - Schilling TITAL 4 and Atlas 7R manipulator
  - Payload 200 kg
  
- Kystdesign Supporter
  - Workclass deepwater ROV
  - 150 shaft horse power (shp)
  - 6000 meter depth rating
  - TITAN 4 Schilling Manipulator (7 function) & Rigmaster Schilling Manipulator (5 function)
  - Payload 200 kg



# PROJECT EXPERIENCE FROM THE SEARCH FOR MH370



PUBLIC


# THE SEARCH FOR MH370

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The search for MH370

## A fantastical ship has set out to seek Malaysian Airlines flight 370

*A swarm of submarine drones will scour the depths for the plane*

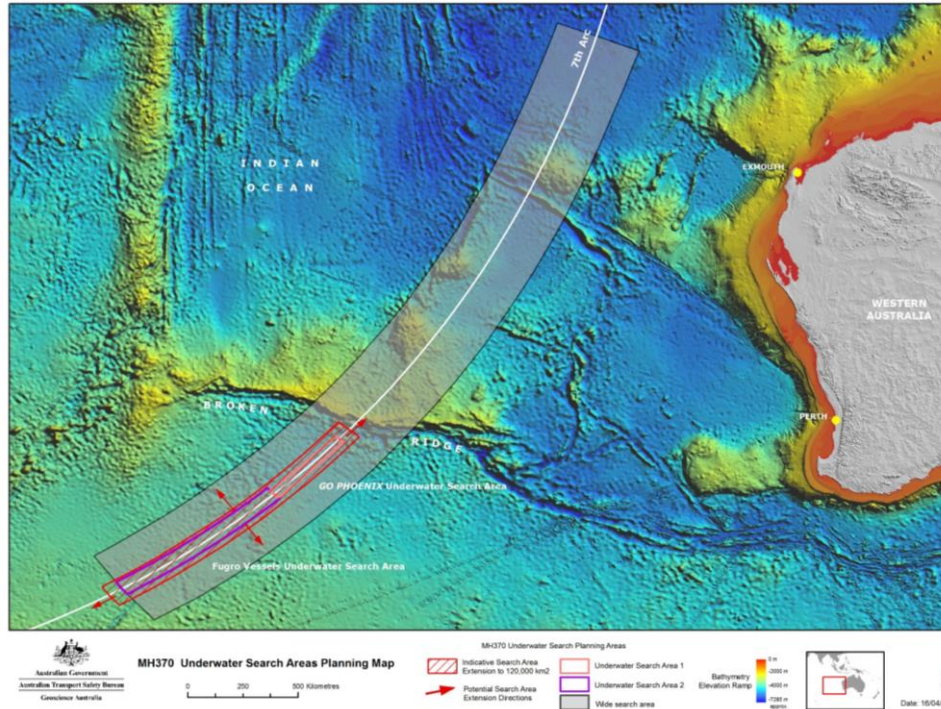


Swire Seabed

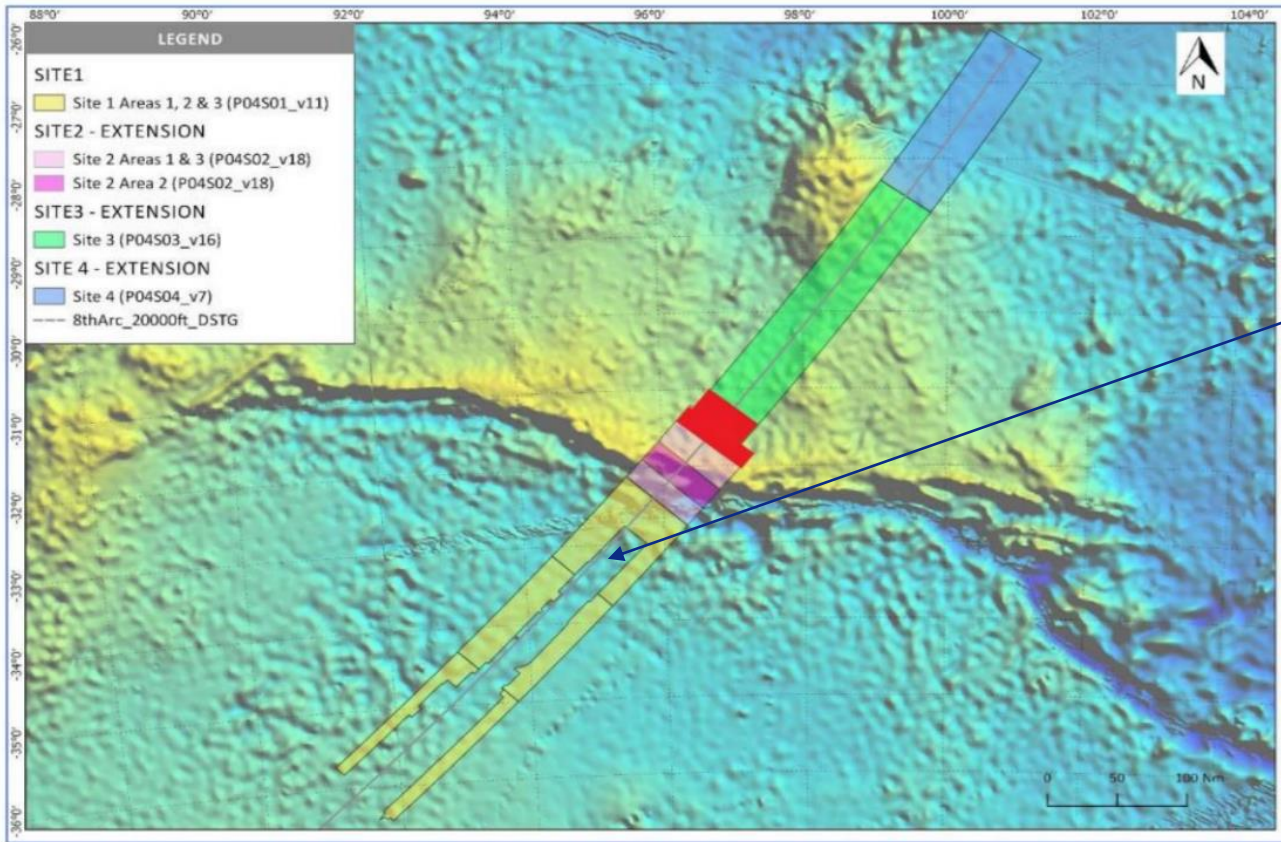
Print edition | Science and technology >  
Jan 2nd 2018 | DURBAN

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# THE SEARCH FOR MH370



<https://geoscience-au.maps.arcgis.com/apps/Cascade/index.html?appid=038a72439bfa4d28b3dde81cc6ff3214>



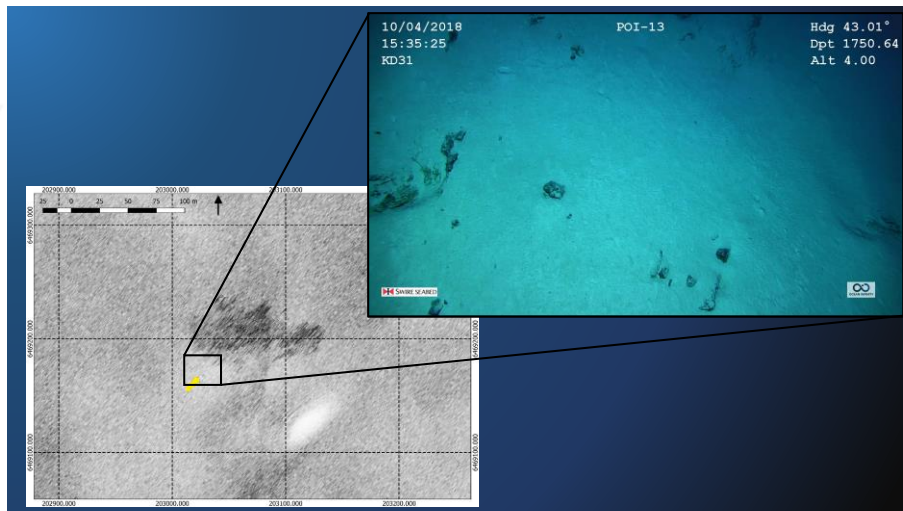
Original search area

# UNPRECEDENTED COVERAGE

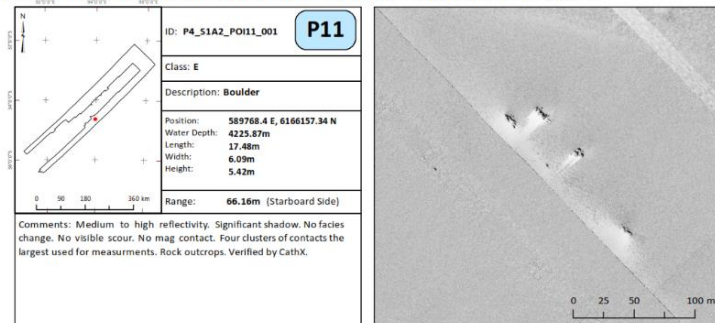
120 000 km<sup>2</sup> during a little over 4 months survey

- Initial agreed 25 000 km<sup>2</sup>
- 160 times the size of Singapore (697 km<sup>2</sup>)
- 2.6 times the size of Denmark (42 430 km<sup>2</sup>)
- Covered about 1200 km<sup>2</sup> / day with 7 AUVs running
- Deepest area was 5350 m
  
- All data was acquired in 138 operational days
- Over 115,000 man hours on site
- Zero LTI

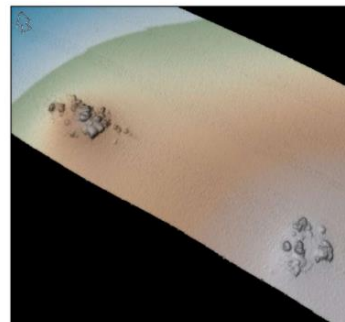
# EXAMPLE OF INVESTIGATION



## POST-INVESTIGATION AUV ID SHEET - PROJECT 4 SITE 1

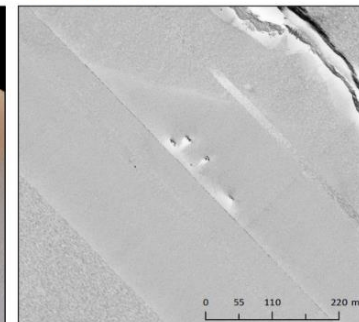


SSX (410 KHz) VIEW



MBES DTM 3D VIEW

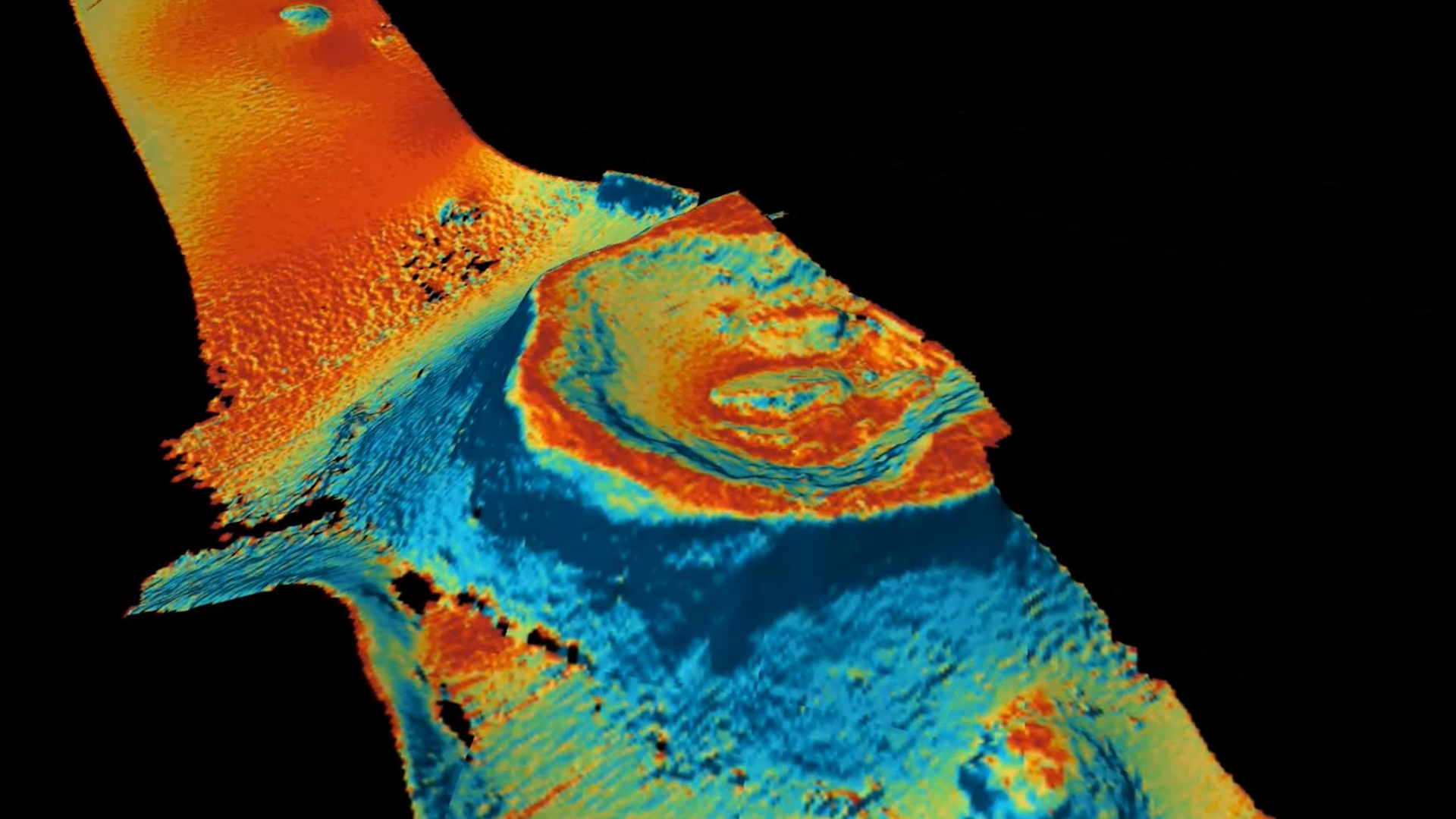
Drawn: offline07 Checked: B.Hayden / K.Ciembro  
Date: 18/03/2018 Size: A3



SSS AND MAGNETOMETER VIEW

Coordinate System: WGS 1984 UTM Zone 46S  
Projection: Transverse Mercator





Broken Ridge

0 5 km

