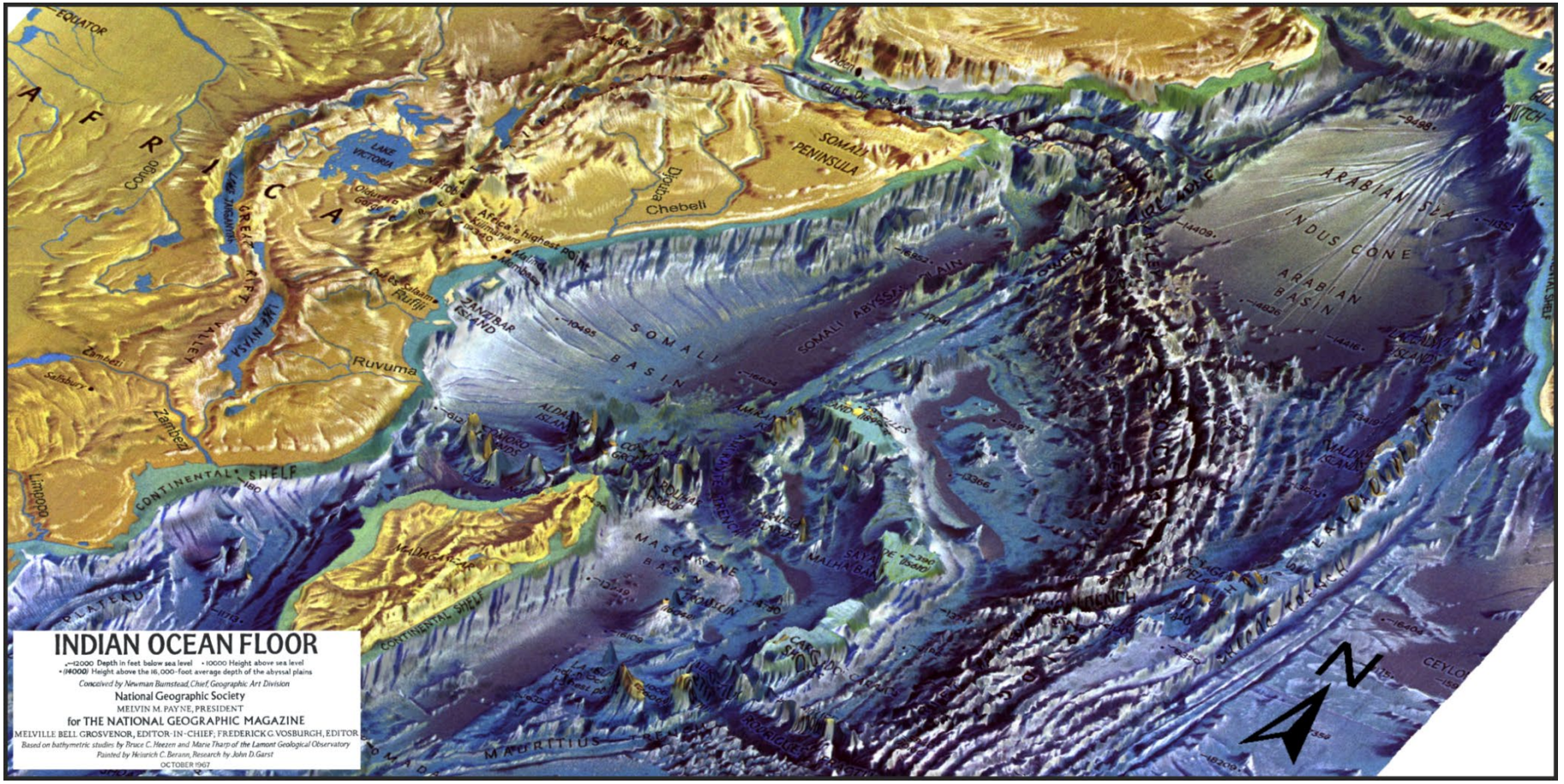
BATHYMETRIE DES FONDS OCEANIQUES



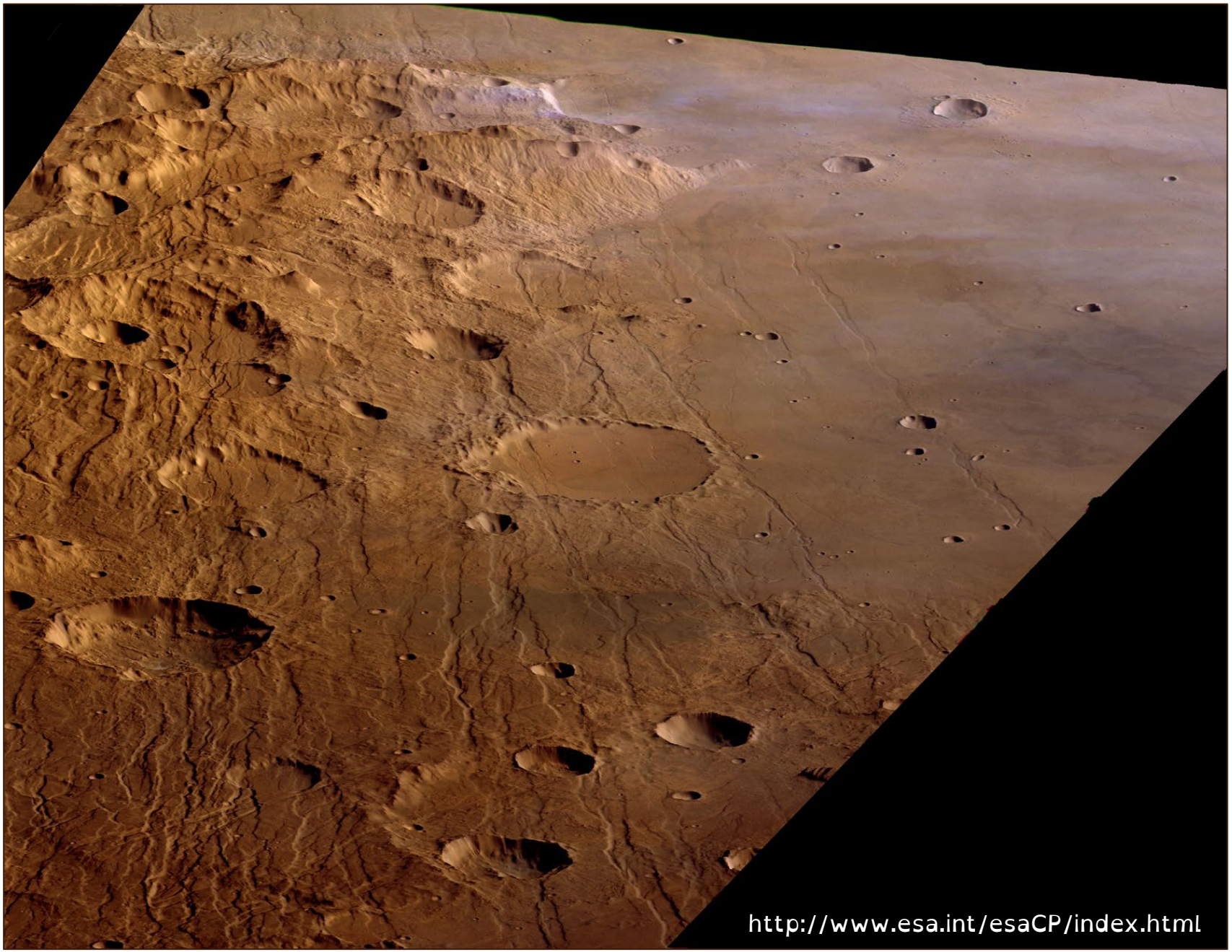
Sébastien Zaragosi

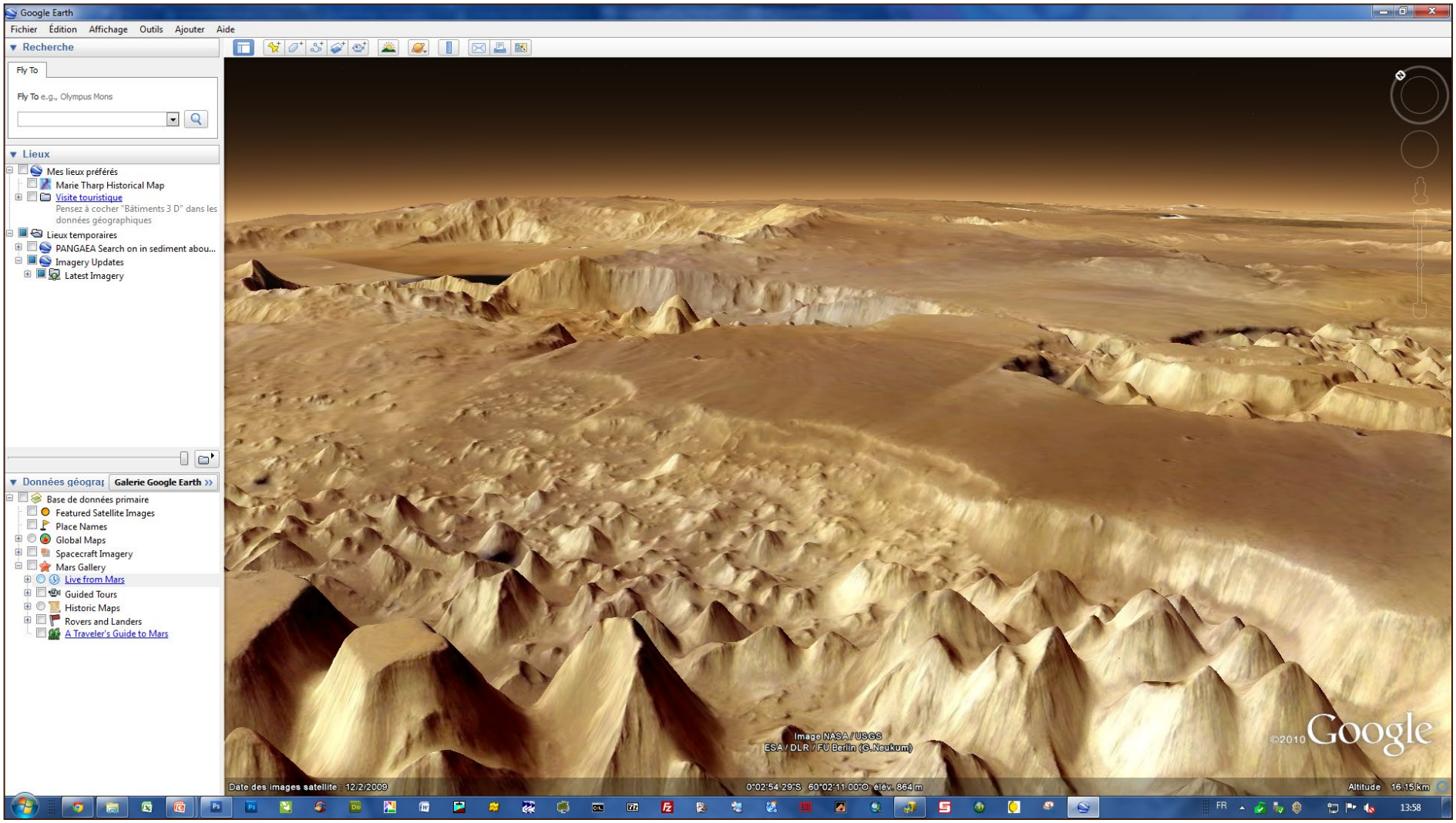
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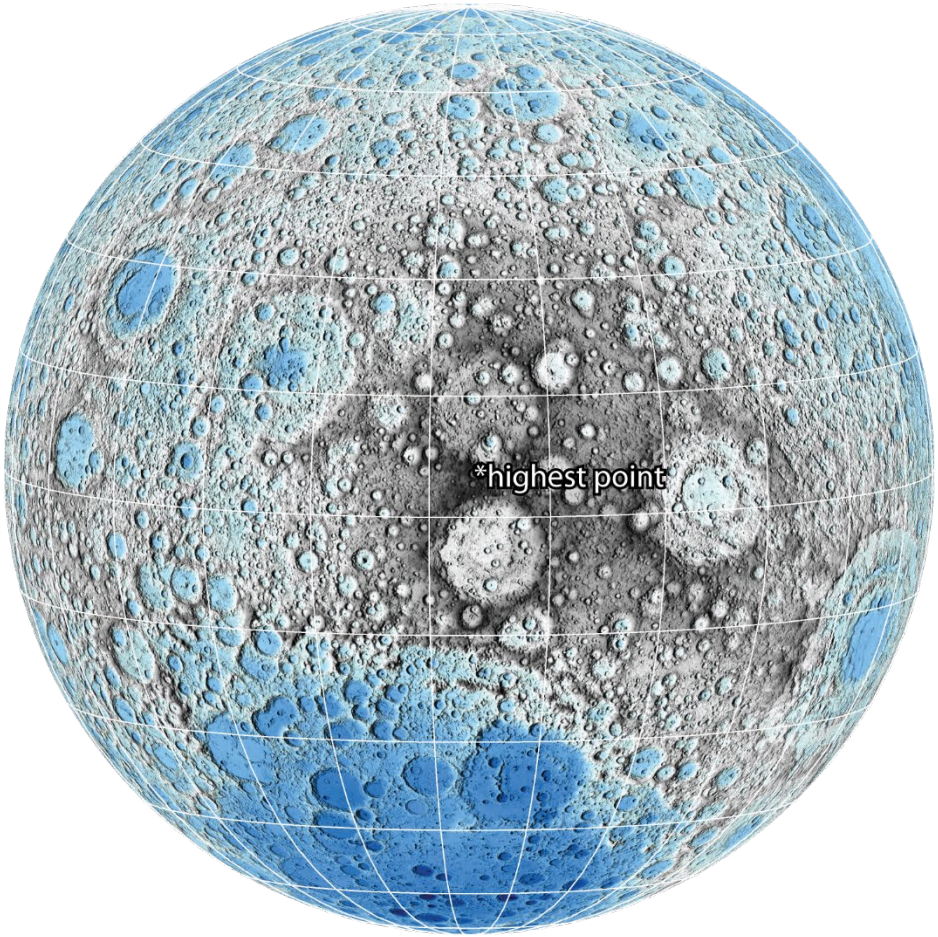
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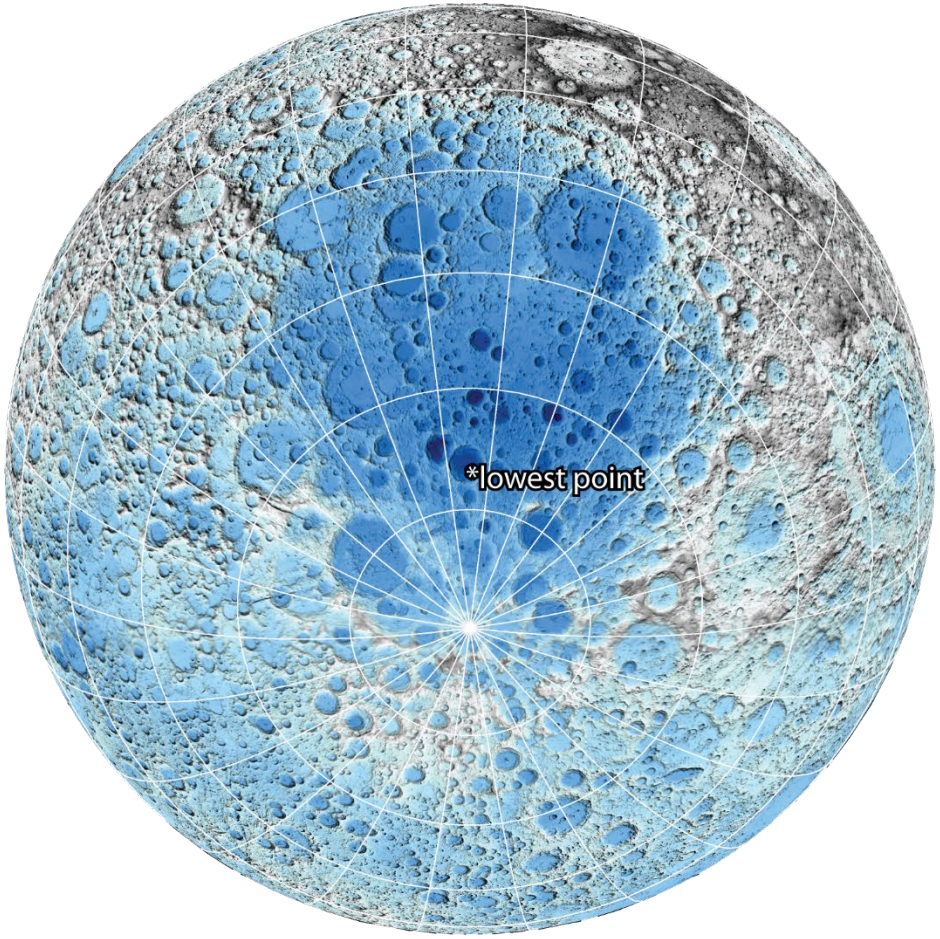
université de BORDEAUX



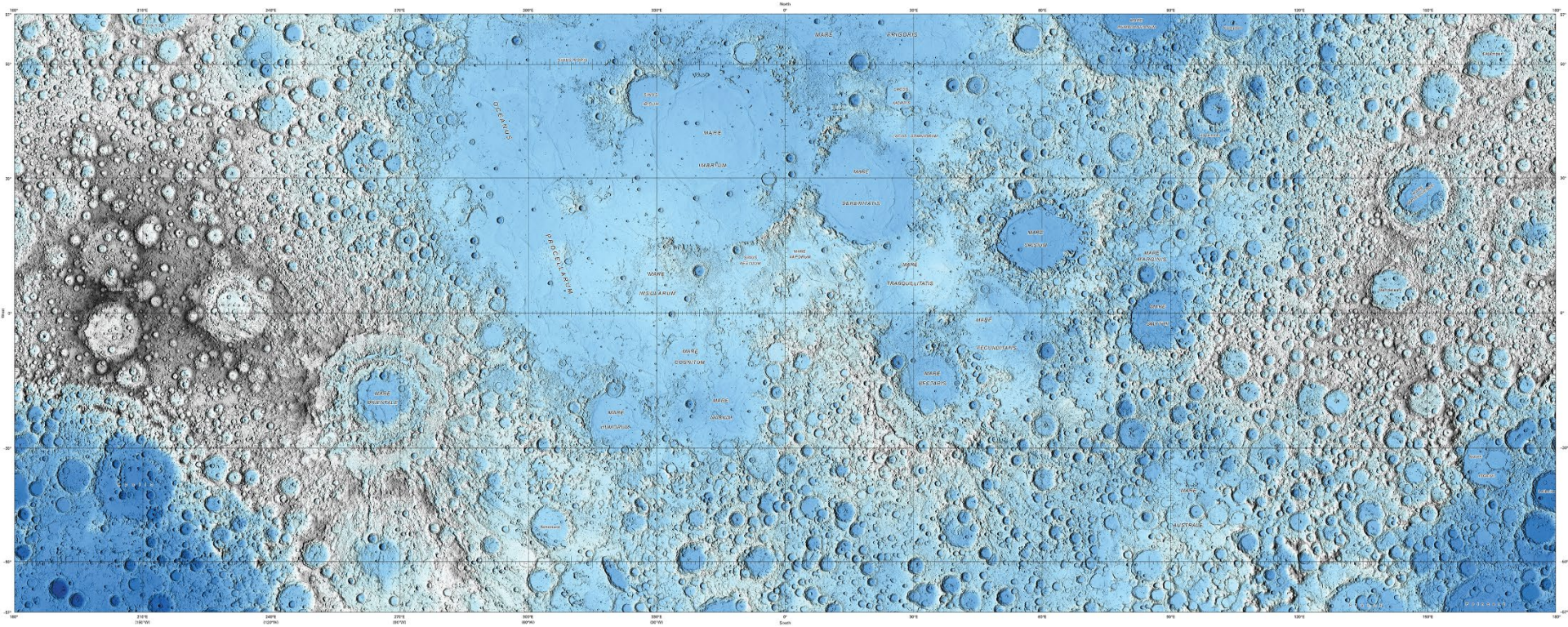

http://www.esa.int/esaCP/index.html


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ESA / DLR / FU Berlin (G.Neukum)
©2010 Google
Date des images satellite : 12/2/2009
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Altitude 16.15 km
FR
13:58

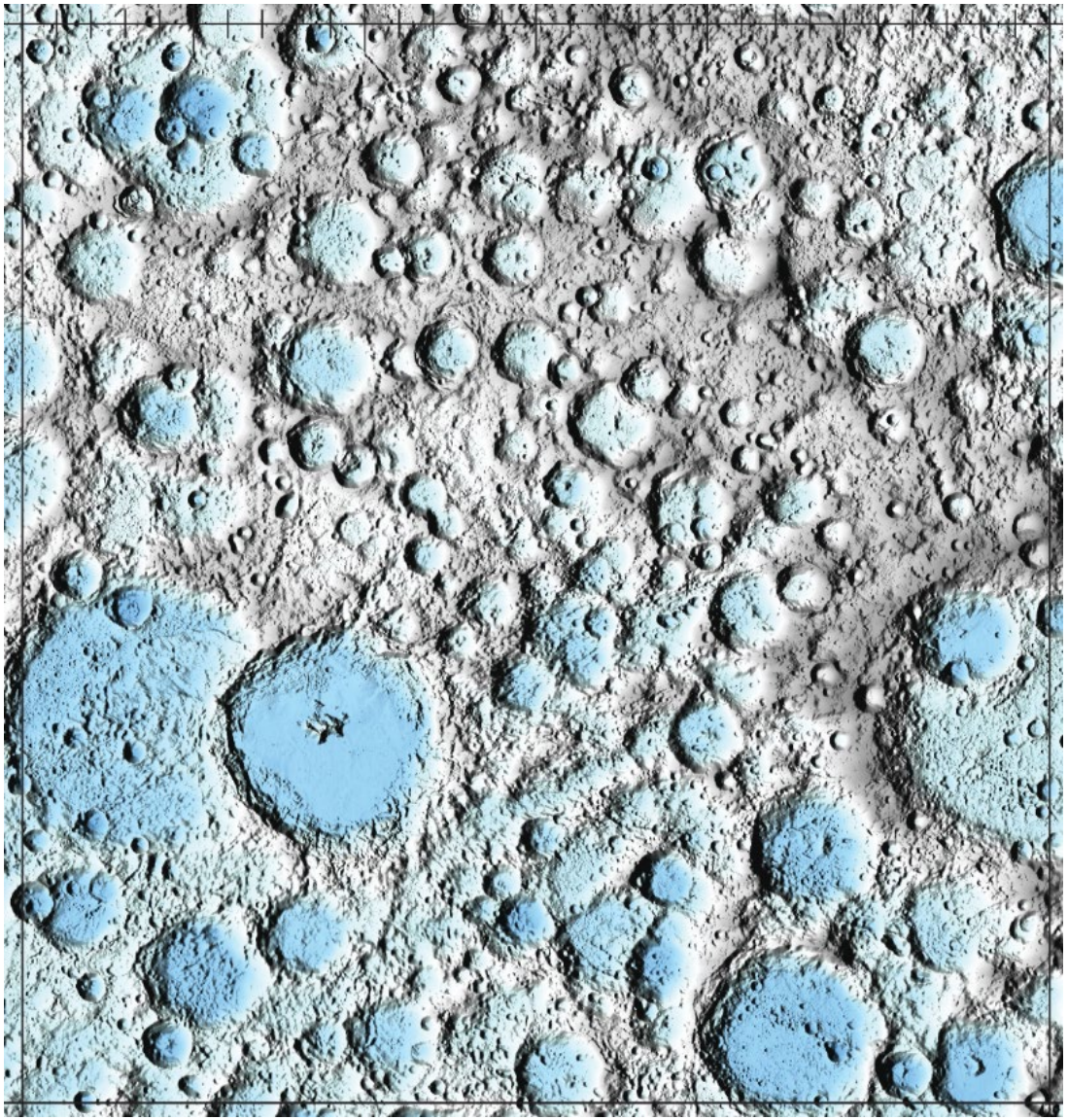




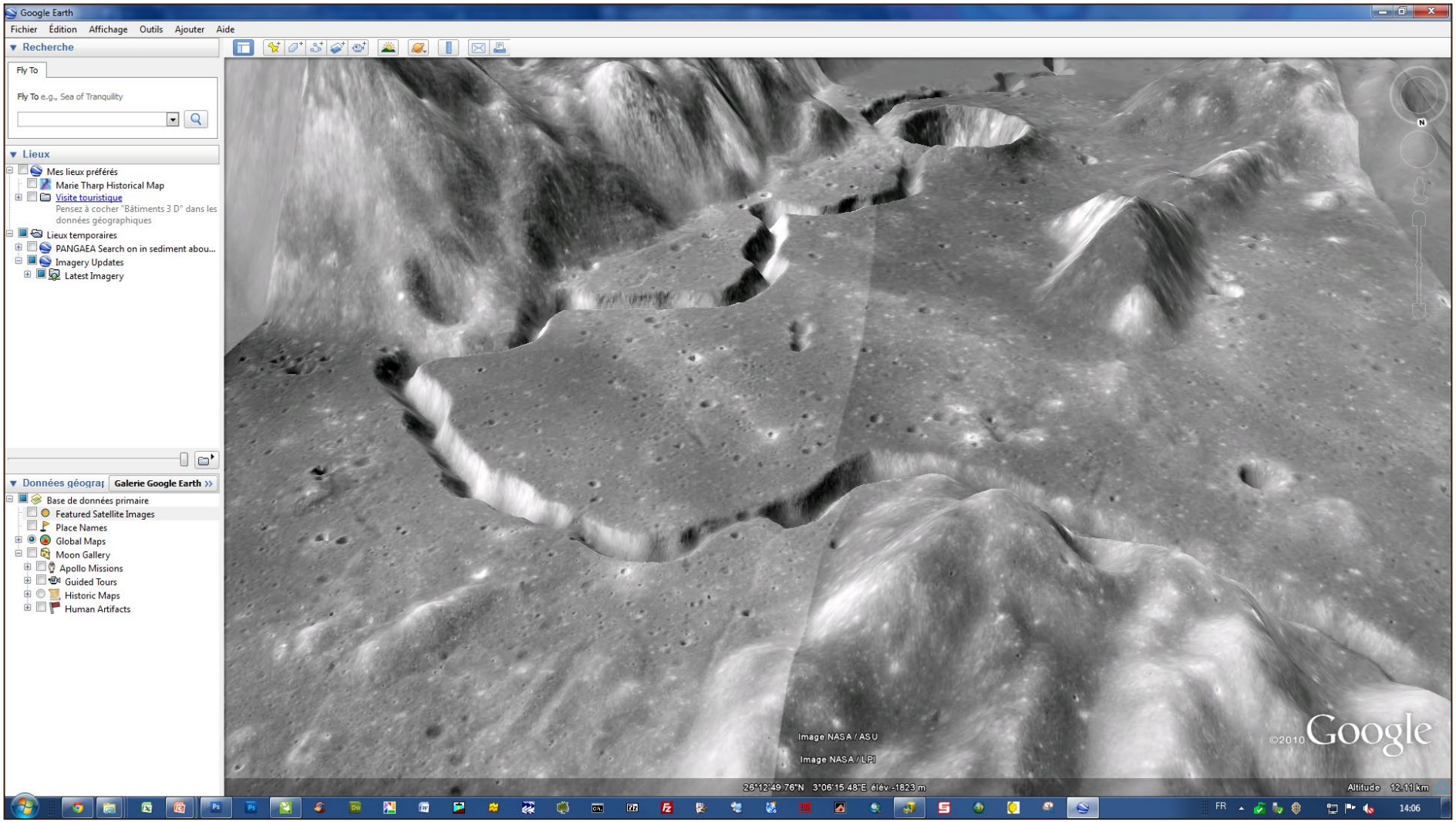
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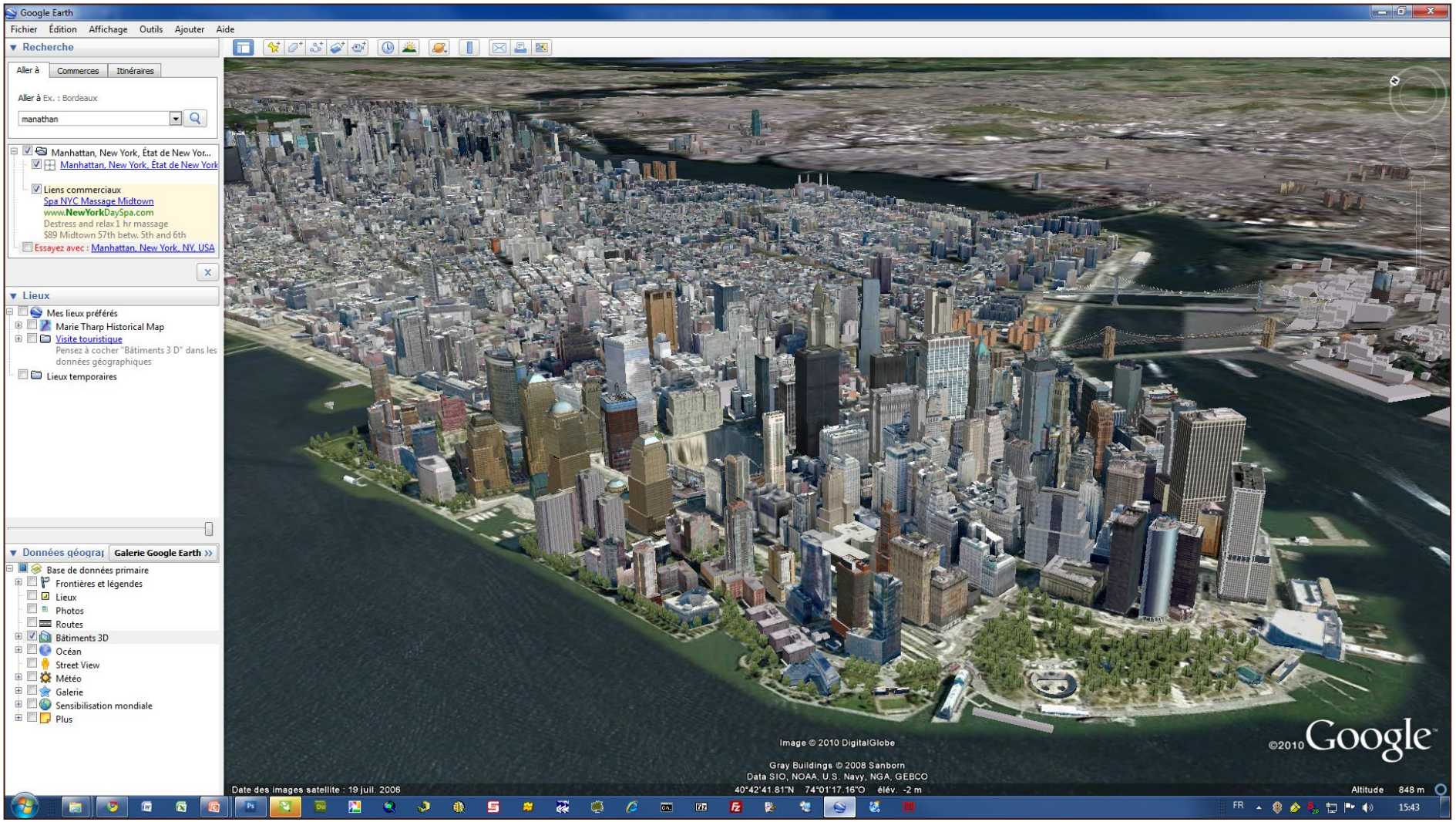


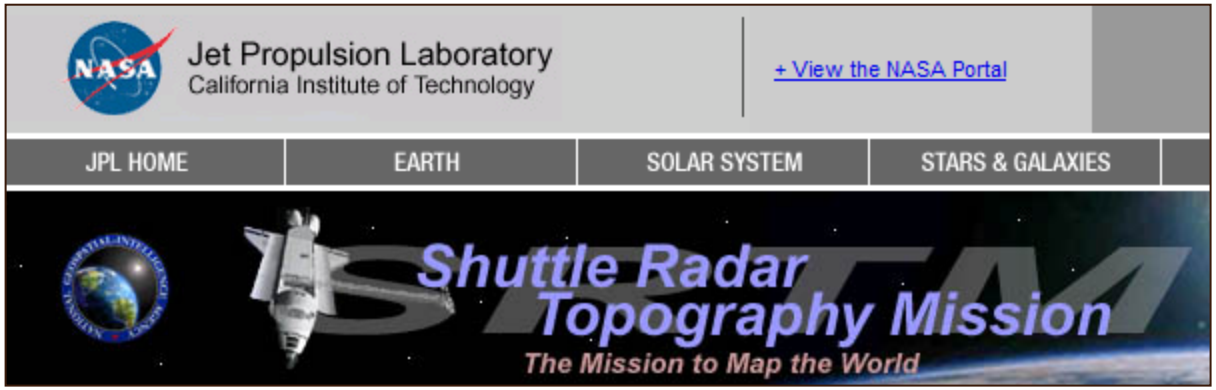
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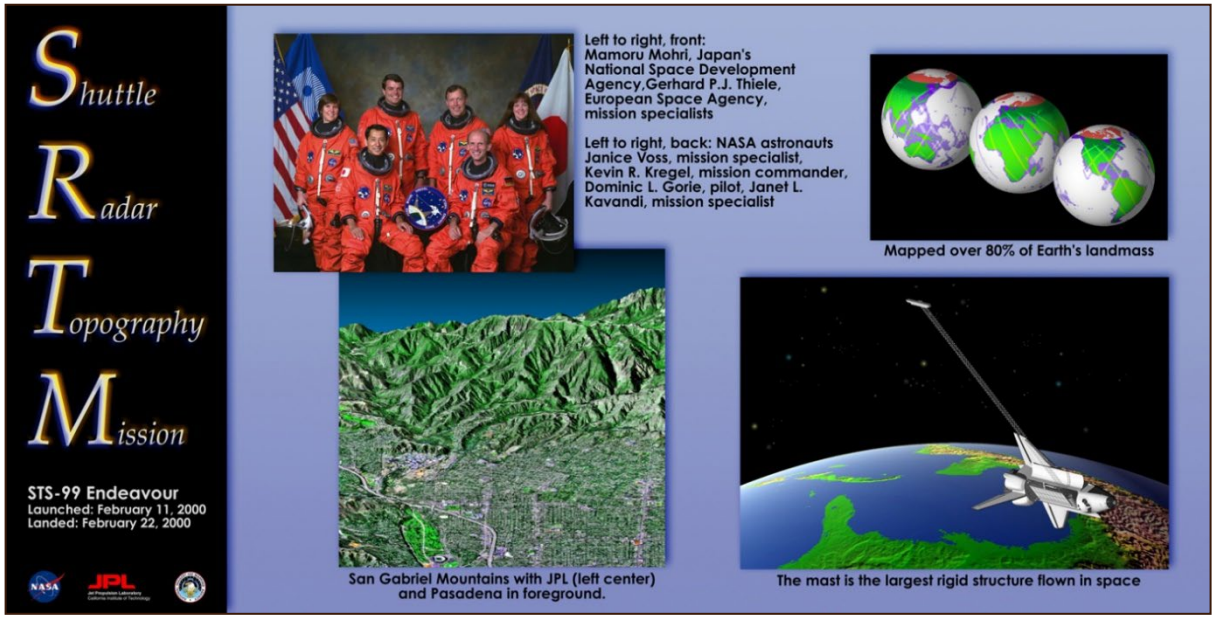


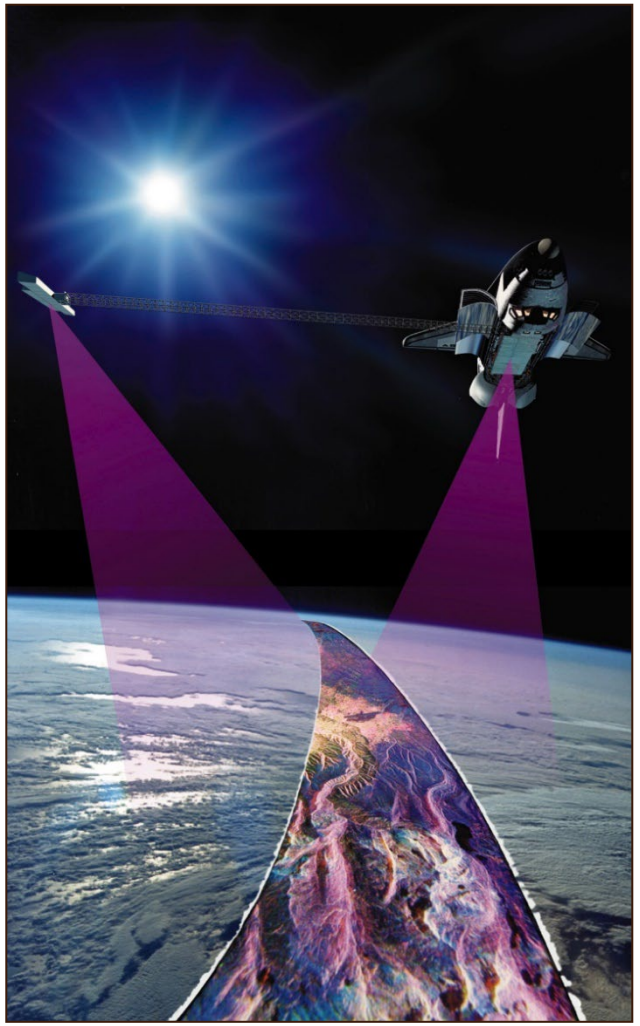
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Image NASA / ASU
Image NASA / LPI
©2010 Google
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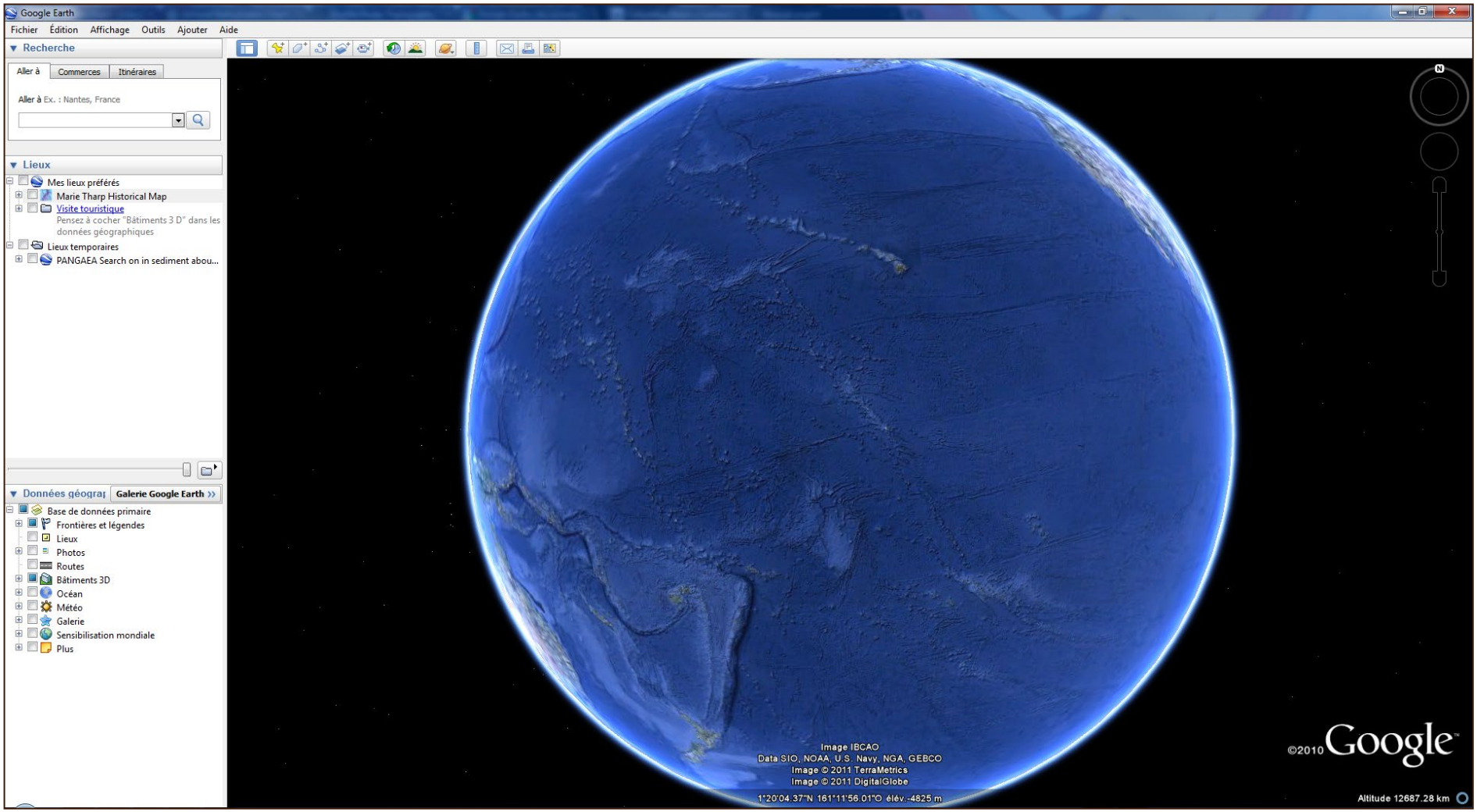

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©2010 Google
Date des images satellite : 19 juil. 2006
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Altitude 848 m
FR
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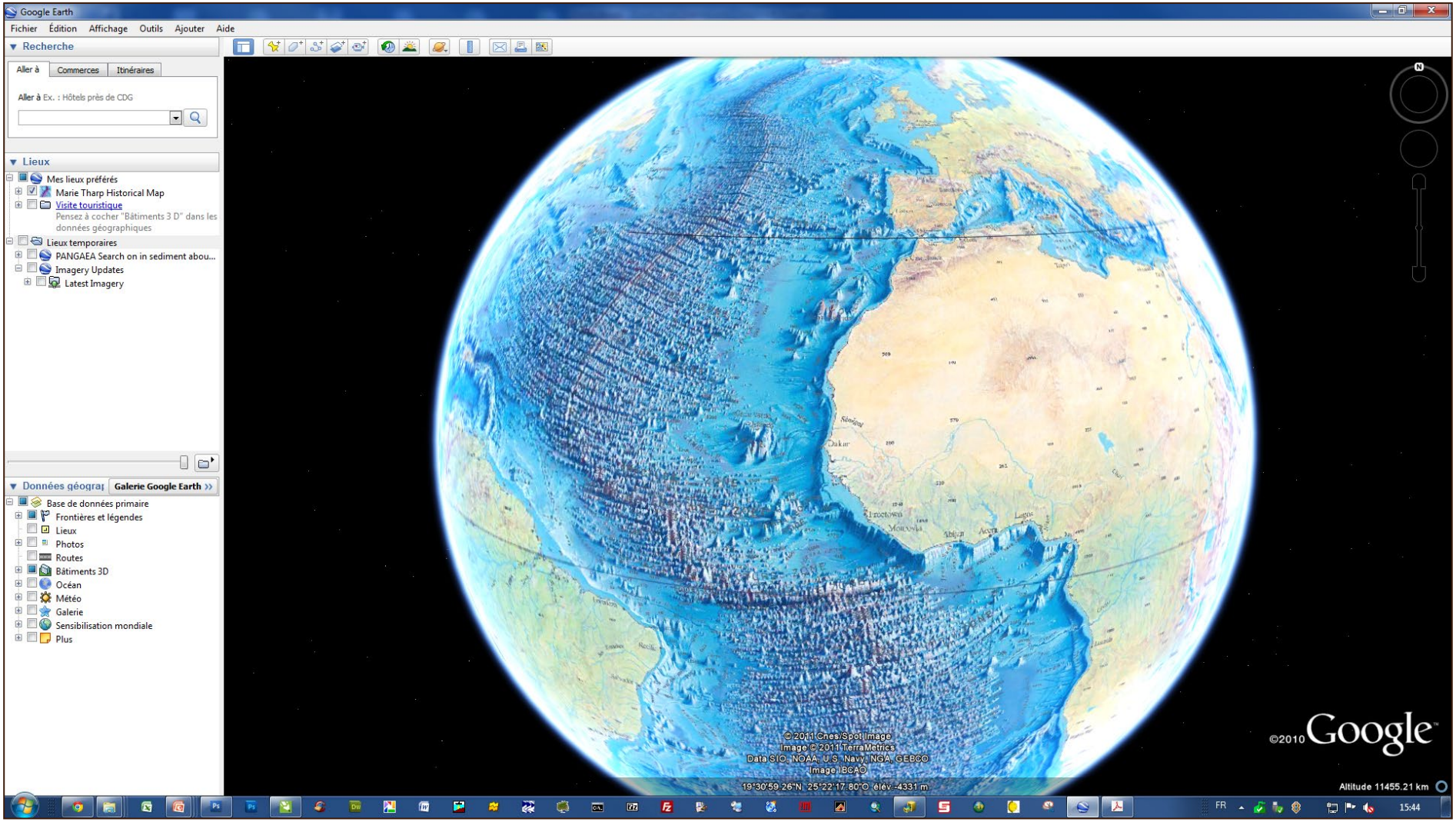




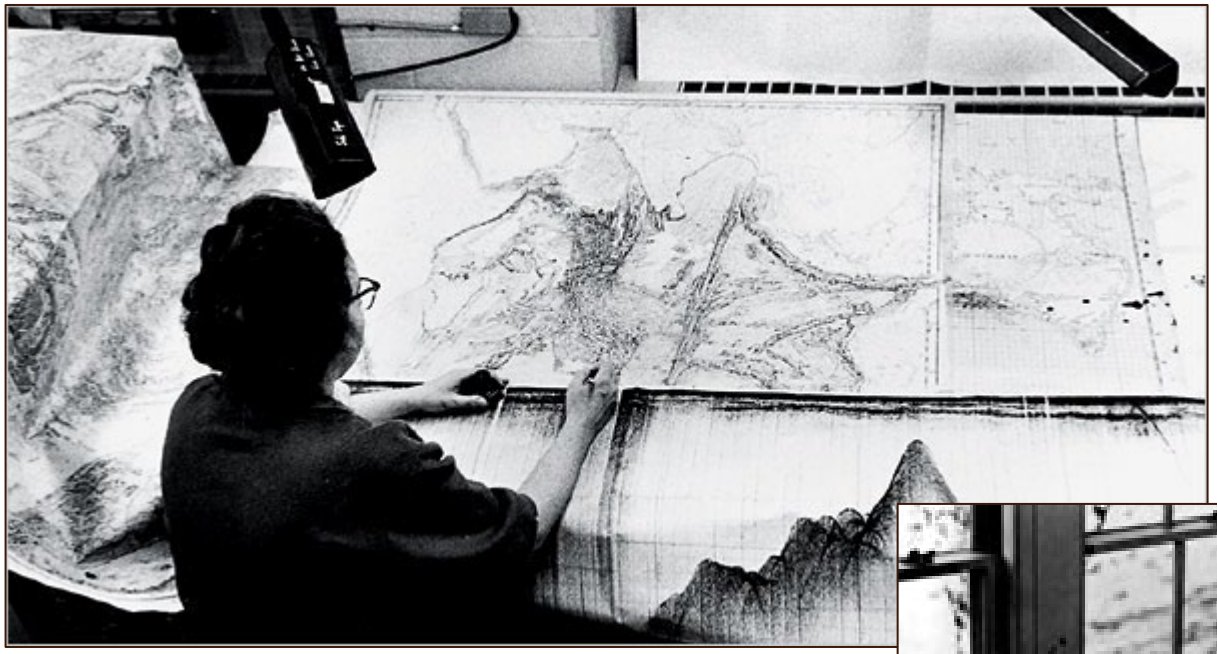
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Frontières et légendes
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Photos
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Météo
Galerie
Sensibilisation mondiale
Plus
Image IBCAO
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2011 TerraMetrics
Image © 2011 DigitalGlobe
1°20'04.37"N 161°11'56.01"O élév. -4825 m
©2010 Google
Altitude 12687.28 km

Marie Tharp et Bruce Heezen années 50 par Google Earth 21e siècle…



http://mw1.google.com/mw-earth-vectordb/gallery_website/nl/ocean/Marie_Tharp_Historical_Map.kml

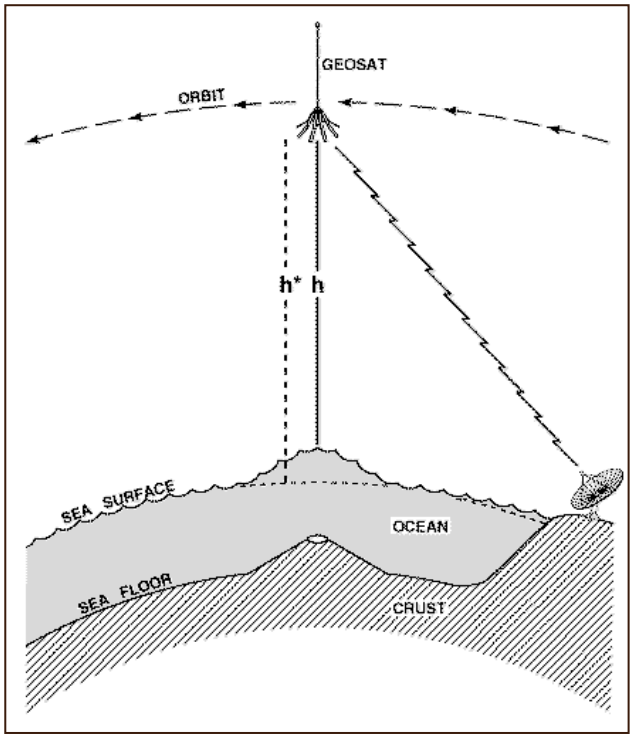


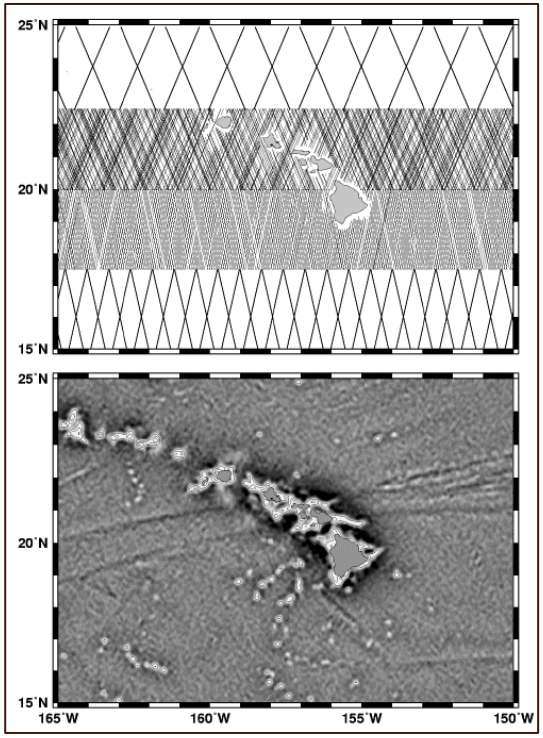


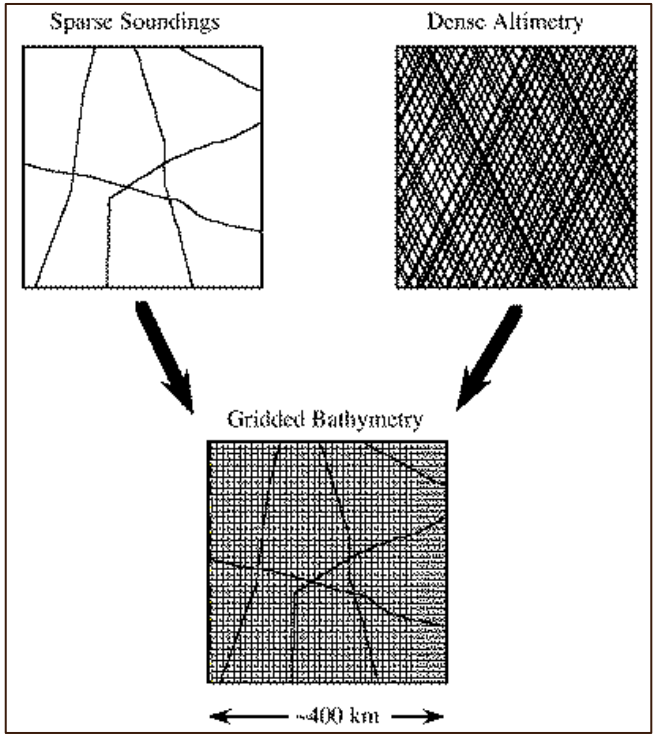
Marie Tharp (1920 – 2006)
Université de Columbia


WORLD OCEAN FLOOR
BY BRUCE C. HEEZEN AND MARIE THARP
Lamont Doherty Geological Observatory, Palisades, New York 10964
Based on Research and Exploration Initiated and Supported by the
UNITED STATES NAVY
OFFICE OF NAVAL RESEARCH
PUBLISHED BY THE UNITED STATES NAVY AS A MEMORIAL TO DR. BRUCE C. HEEZEN
IN RECOGNITION OF HIS CONTRIBUTIONS TO MAN'S KNOWLEDGE OF THE WORLD OCEAN FLOOR
URAL MOUNTAINS
CARPATHIAN MTNS.
ALPS MOUNTAINS
CAUCASUS MTNS.
TIEN SHAN
HINDU KUSH
GREATER KHINGAN RANGE
MID-ATLANTIC RIDGE
MID-INDIAN RIDGE
BROKEN RIDGE
MADAGASCAR
Reykjavik
Oslo
Stockholm
Helsinki
Copenhagen
Edinburgh
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Liverpool
London
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Plymouth
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Gibraltar
Algiers
Oran
Palermo
Tunis
Casablanca
Tripoli
Istanbul
Athens
Beirut
Tel Aviv
Alexandria
Cairo
Port Said
Kuwait
Karachi
Calcutta
Bombay
Madras
Rangoon
Bangkok
Saigon
Singapore
Dakar
Freetown
Monrovia
Abidjan
Accra
Lagos
Luanda
Walvis Bay
Durban
Cape Town
Port Elizabeth
Dar Es Salaam
Fortaleza
Recife
Salvador
Rio de Janeiro
Cape Verde

Bathymétrie par altimétrie satellitaire



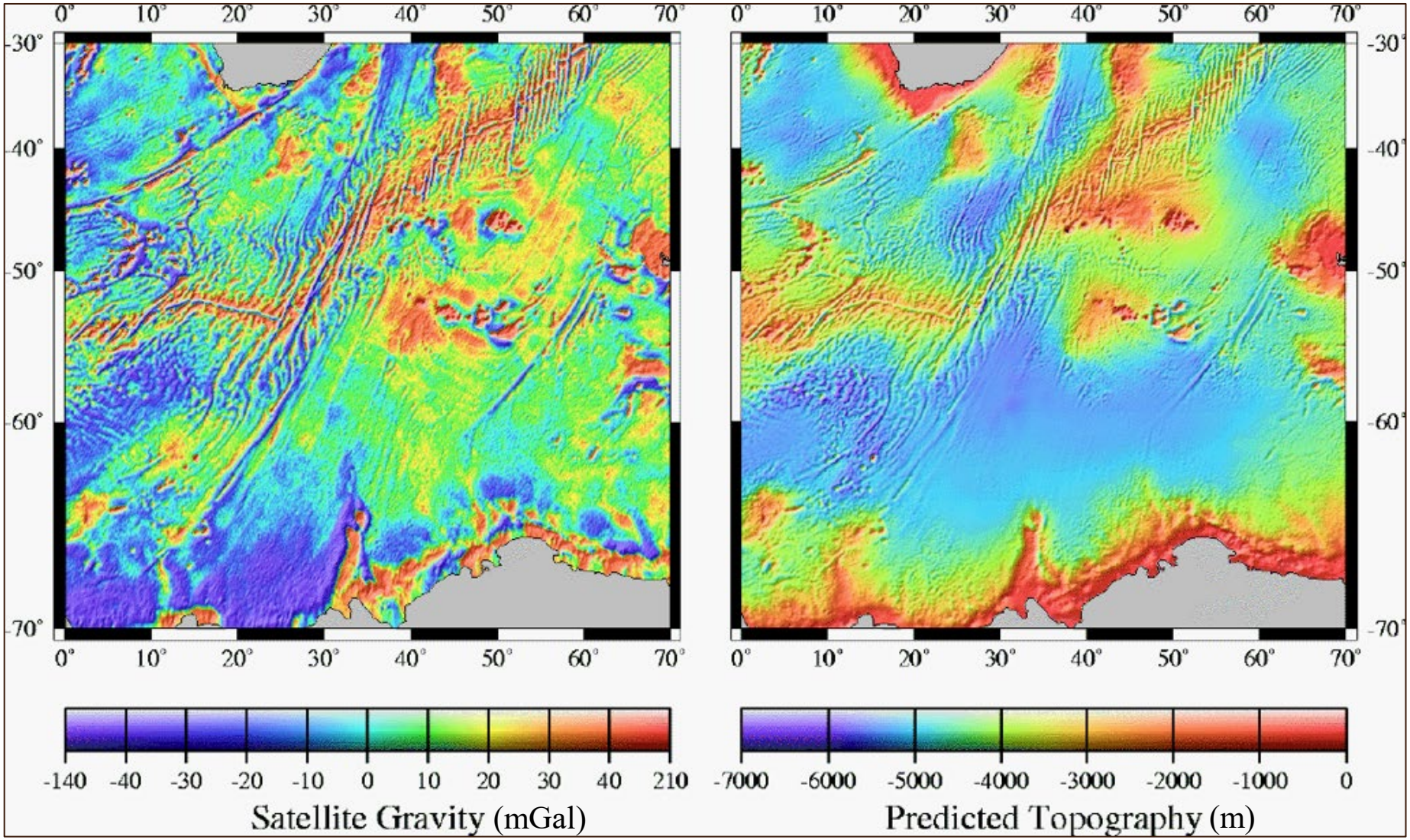




http://topex.ucsd.edu/marine_grav/explore_grav.html#sat_alt

Plusieurs passages d'un satellite altimétrique permettent de moyenner les mesures altimétriques -> surface moyenne de l'océan au repos

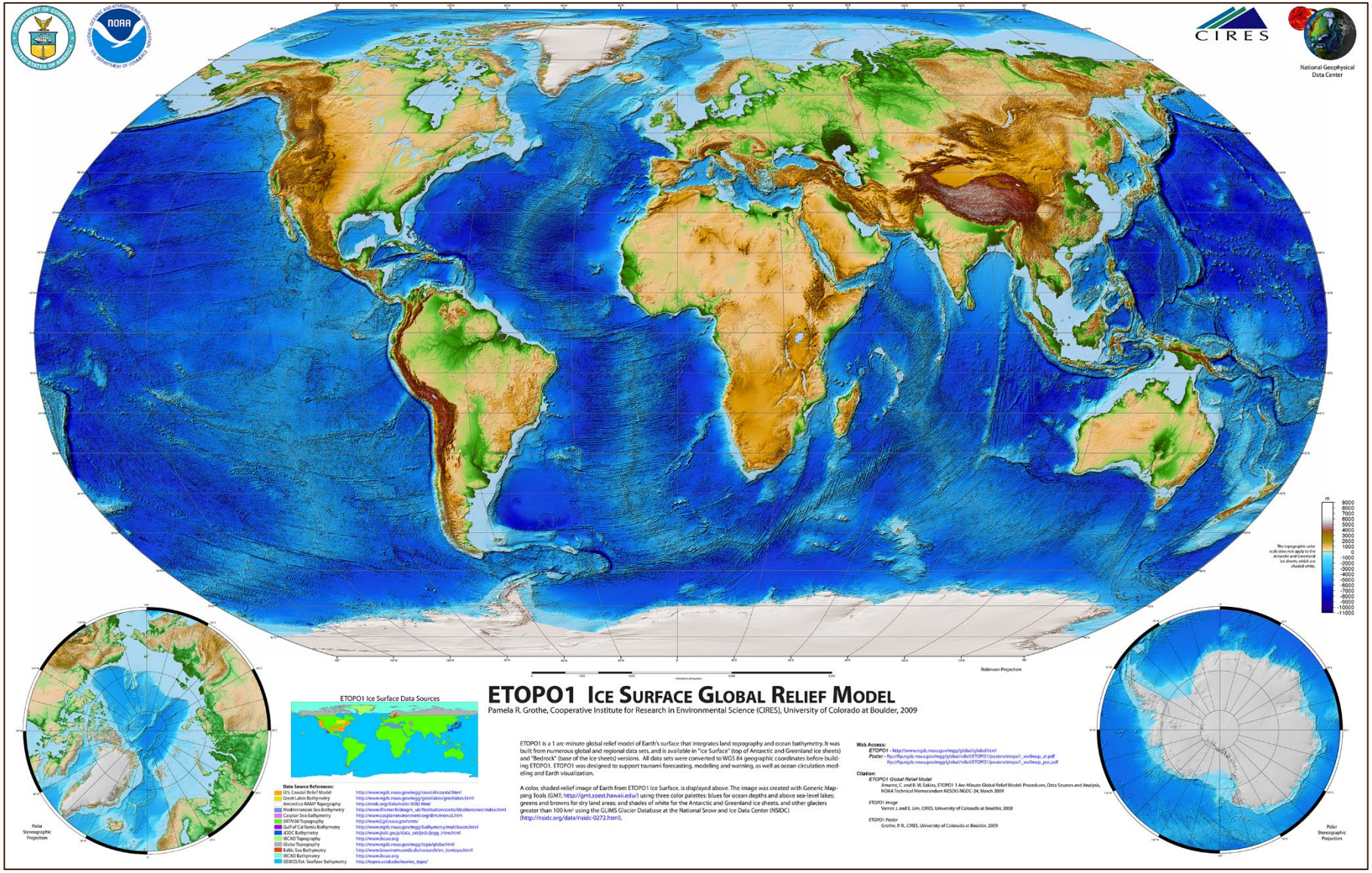
Mesures des variations de la gravité engendrées par des reliefs océaniques



http://topex.ucsd.edu

Les données gravimétriques servent à prédire la topographie des zones vierges de sondages bathymétriques

ETOPO 1 : Précision 1 minute d'arc (111km/60 = ~ 1.85 km)



http://www.ngdc.noaa.gov/mgg/global/global.html

Bathymétrie par altimétrie satellitaire

NOAA NATIONAL GEOPHYSICAL DATA CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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Extract Custom Grid

Interactive Map Interface to Bathymetry Data

ETOPO1 Development Report (.PDF)
(download data files at right)

NEW! Frequently Asked Questions

Ocean Volumes

NEW! Earth Hypsographic Curve

Data Sources

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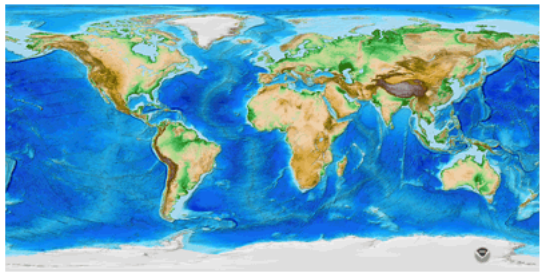
Global Grids at NGDC:

ETOPO2 Historic Global Relief
ETOPO5 Historic Global Relief
GLOBE Topography
Ocean Crustal Ages
Ocean Sediment Thickness

Project Contact:

Barry.Eakins@noaa.gov
phone: 303-497-6505

ETOPO1 Global Relief Model



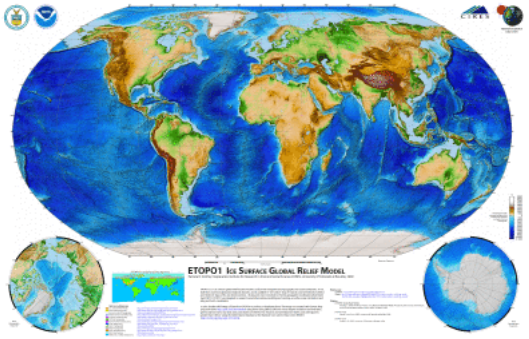
ETOPO1 is a 1 arc-minute global relief model of Earth's surface that integrates land topography and ocean bathymetry. It was built from numerous global and regional data sets, and is available in "Ice Surface" (top of Antarctic and Greenland ice sheets) and "Bedrock" (base of the ice sheets) versions. Historic ETOPO2v2 and ETOPO5 global relief grids are deprecated but still available.

NEW! NGDC has utilized the ETOPO1 Global Relief Model to calculate the volumes of the world's oceans and to derive a hypsographic curve of Earth's surface.

Color Image of Earth

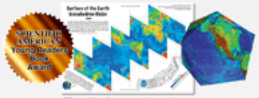
A color shaded-relief image of Earth from ETOPO1 Ice Surface, created by NGDC, is displayed above. The image is downloadable as a georeferenced TIFF or KMZ file, and available for NOAA's Science On a Sphere®. It is also viewable in web browsers at ArcGIS.com. The image was created with Generic Mapping Tools (GMT) using three color palettes: blues for ocean depths and above sea-level lakes; greens and browns for dry land areas; and shades of white for the Antarctic and Greenland ice sheets, and other glaciers greater than 100 km^2 using the GLIMS Glacier Database at the National Snow and Ice Data Center (NSIDC). Image authors are J. Varner and E. Lim, CIRES, University of Colorado at Boulder.

NEW! Atlantic-centered and Pacific-centered wall posters of ETOPO1 are now available. Poster author is P. Grothe, University of Colorado at Boulder, now with Georgia Institute of Technology.





DEM Discovery Portal



Earth Icosahedron

More Images & Animations...

Related Projects:

Coastal Relief Models
Great Lakes

Related Data at NGDC:

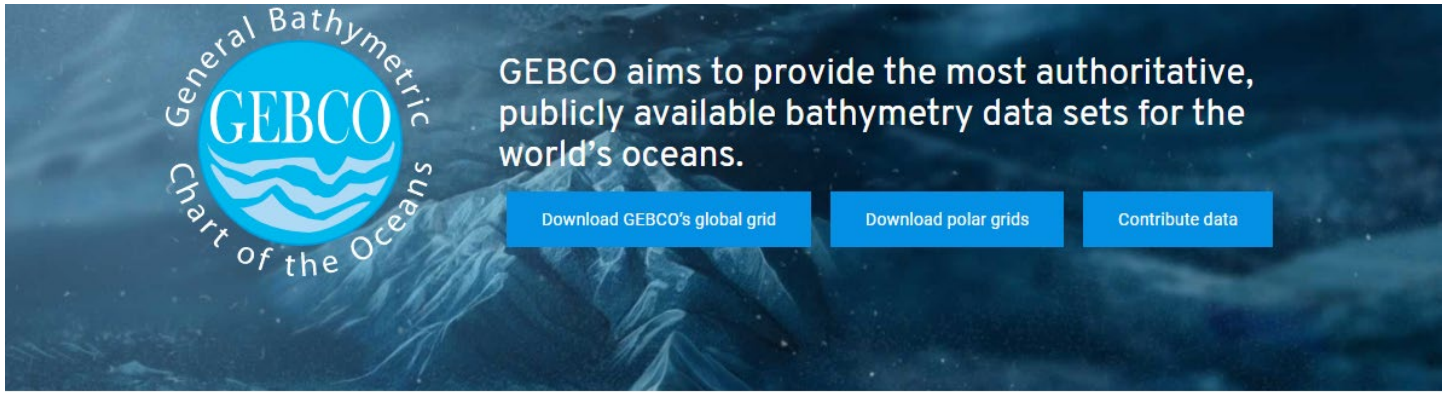
Bathymetry & Relief
Marine Geology & Geophysics

Related External Links:

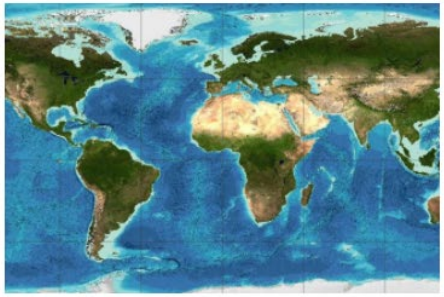
- ETOPO1 in NOAA's Science On a Sphere®
- Measured & Estimated Seafloor Topography from Satellite Altimetry
- GEBCO Global Bathymetric Grids
- MGDS Global Multi-Resolution Topography

http://www.ngdc.noaa.gov/mgg/global/global.html

Précision 15 secondes d'arc (111km/240 = 463m)



Gridded Bathymetry Data



GEBCO's gridded bathymetric data sets are global terrain models for ocean and land. The grids are available to download or access through Web Map Services.

Read more

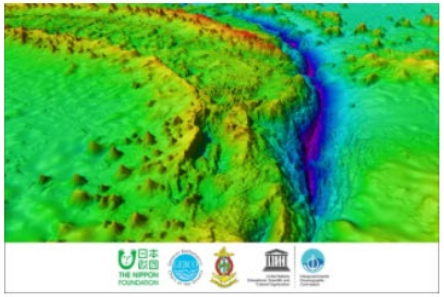
Data & Products



GEBCO produces and makes available a range of bathymetric data sets and products. This includes a global bathymetric grid; gazetteer of undersea feature names, a Web Map Service and printable maps of ocean bathymetry.

Read more

Seabed 2030

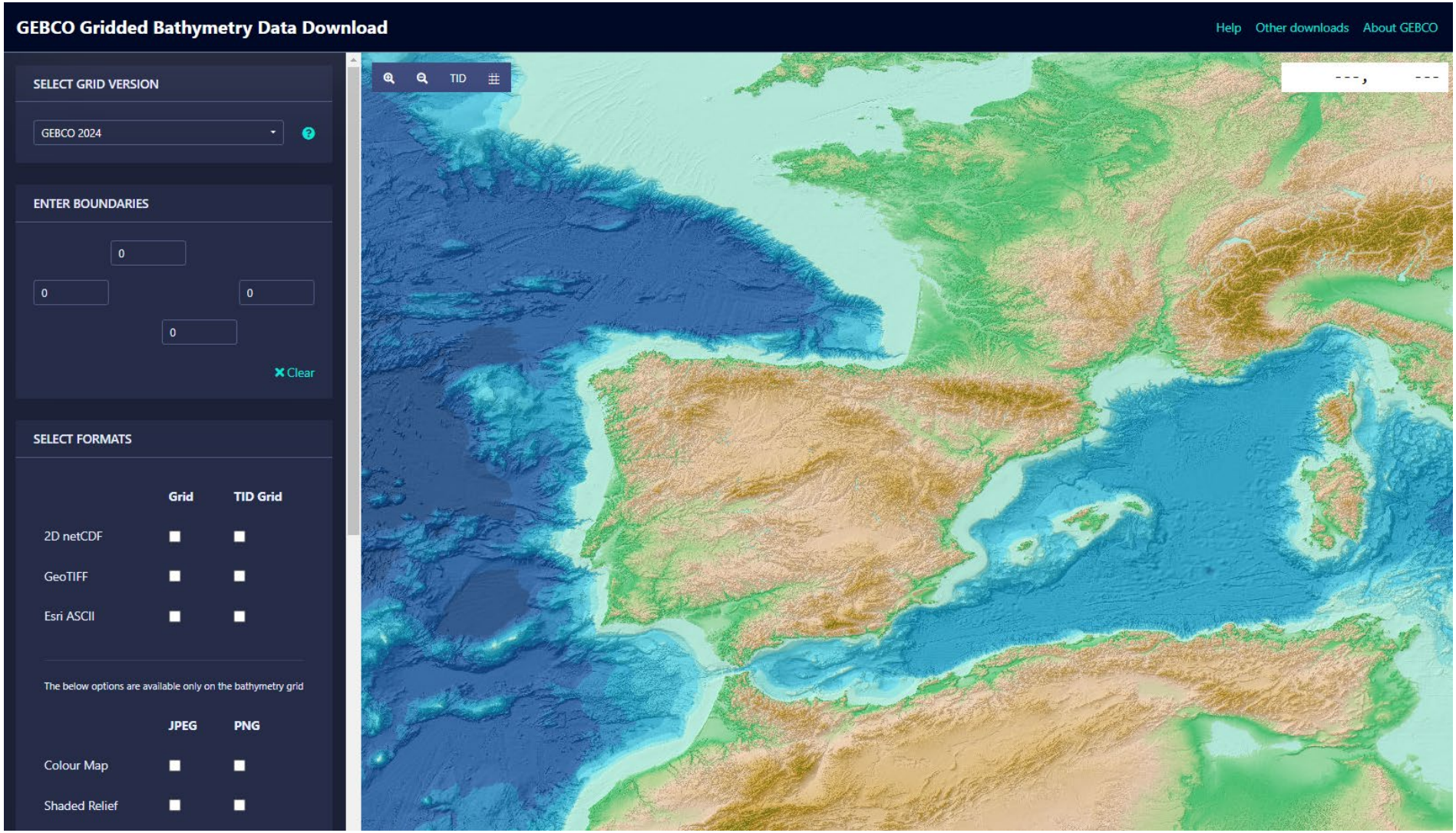


Seabed 2030 is a collaborative project between the Nippon Foundation and GEBCO. It aims to bring together all available bathymetric data to produce the definitive map of the world ocean floor by 2030 and make it available to all.

Read more

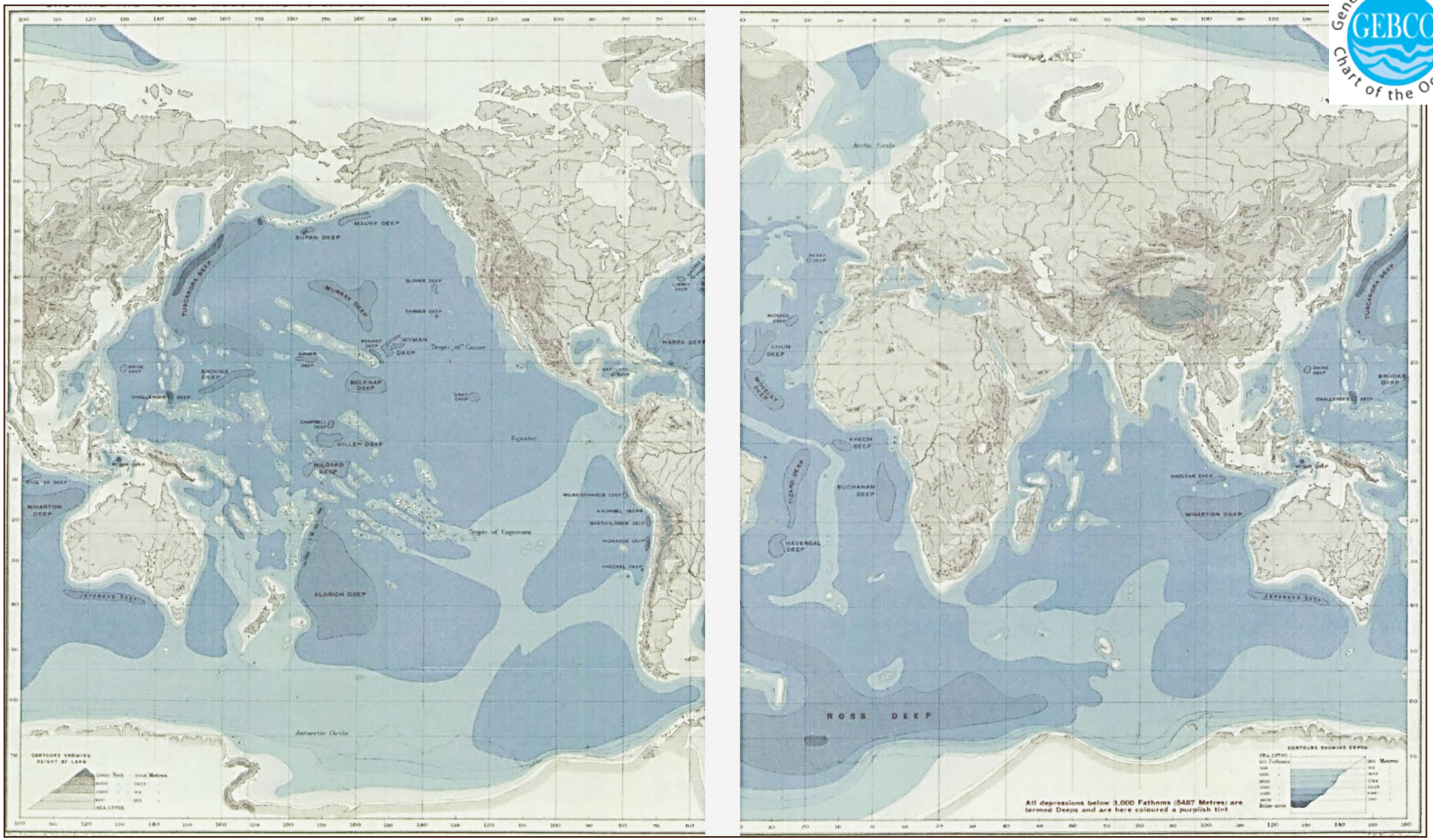
http://www.gebco.net/

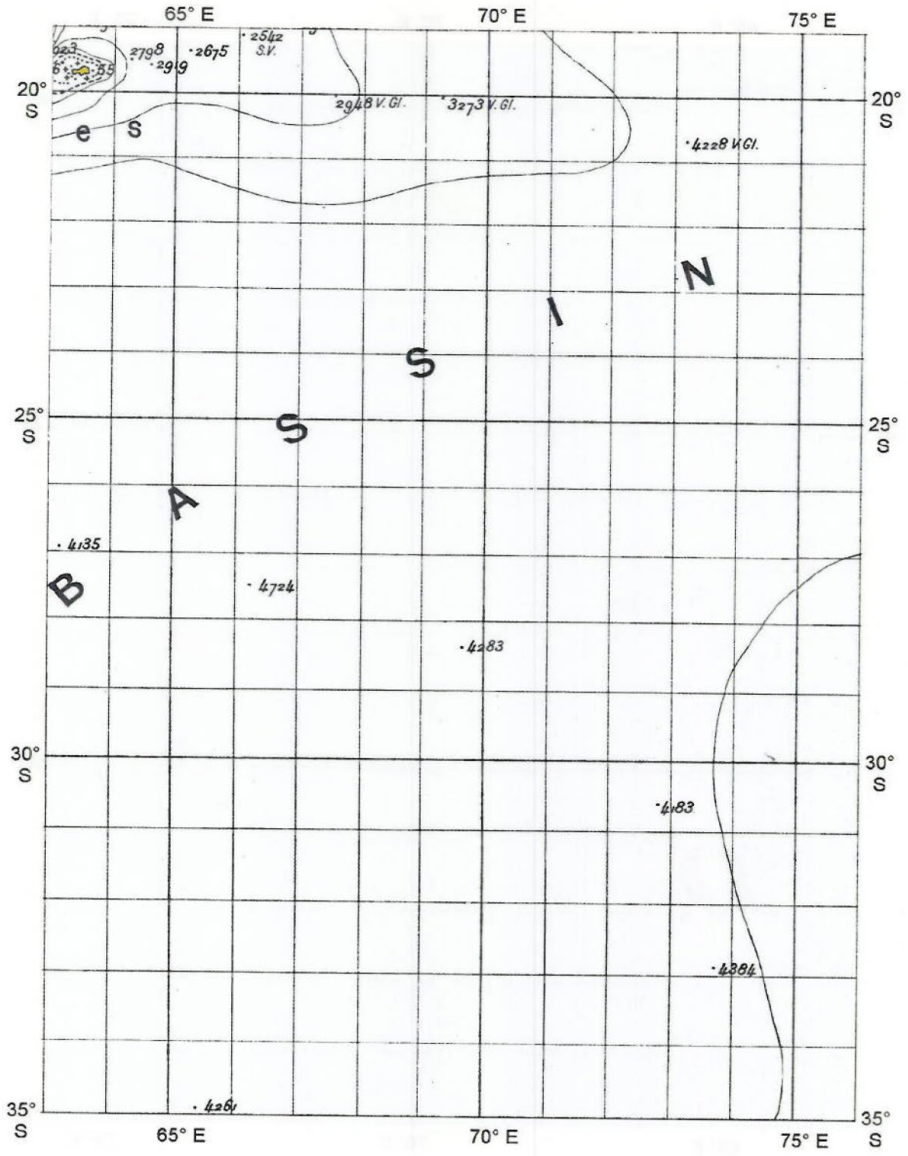
Bathymétrie par sondages



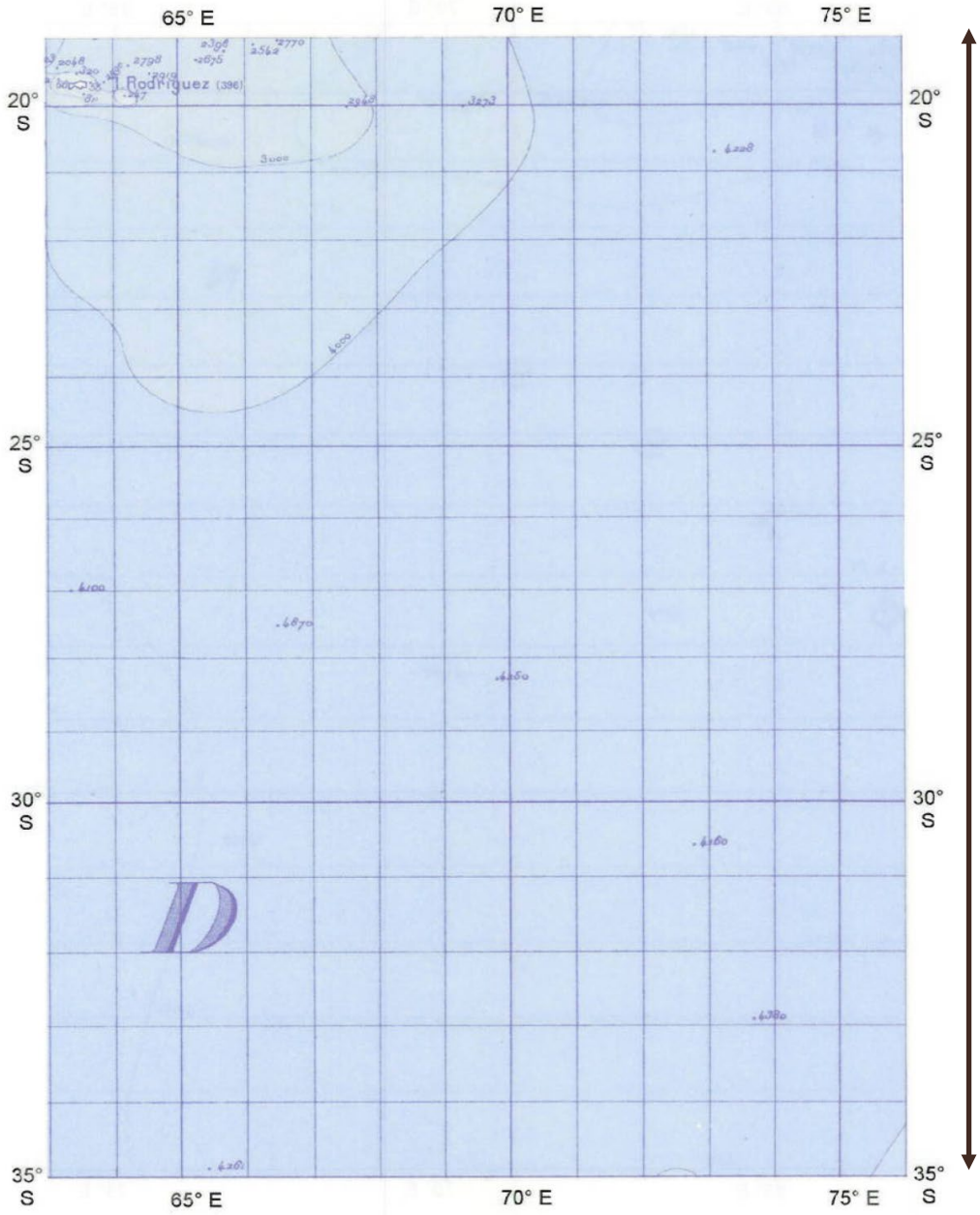
http://www.gebco.net/

1e carte bathymétrique mondiale Sir John Murray 1899

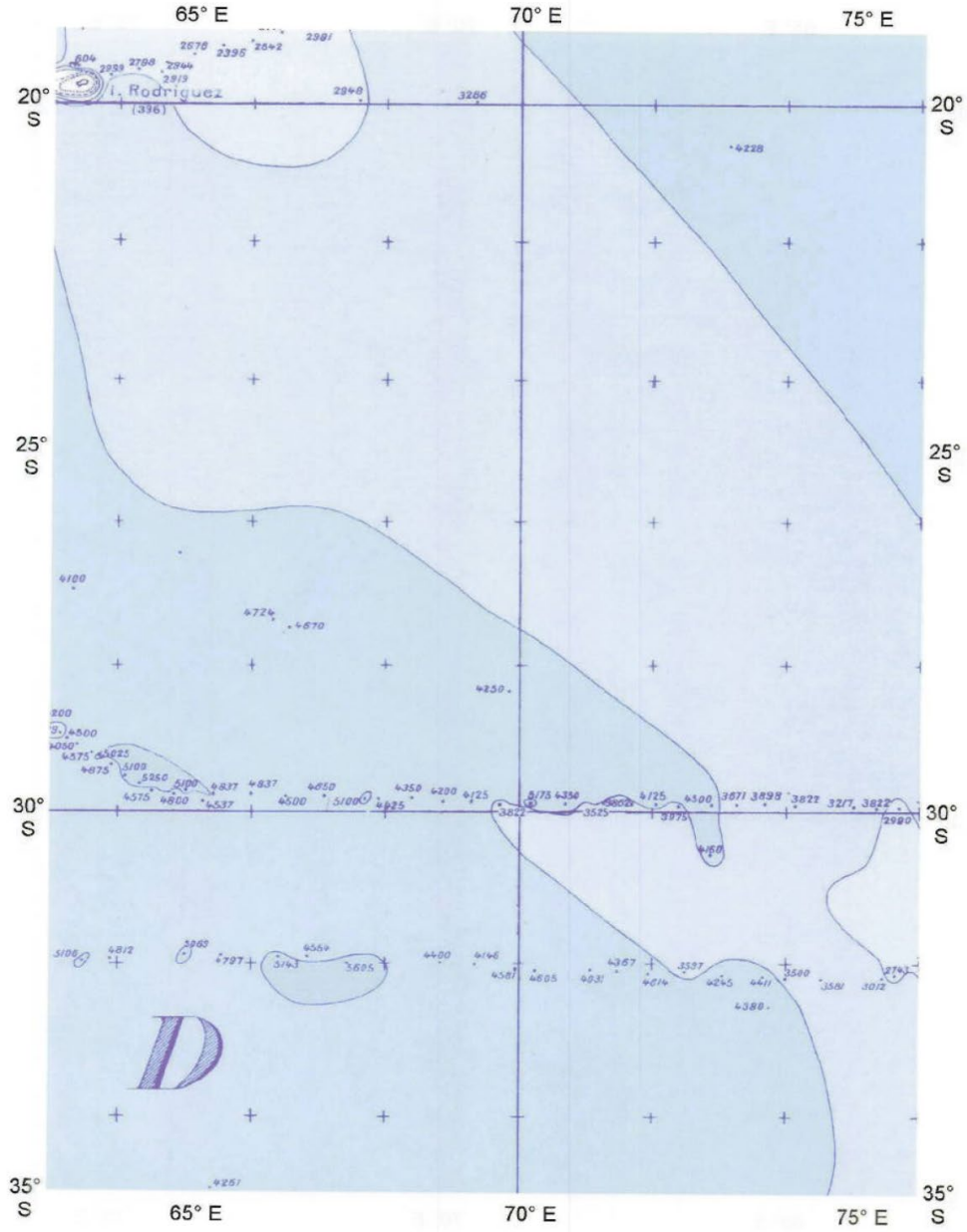




Dorsale Médio-Indienne
1903

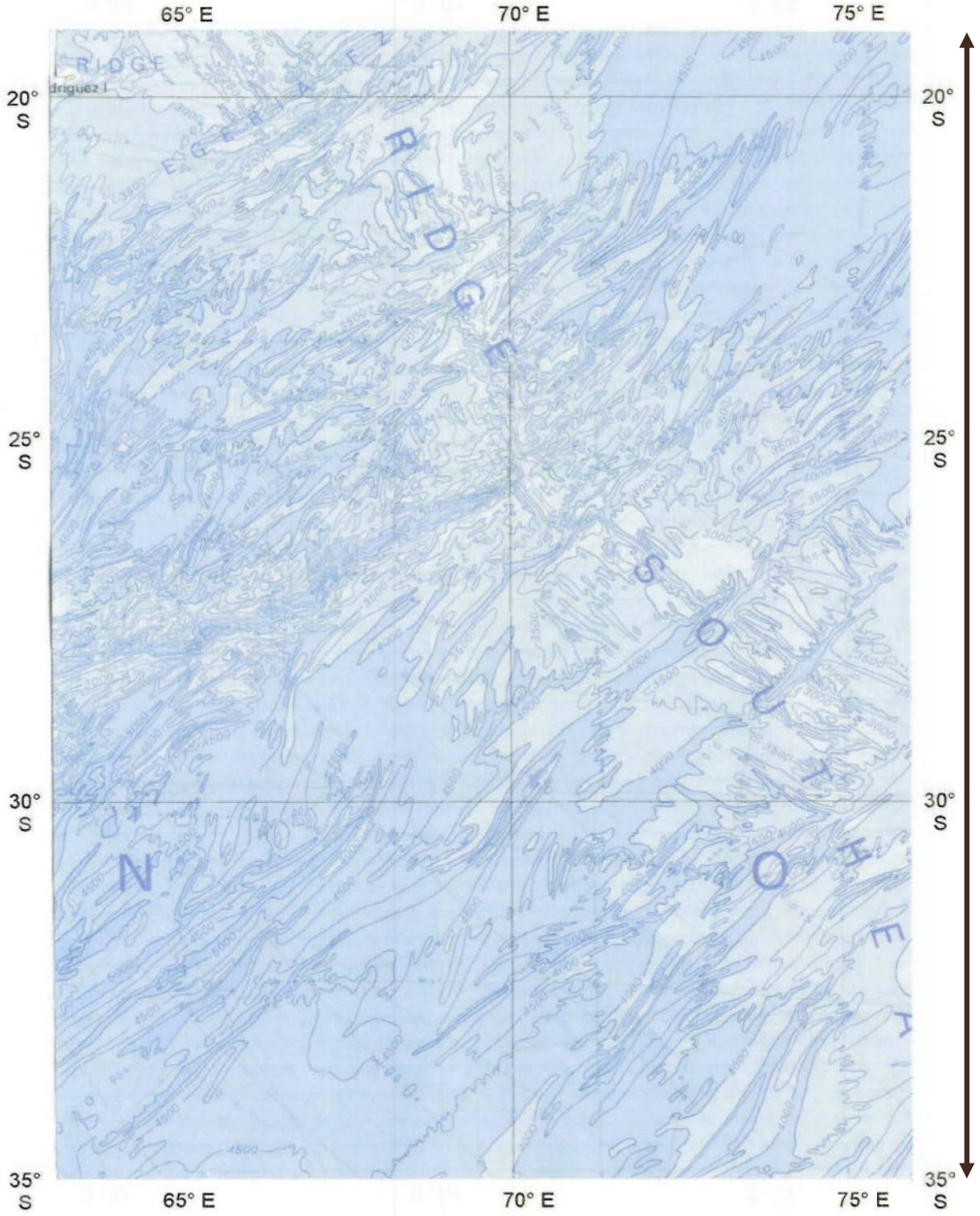


Dorsale Médio-Indienne
1913

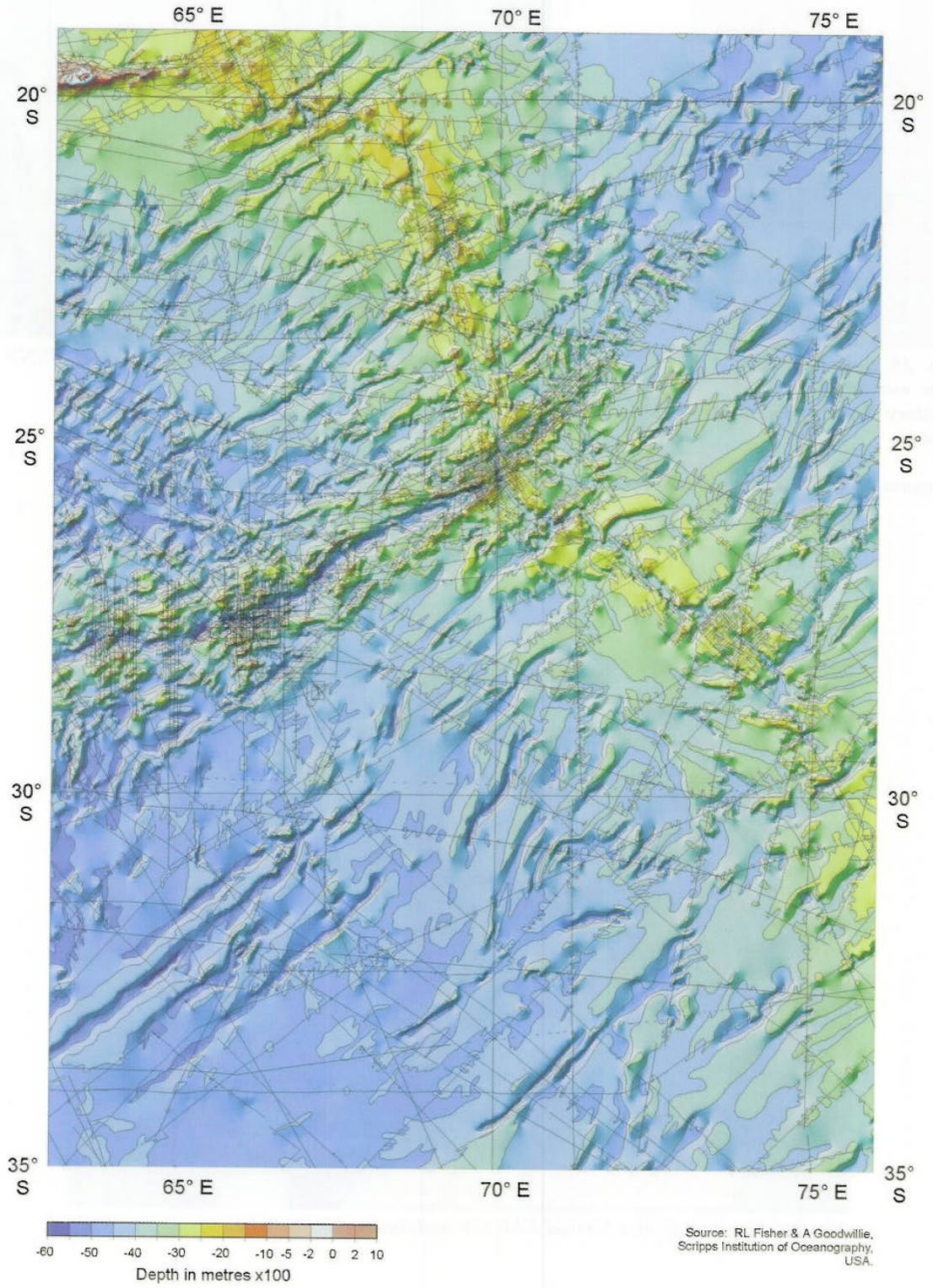


1780 km

Dorsale Médio-Indienne
1938

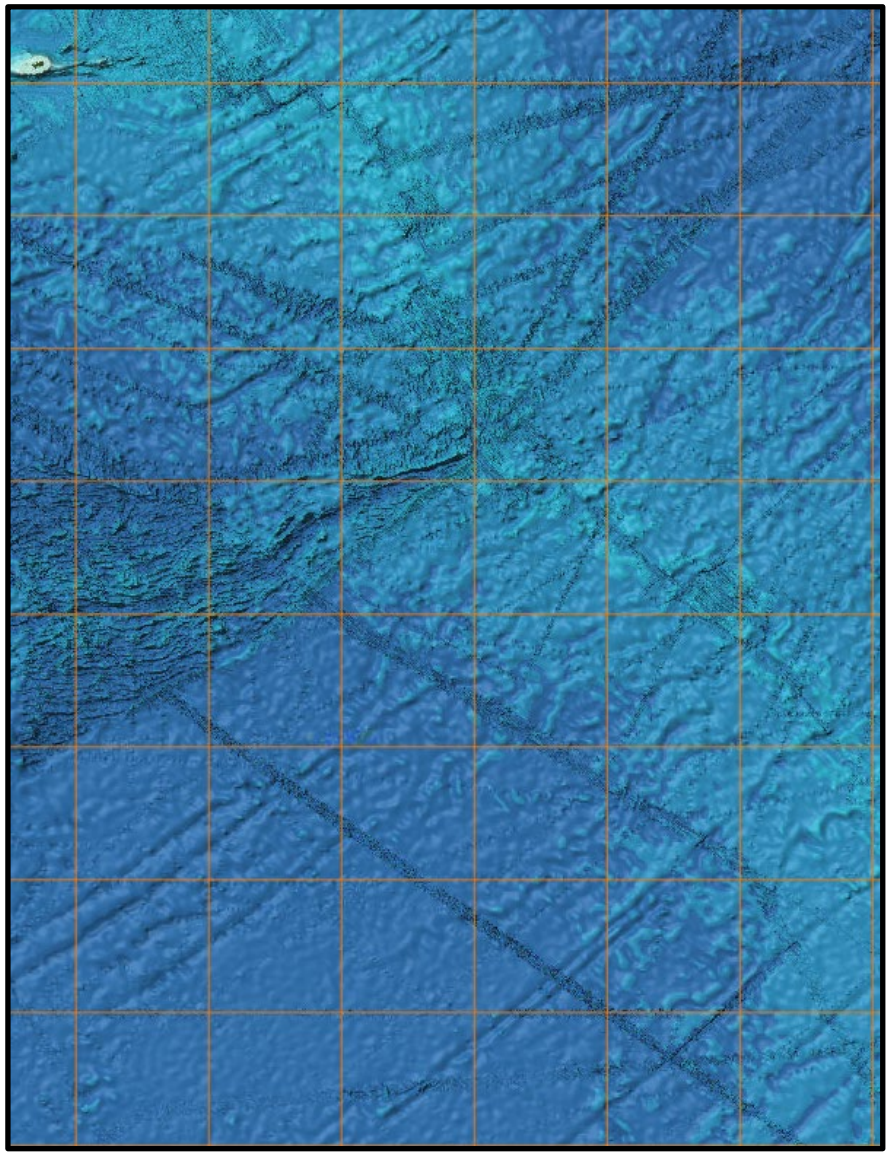


Dorsale Médio-Indienne
1982



1780 km

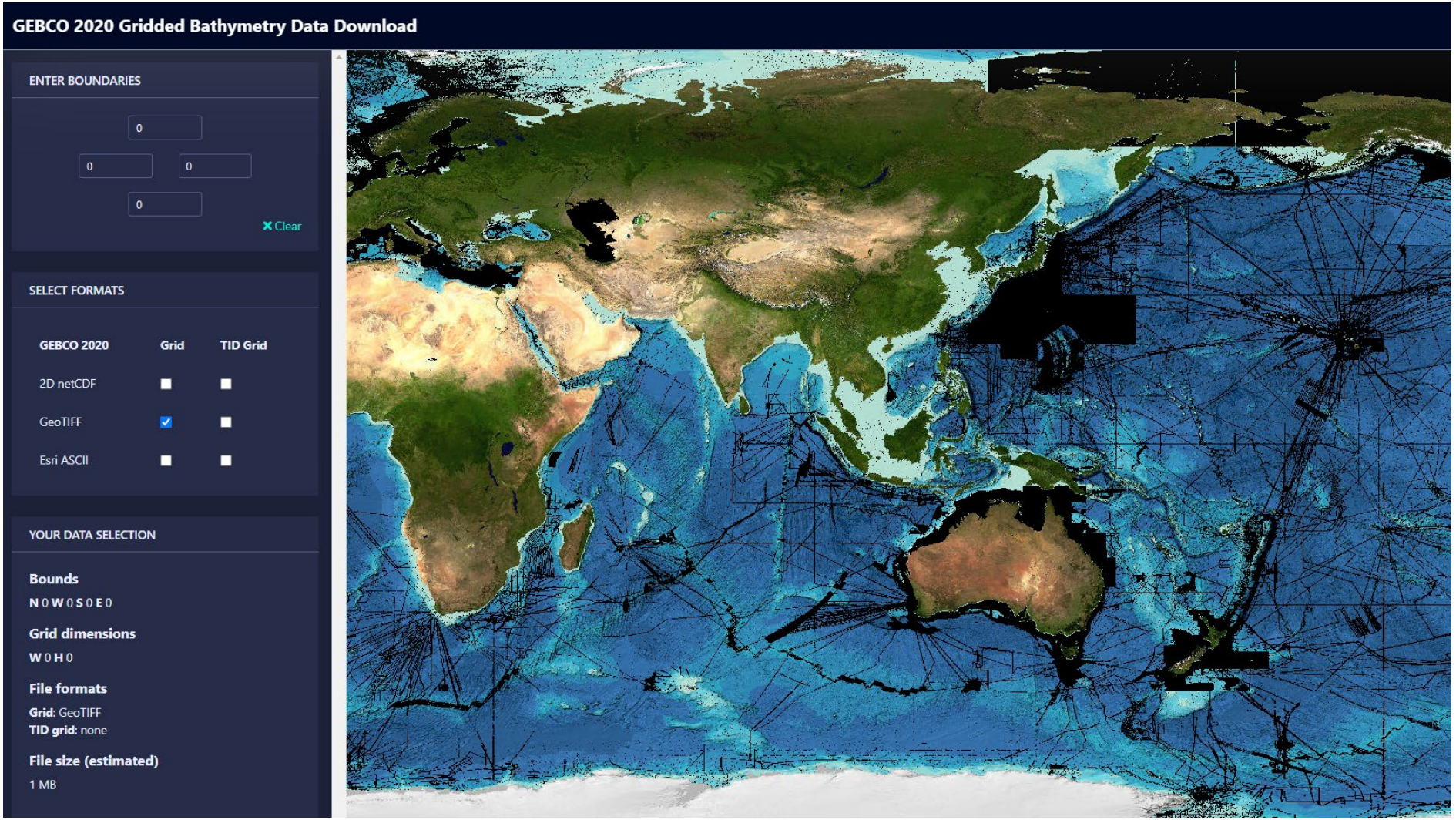
Dorsale Médio-Indienne
2002

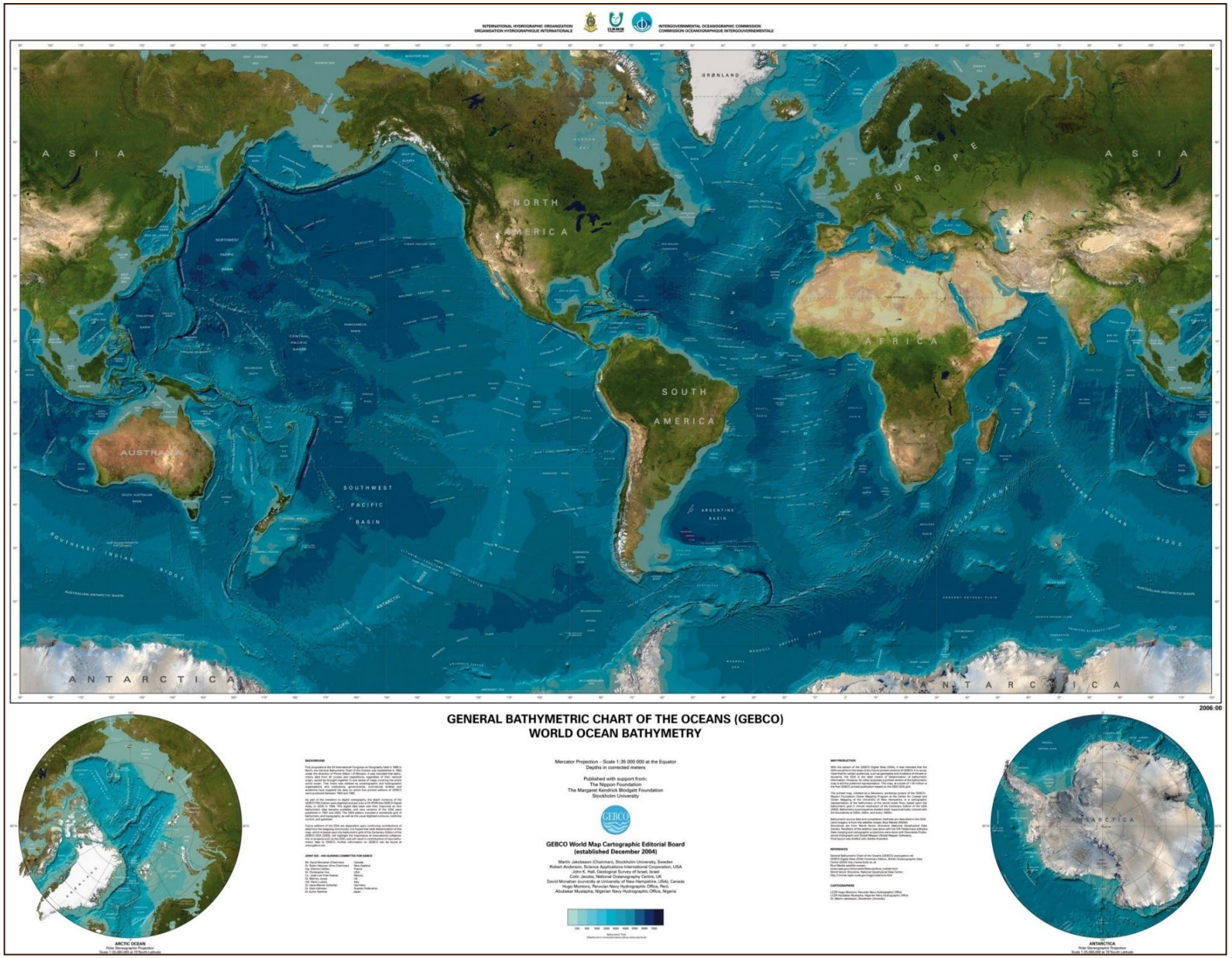


1780 km

Dorsale Médio-Indienne
2020

Bathymétrie par sondages



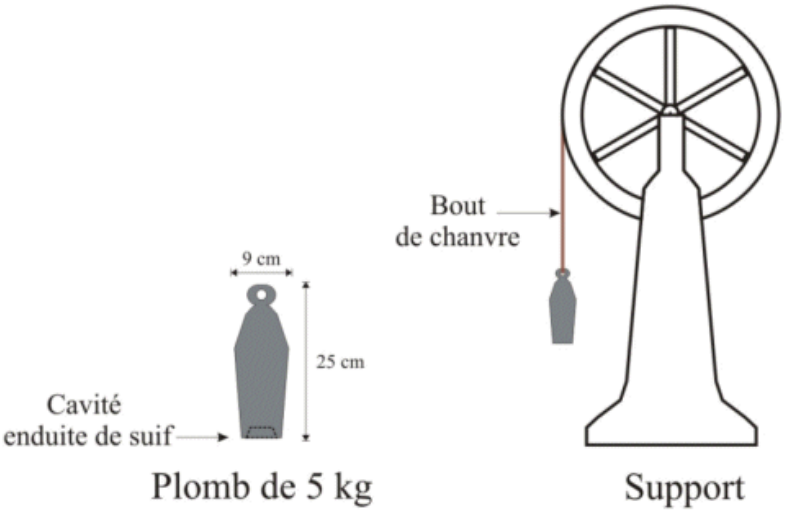


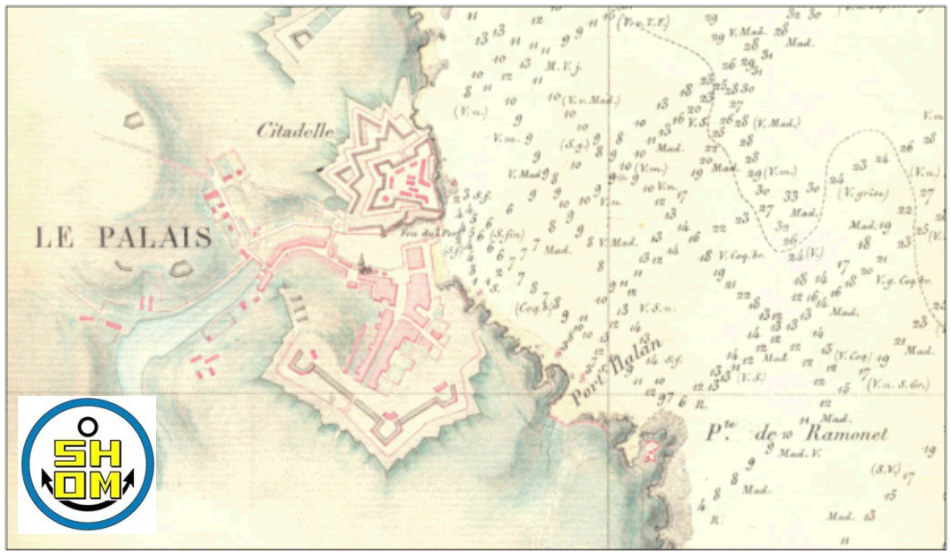
http://www.gebco.net/

Le fil à plomb



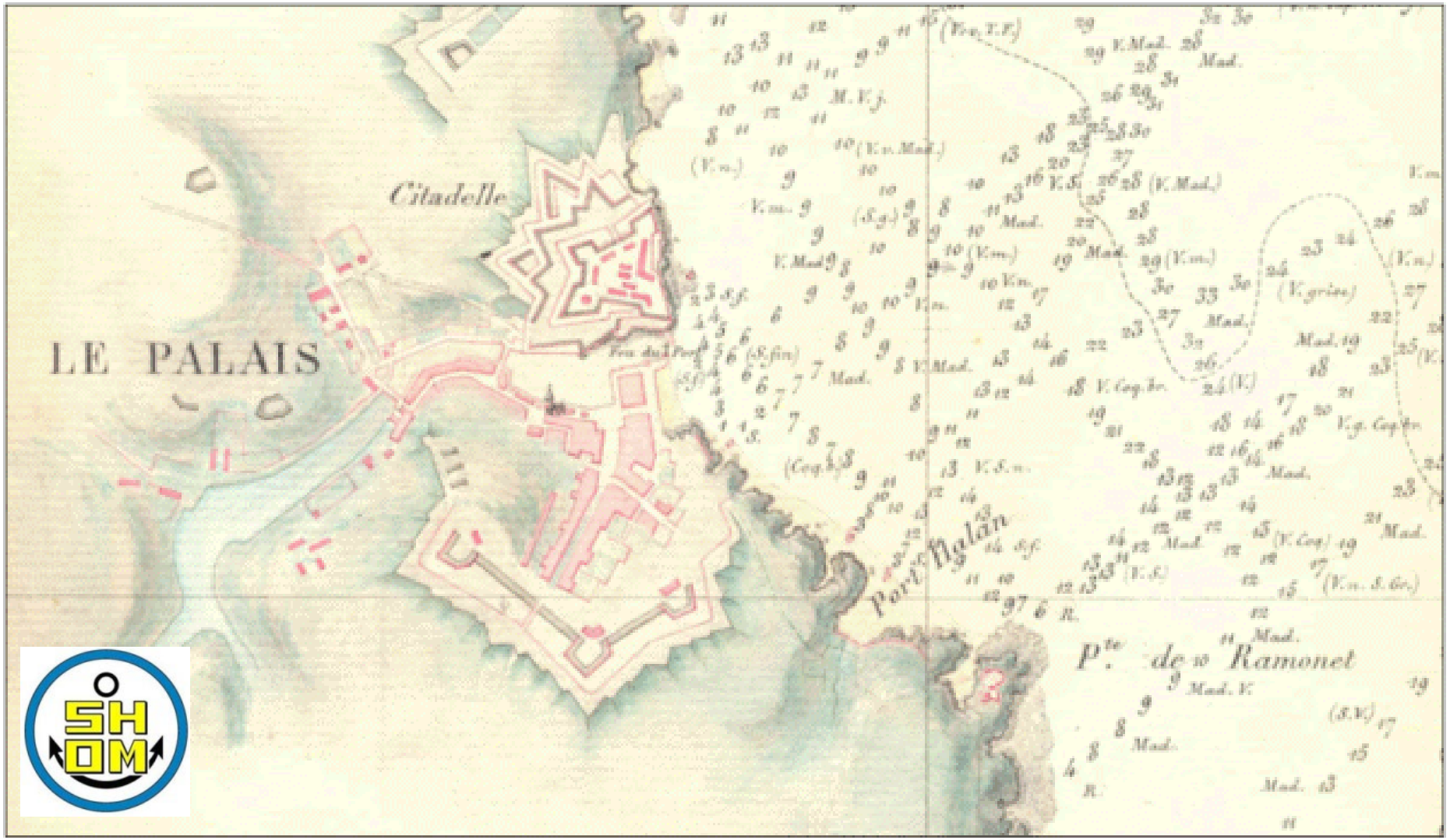
Sondages bathymétriques en Norvège (14e siècle)





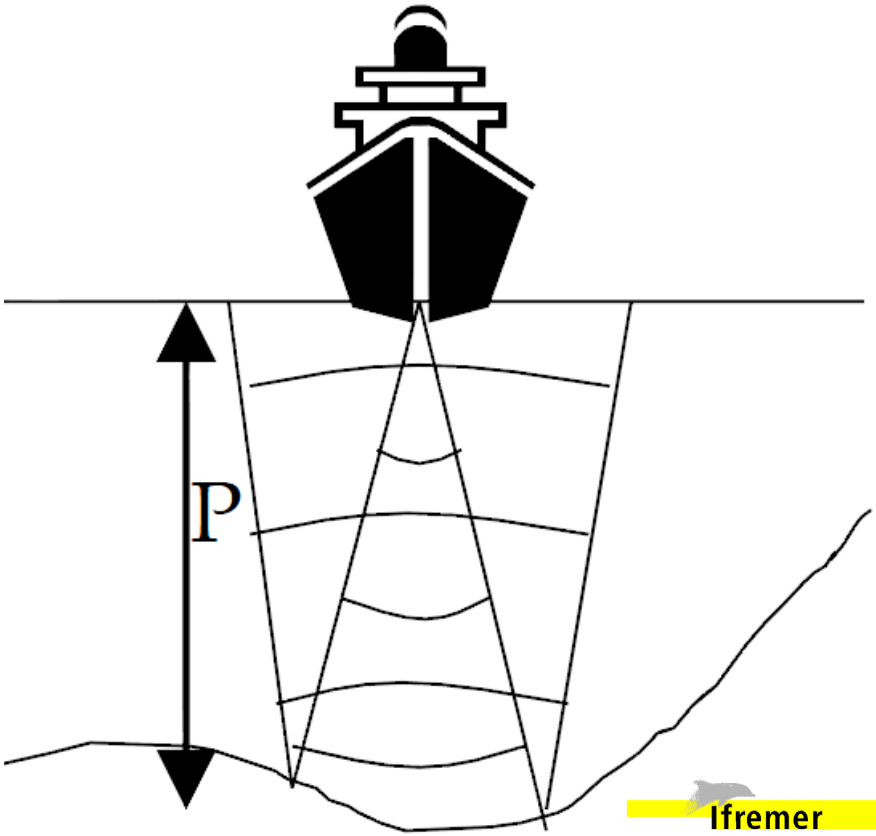


=> Utilisé jusqu'en 1940 !!!!

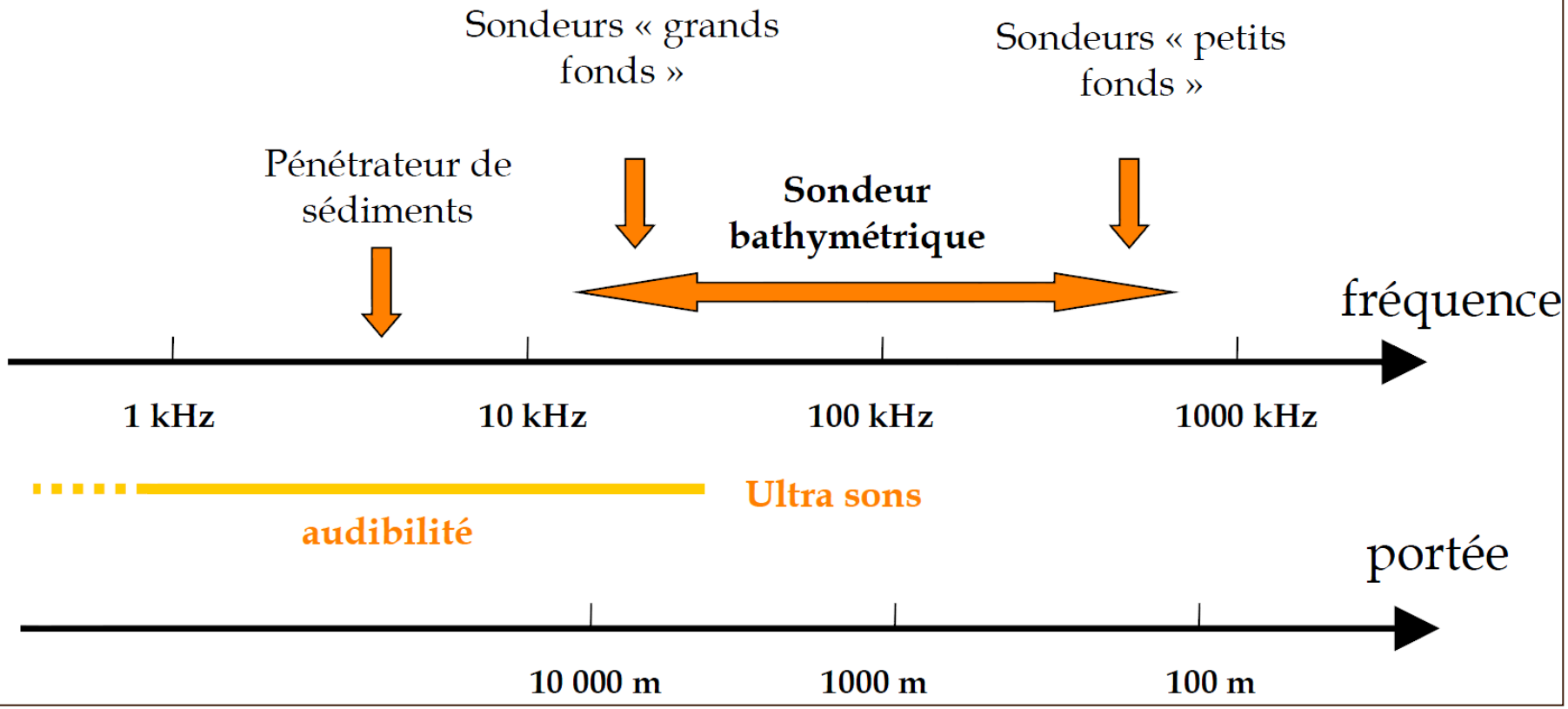

Citadelle
LE PALAIS
Port Aglan
P.te de Ramonet

Le sondeur monofaisceau :

Profondeur = (Célérité x Δt) / 2

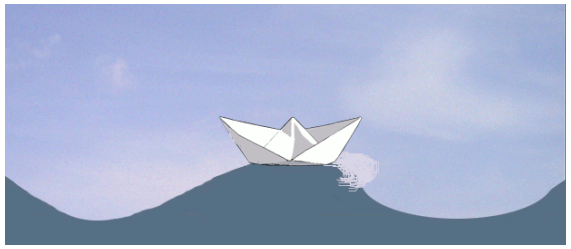


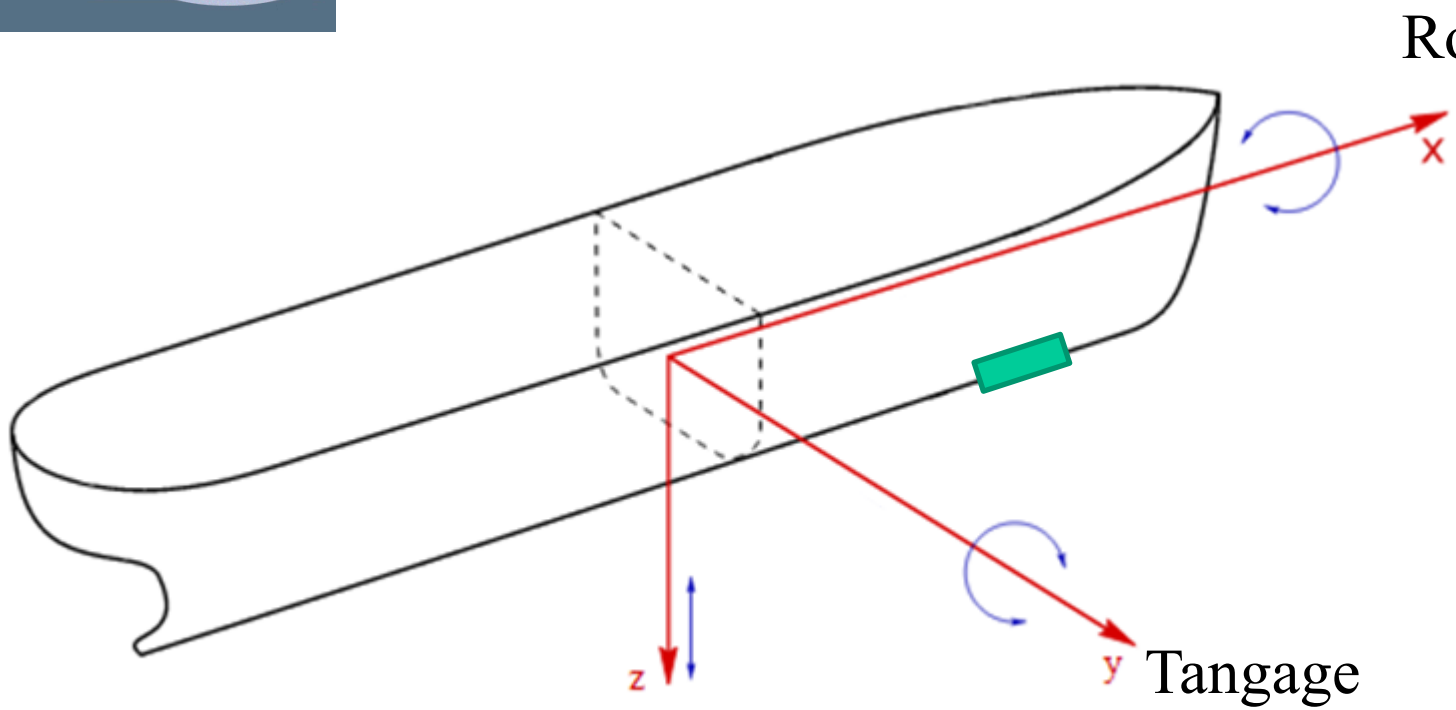
– **Quand la fréquence ↑ , le coefficient d'absorption ↑, la portée ↓**

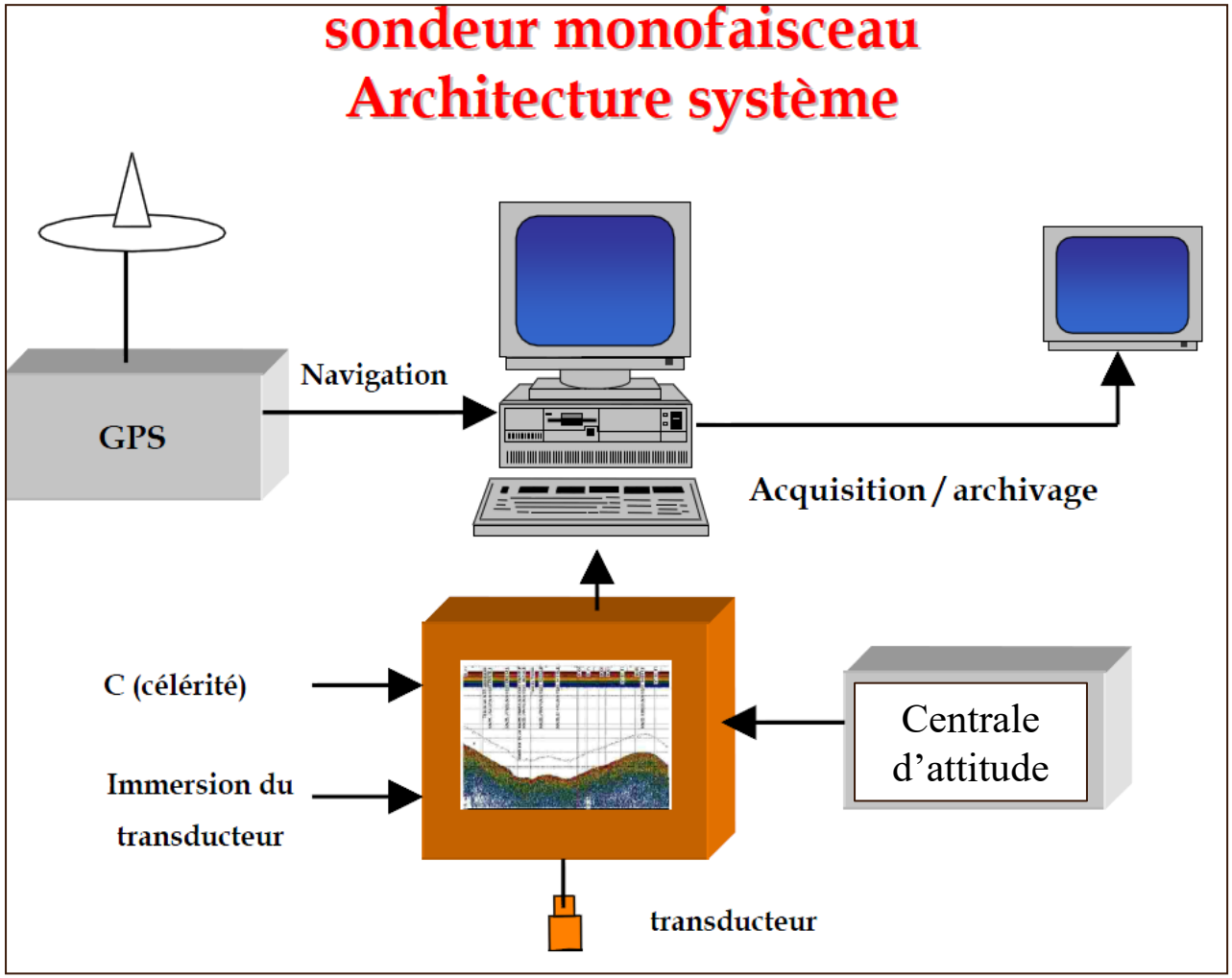


Sondeur monofaisceau fréquences couramment utilisées

- 12 kHz : océan
- 33 ou 38 kHz: grands fonds
- 200 kHz : plateau continental
- 400 kHz : très petits fonds

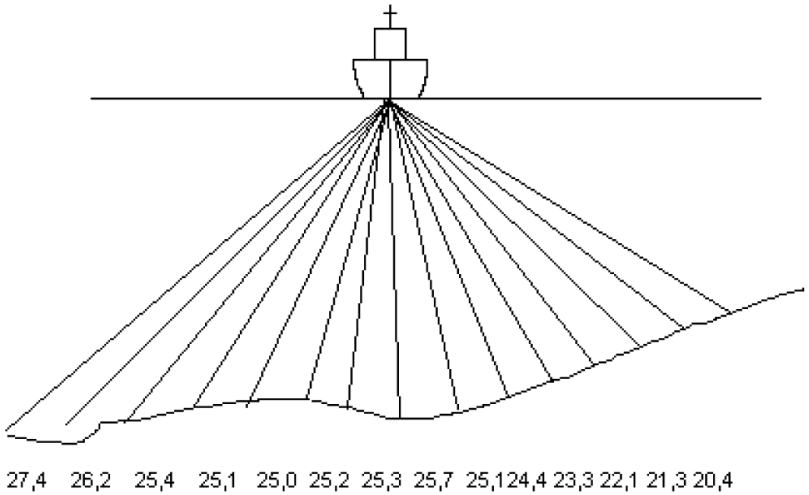



Roulis
x
z
y
Tangage
Pilonnement


sondeur monofaisceau
Architecture système
GPS
Navigation
Acquisition / archivage
C (célérité)
Immersion du transducteur
Centrale d'attitude
transducteur

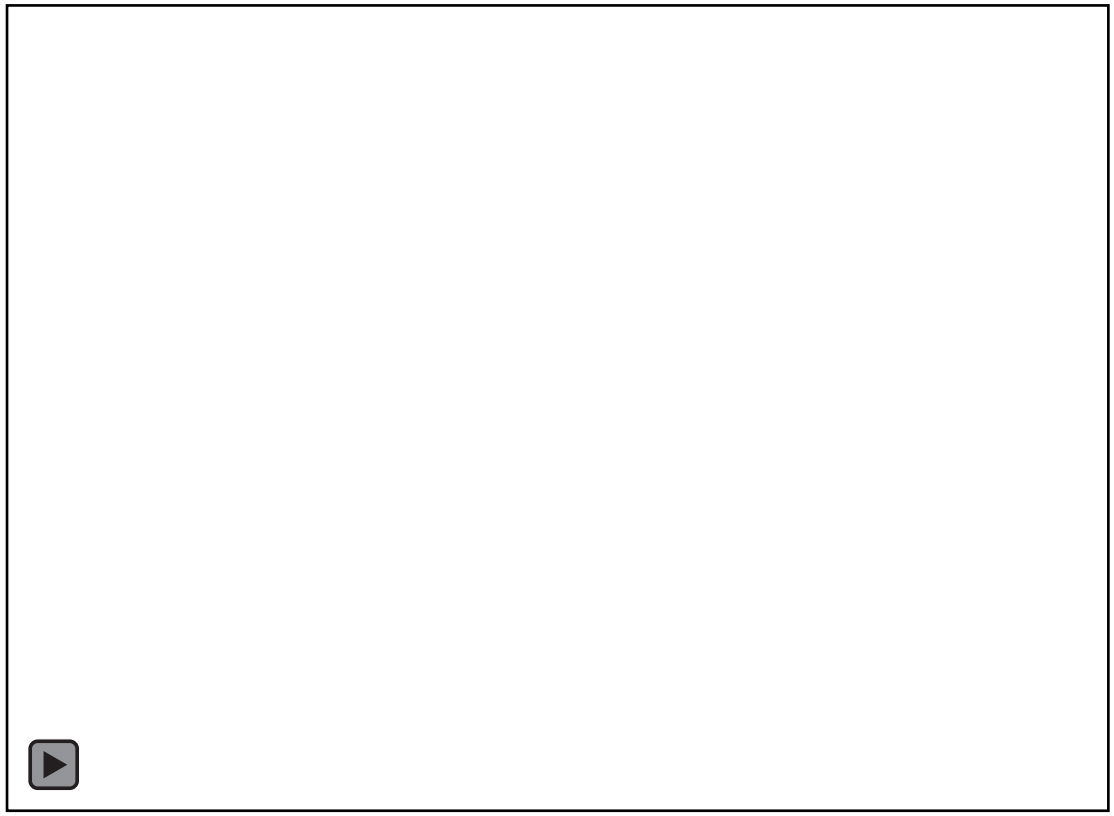
Sondeurs multifaisceaux

Mesure de la profondeur dans n directions (n faisceaux acoustiques).
Ces faisceaux forment une fauchée perpendiculaire à l'axe du navire.
On explore ainsi le fond sur une large bande :**levé surfacique - insonification totale**



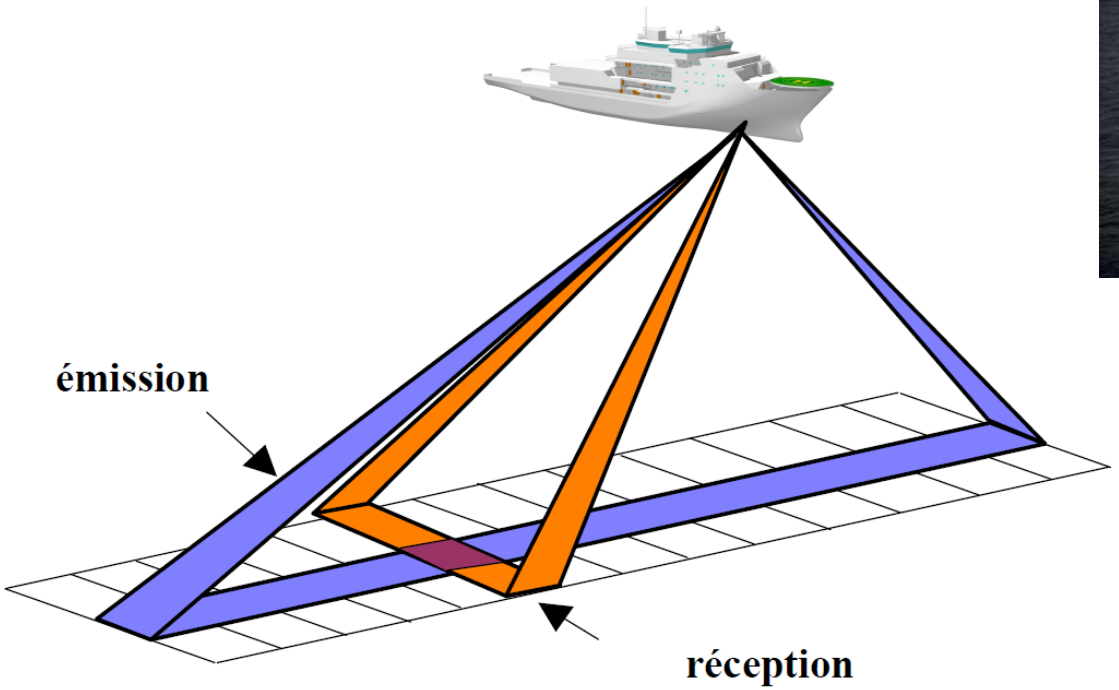
Avantages du sondeur multifaisceau :

- exploration (“ insonification ”) d’un large couloir (“ fauchée ”), le long de la route du navire,
- grande résolution (d’autant plus grande que ses faisceaux sont étroits).



Ifremer

Principe des faisceaux croisés







- **Emission d'une impulsion sonore au travers d'un faisceau d'émission** (longitudinalement # 1° - transversalement # 150°)
- **Réception du signal réfléchi par le fond selon N faisceaux de réception** (transversalement # 1°)
- Pour chaque faisceau de réception, la zone du fond explorée est l'intersection entre les faisceaux d'émission et de réception.

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Systèmes multifaisceaux – antennes carénages



Le Suroît - EM302 - 30 kHZ

Tx = 3 m / Rx = 1,5 m



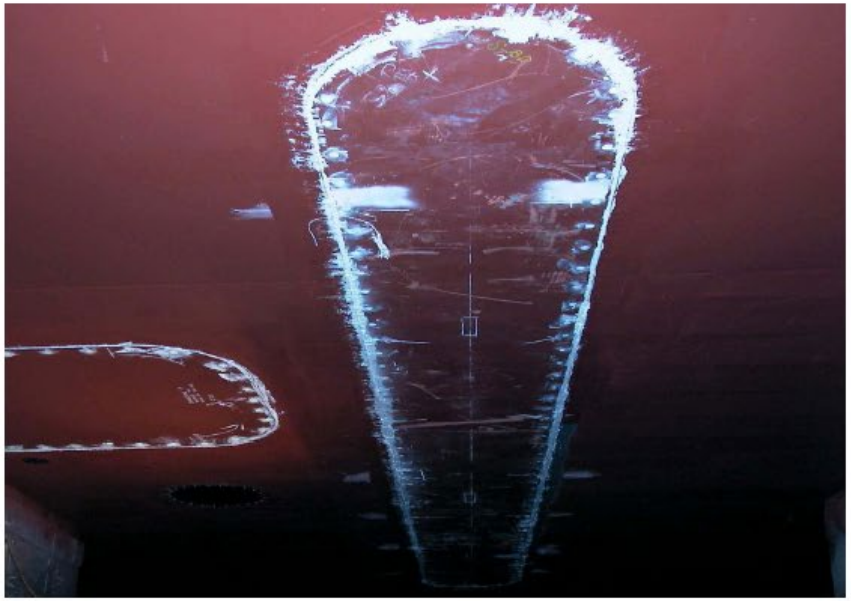
BH2 - EM1002 - 95 kHZ Tx/RX : Ø = 0,6 m

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INTECHMER

Systèmes multifaisceaux – antennes montage flush

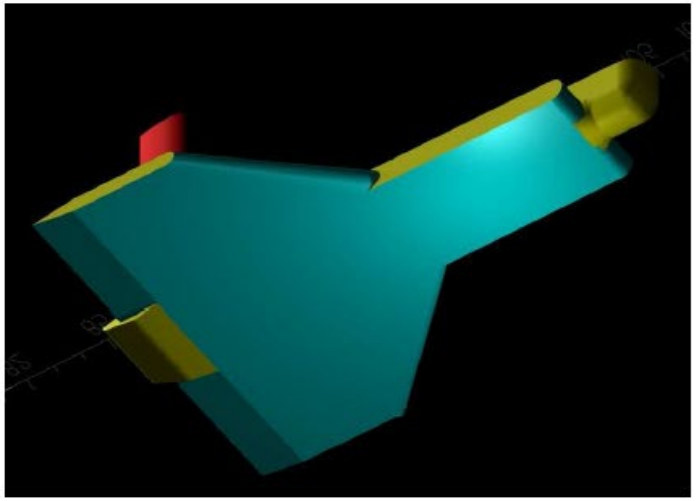


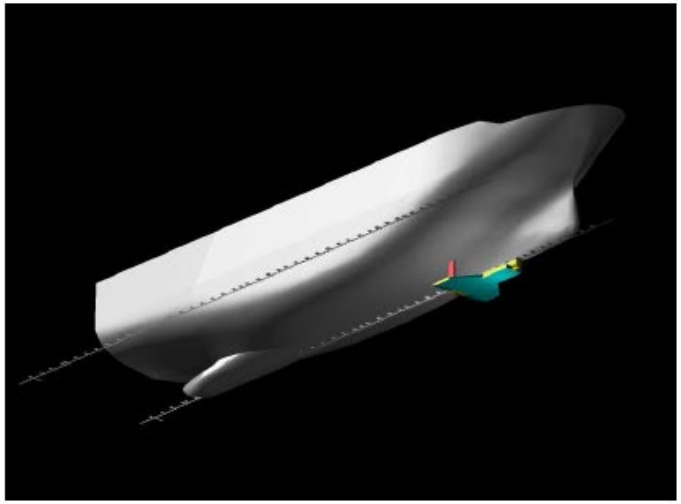


EM120 - 12 kHz

Tx = 8 m / Rx = 8 m

Systèmes multifaisceaux - gondole







Beautemps Beaupré - EM120 - 12 kHZ

Tx = 8 m / Rx = 8 m

L 'ensemble des bases acoustiques est regroupé dans une « gondole »



EA 600 200 kHz

Pourquoi pas?

Seabat 7150 – 12 / 24 kHz

Seabat 7150

Tx 12 kHz

EA 600 12 kHz

EA 600 38 kHz

Sondeur navigation

8,5 m

Seabat 7150

Tx 24 kHz

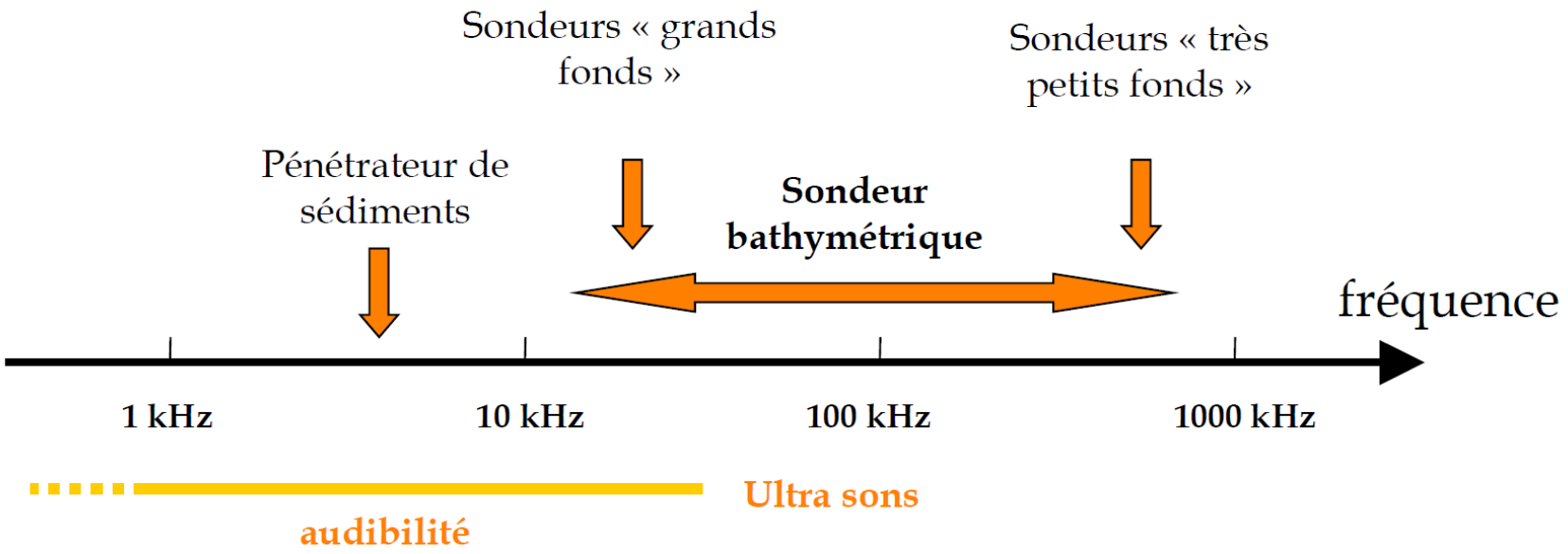
Pénétrateur de Sédiments

Seabat 7150 Rx

12,3 m

Fréquence

- **Quand la fréquence ↑, le coefficient d'absorption ↑, la portée ↓**



sondeurs	Plage de profondeur	Fréquence	Types de levé
Grands fonds	100 à 12 000 m	10 – 15 kHz	Talus, dorsale et plaines abyssales
Moyens fonds	30 à 3000 m	30 – 50 kHz	Plateau, talus
Petits fonds	5 à 500 m	80 – 120 kHz	Plateau continental
Très petits fonds	0 à 100 m	200 à 400 kHz	Zones littorales

Nombre de faisceaux

De 100 à 1000, suivant les équipements

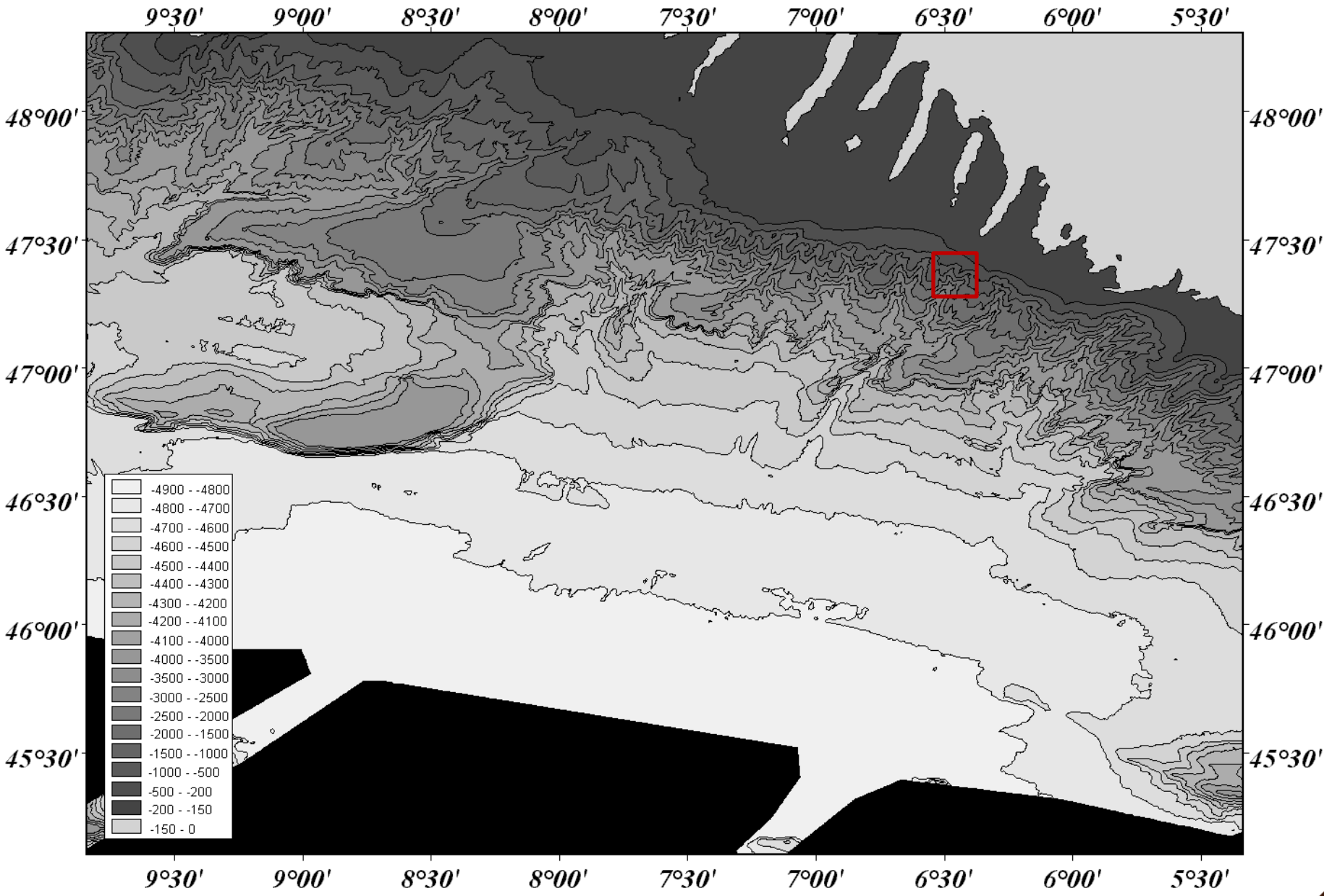
ex : *Seabeam (Jean Charcot - 1977) : 16*

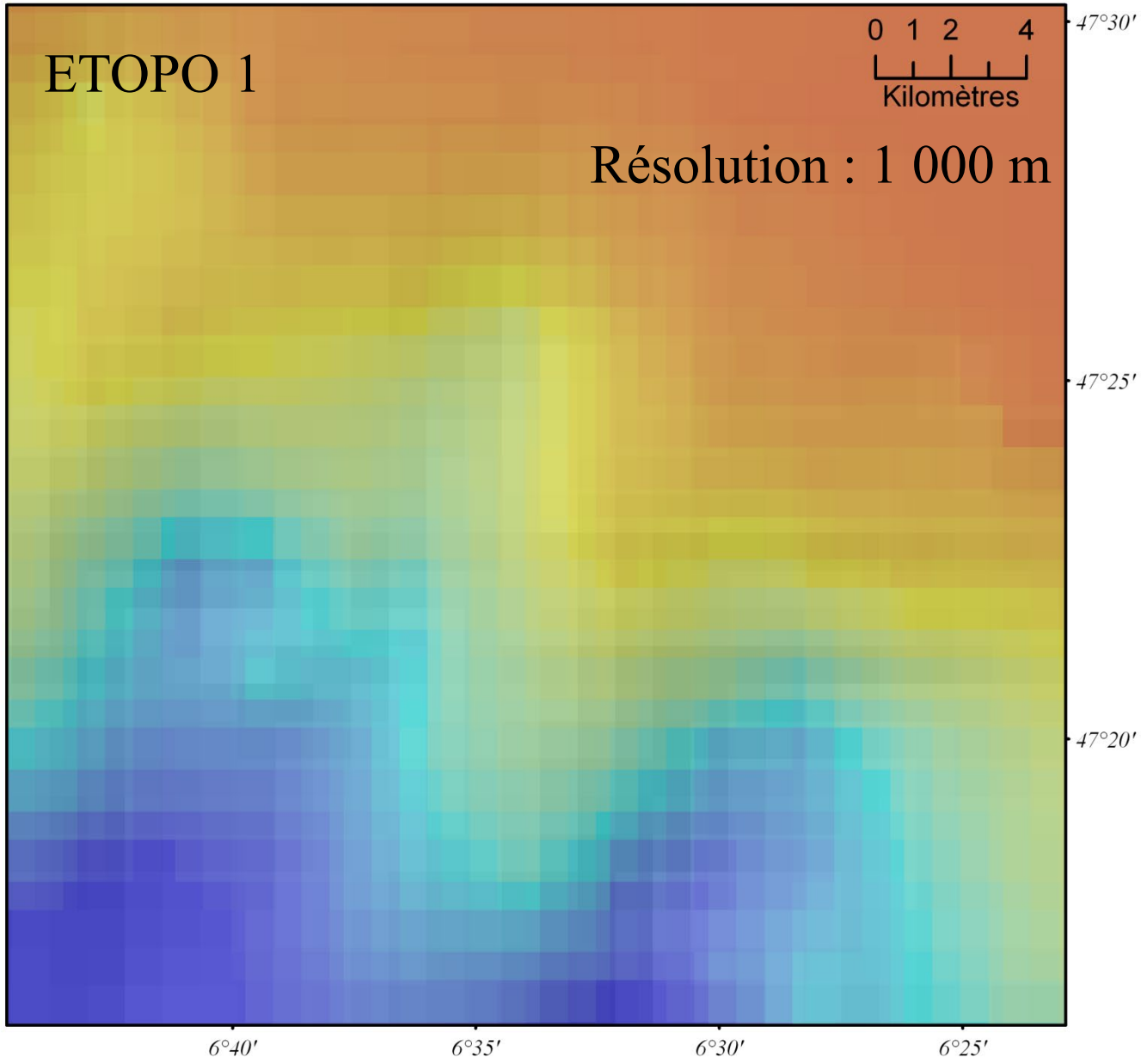
EM1000 (Thalia - 1993) : 60

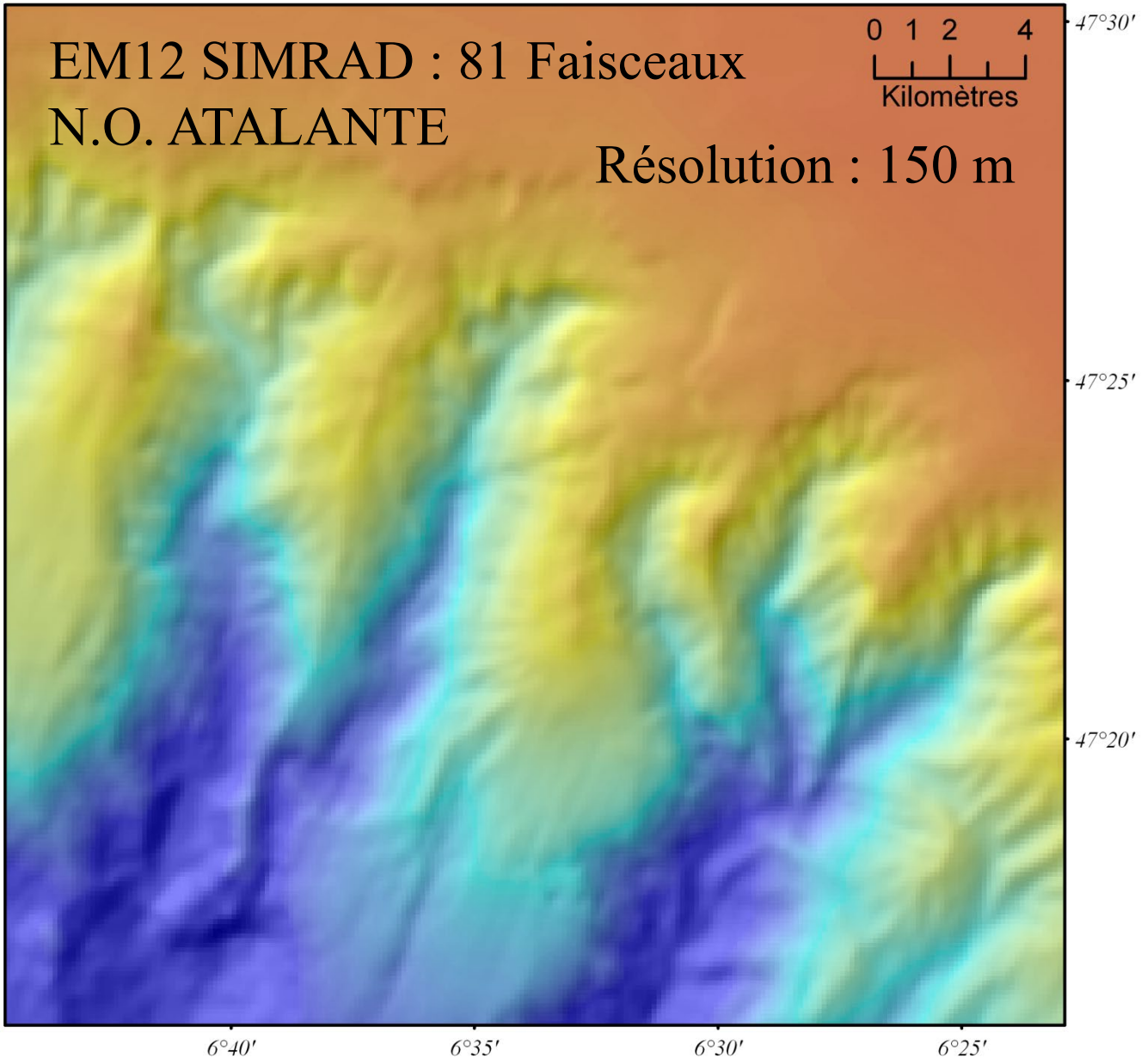
EM120 (Beautemps Beaupré - 2002) : 191

Seabat 7150 (Pourquoi pas? – 2007) : 880



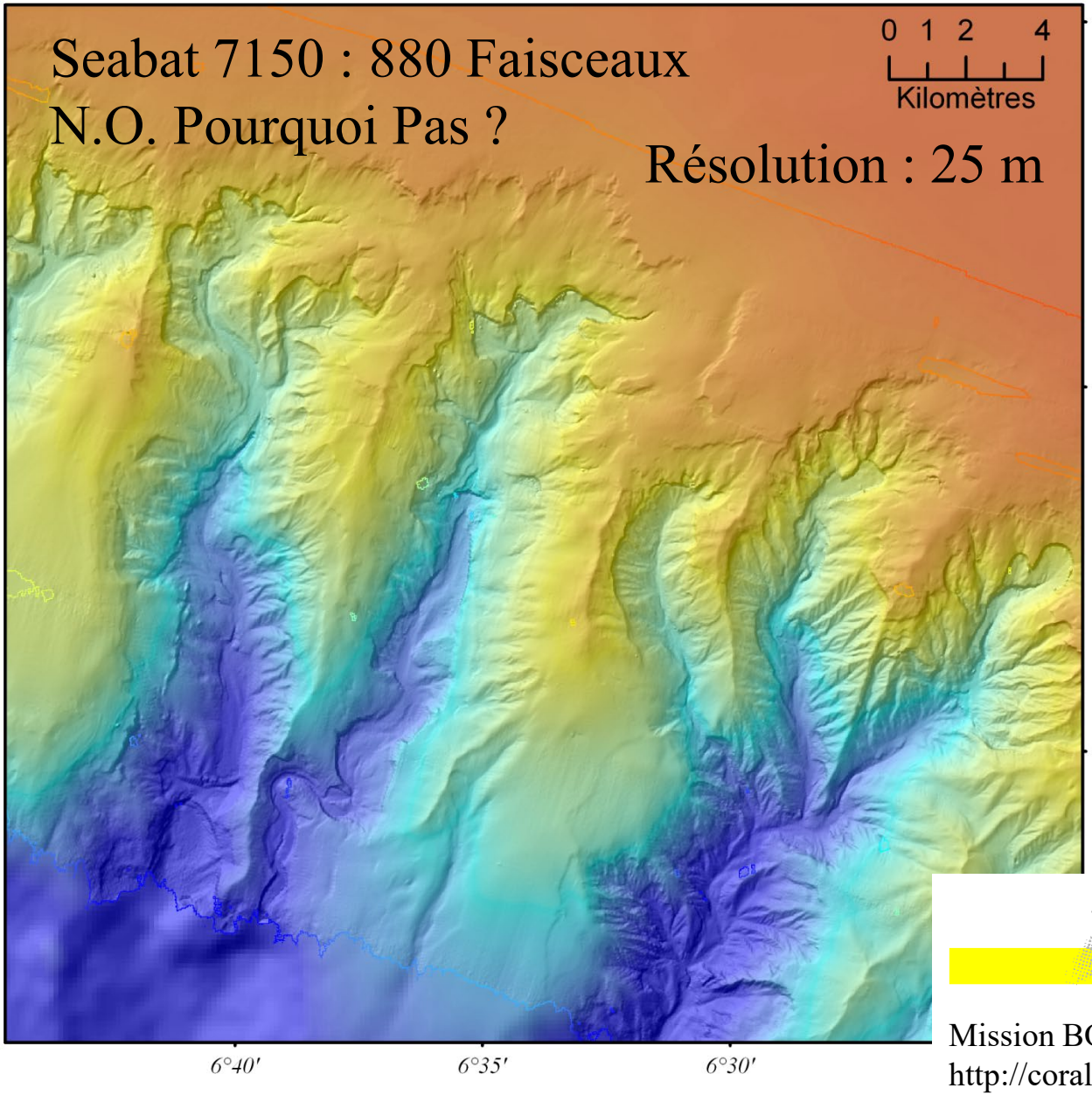

9°30'
9°00'
8°30'
8°00'
7°30'
7°00'
6°30'
6°00'
5°30'
48°00'
47°30'
47°00'
46°30'
46°00'
45°30'
-4900 - -4800
-4800 - -4700
-4700 - -4600
-4600 - -4500
-4500 - -4400
-4400 - -4300
-4300 - -4200
-4200 - -4100
-4100 - -4000
-4000 - -3500
-3500 - -3000
-3000 - -2500
-2500 - -2000
-2000 - -1500
-1500 - -1000
-1000 - -500
-500 - -200
-200 - -150
-150 - 0


ETOPO 1
Résolution : 1 000 m
0 1 2 4
Kilomètres
47°30′
47°25′
47°20′
6°40′
6°35′
6°30′
6°25′



1997

Ifremer

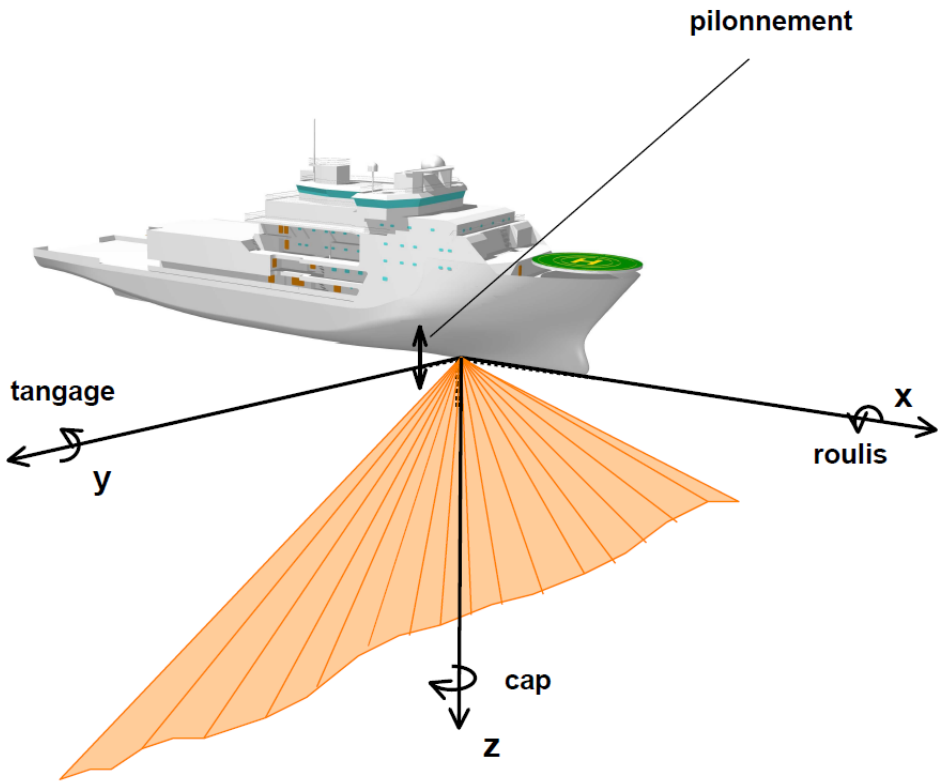


2009

Ifremer

Mission BOBGEO
http://coralwatcher.wordpress.com/

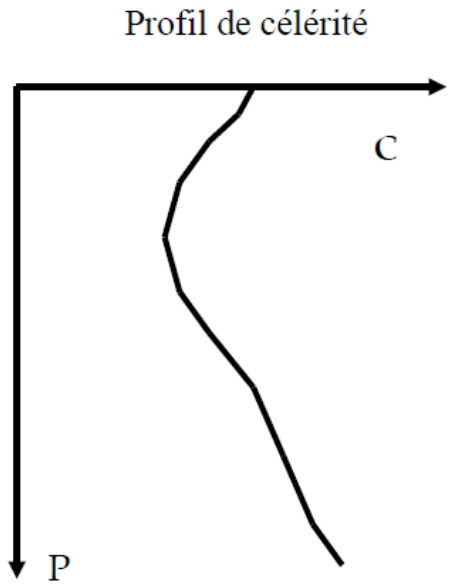
Corrections d'attitude



➡ Correction par la centrale d'attitude

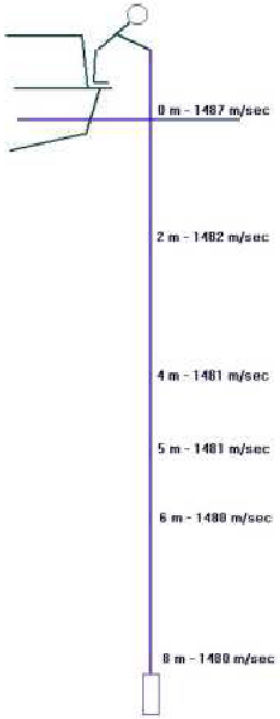
Correction de réfraction

Les variations de célérité provoquent une courbure des rayons sonores. Il est nécessaire, pour établir le trajet de l'onde sonore, pour une incidence et une durée de trajet donnée, de connaître la célérité du son dans l'eau (profil de célérité).



Mesure du profil de célérité cadence

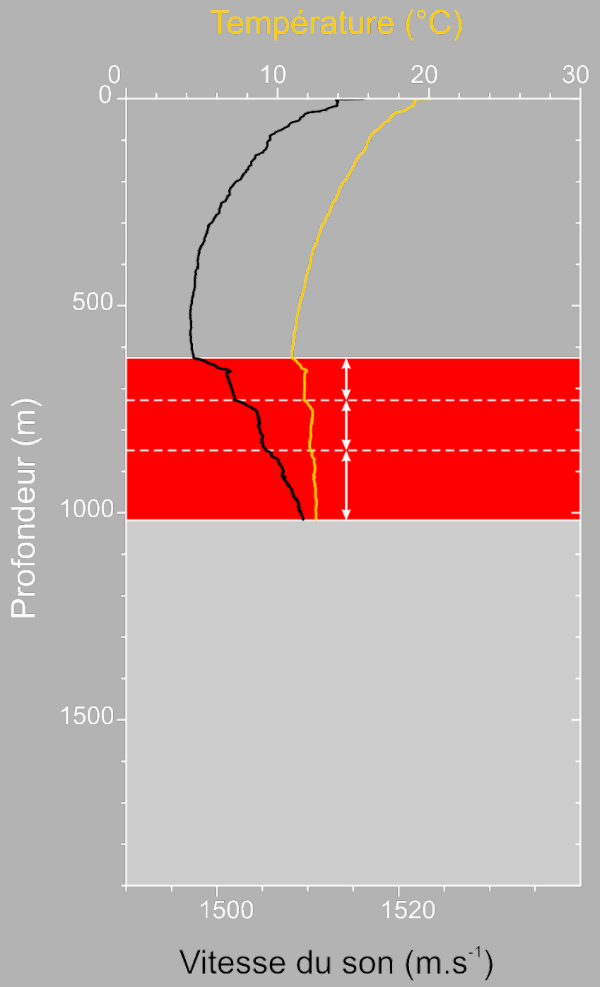
- **Levé « petits fonds »**
  - début / fin de séance



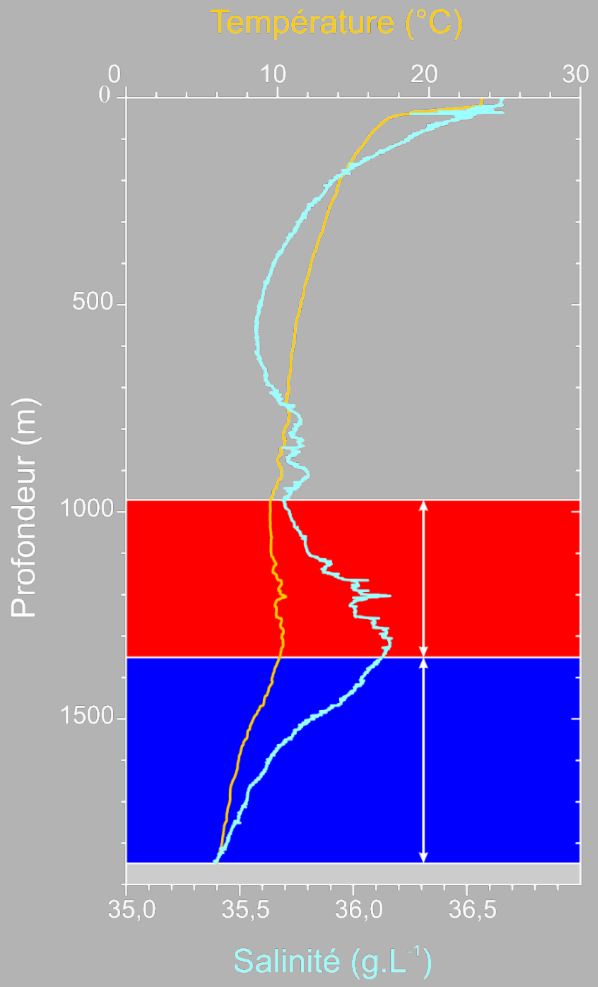
- **Levé « grands fonds »**
  - # 4 / 6 heures



Ifremer



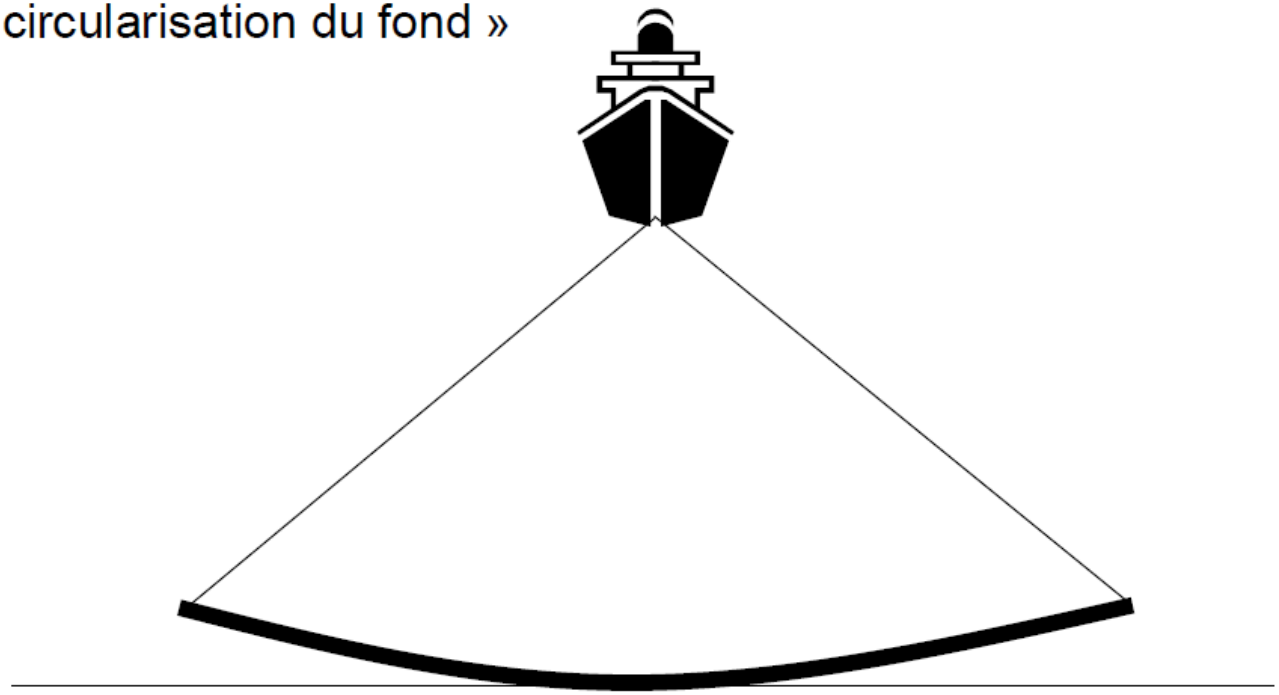
Sonde XBT

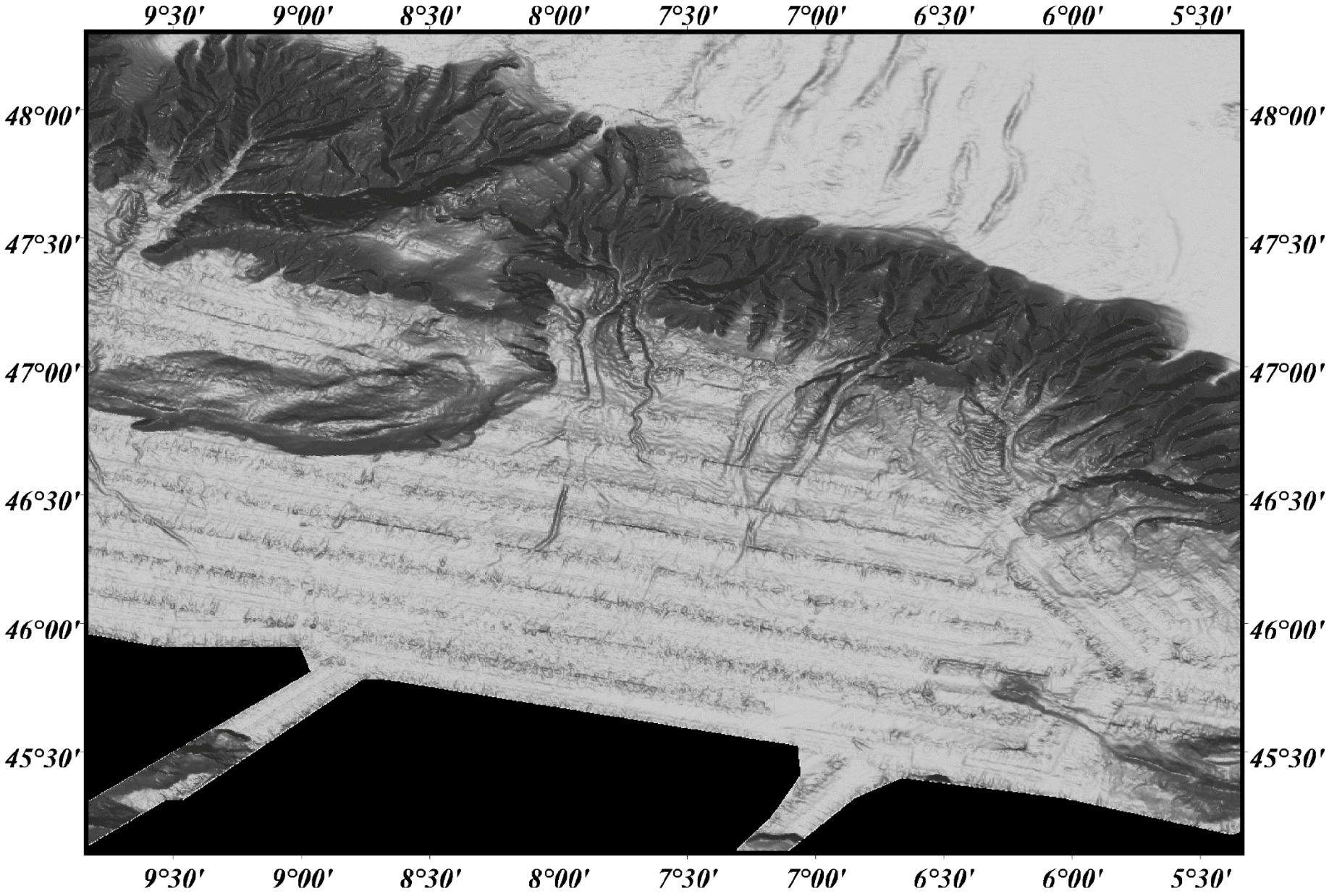


Sonde CTD

Artefact induit par une mauvaise correction de célérité

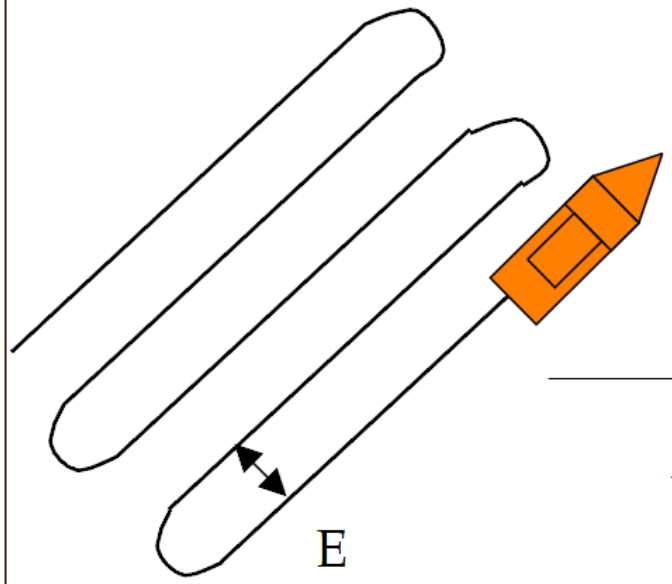
→ « circularisation du fond »



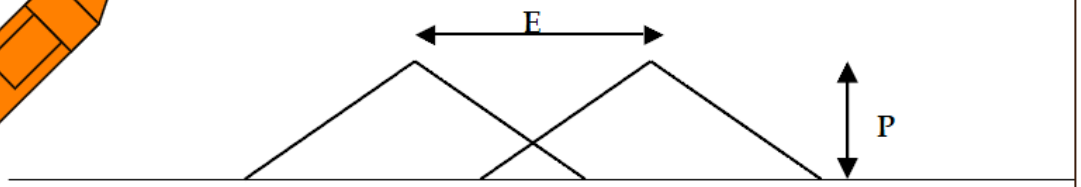

9°30'
9°00'
8°30'
8°00'
7°30'
7°00'
6°30'
6°00'
5°30'
48°00'
47°30'
47°00'
46°30'
46°00'
45°30'

Le levé « régulier »

Suivi de routes (« profils ») régulièrement espacées



E = f (profondeur)



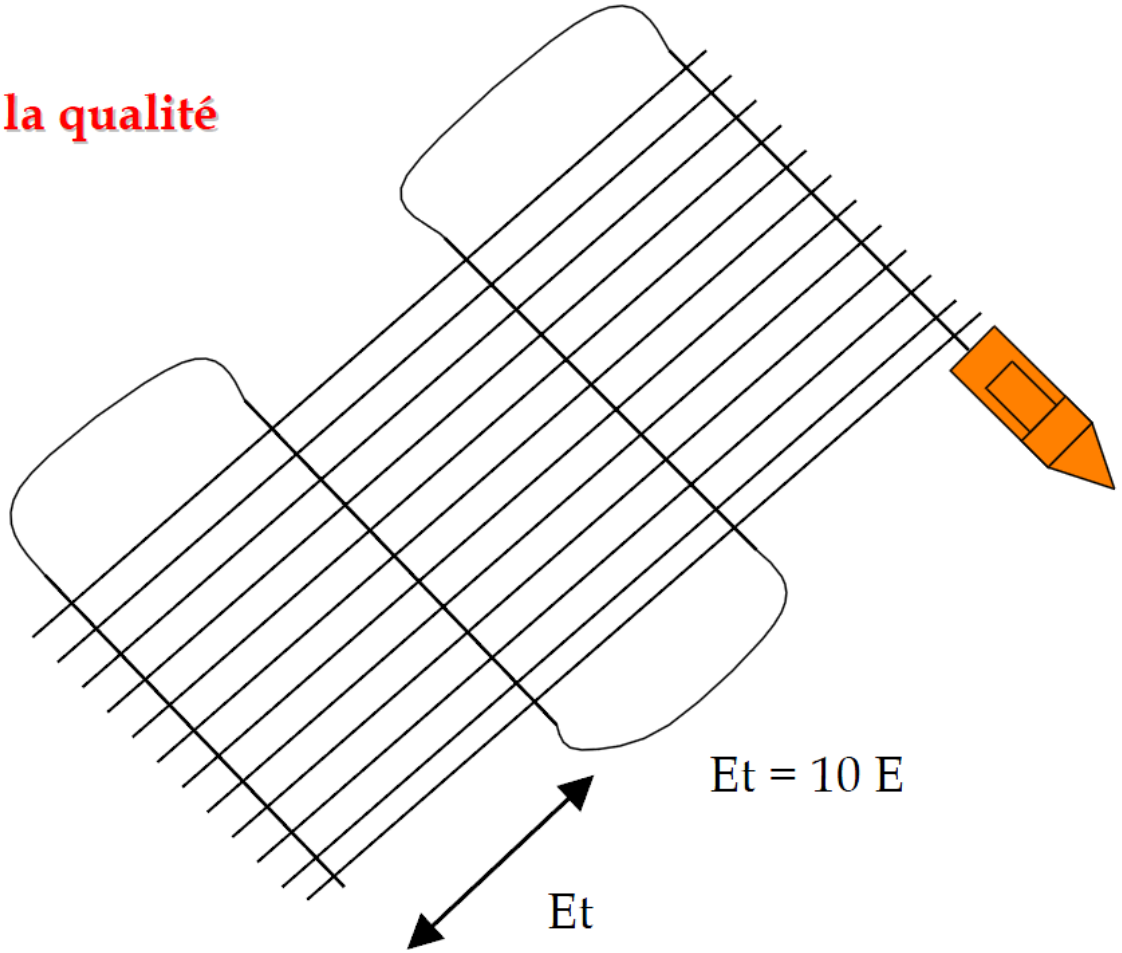
$E = 0{,}8 * F = 0{,}8 \times 2 * P \tan(\theta_M)$

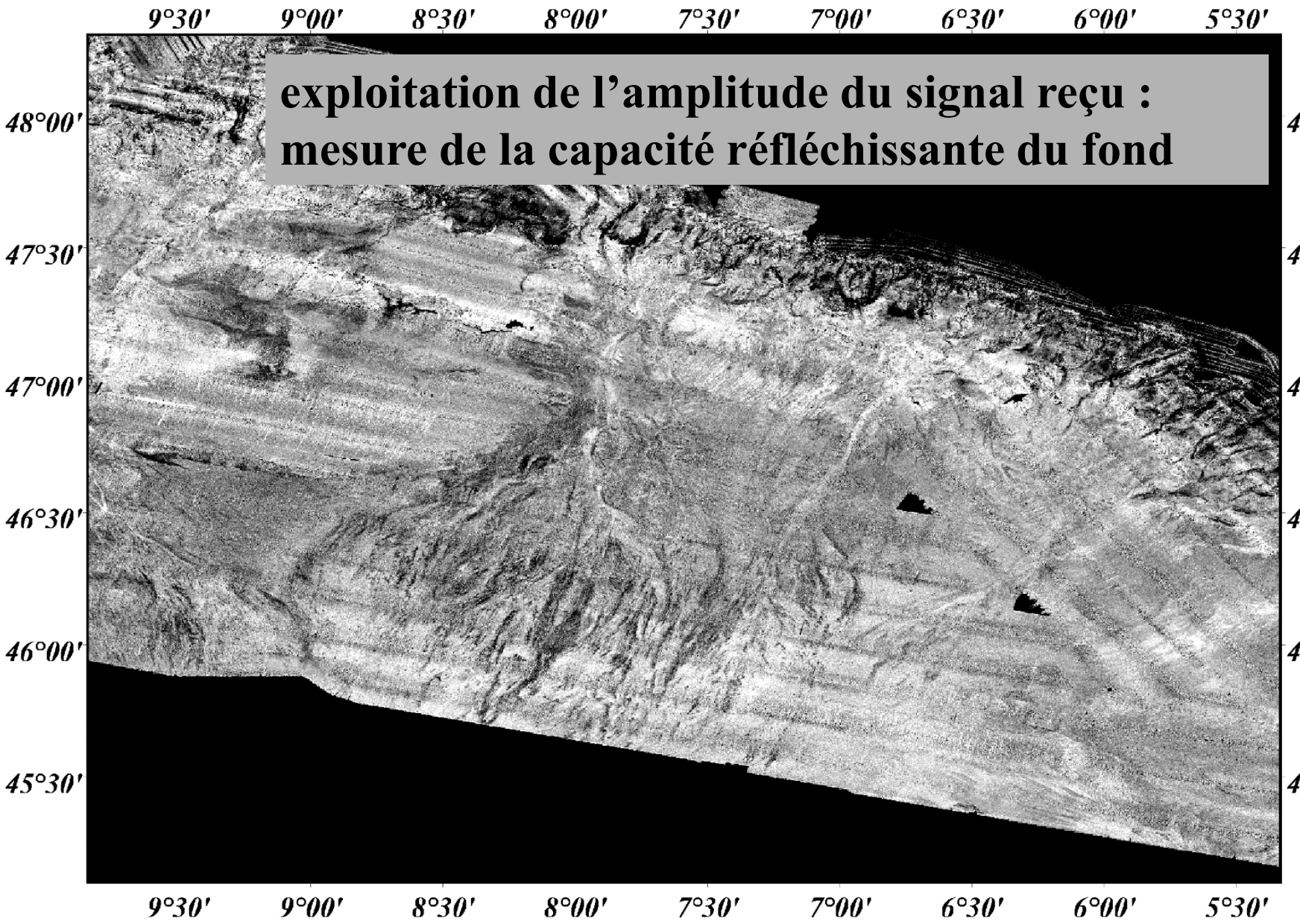
ex = $P = 1000$ m / $2\theta_M = 140°$ -> E # 4000 m

$P = 5$ m / $2\,\theta_M = 140°$ -> E # 20 m

Profils traversiers

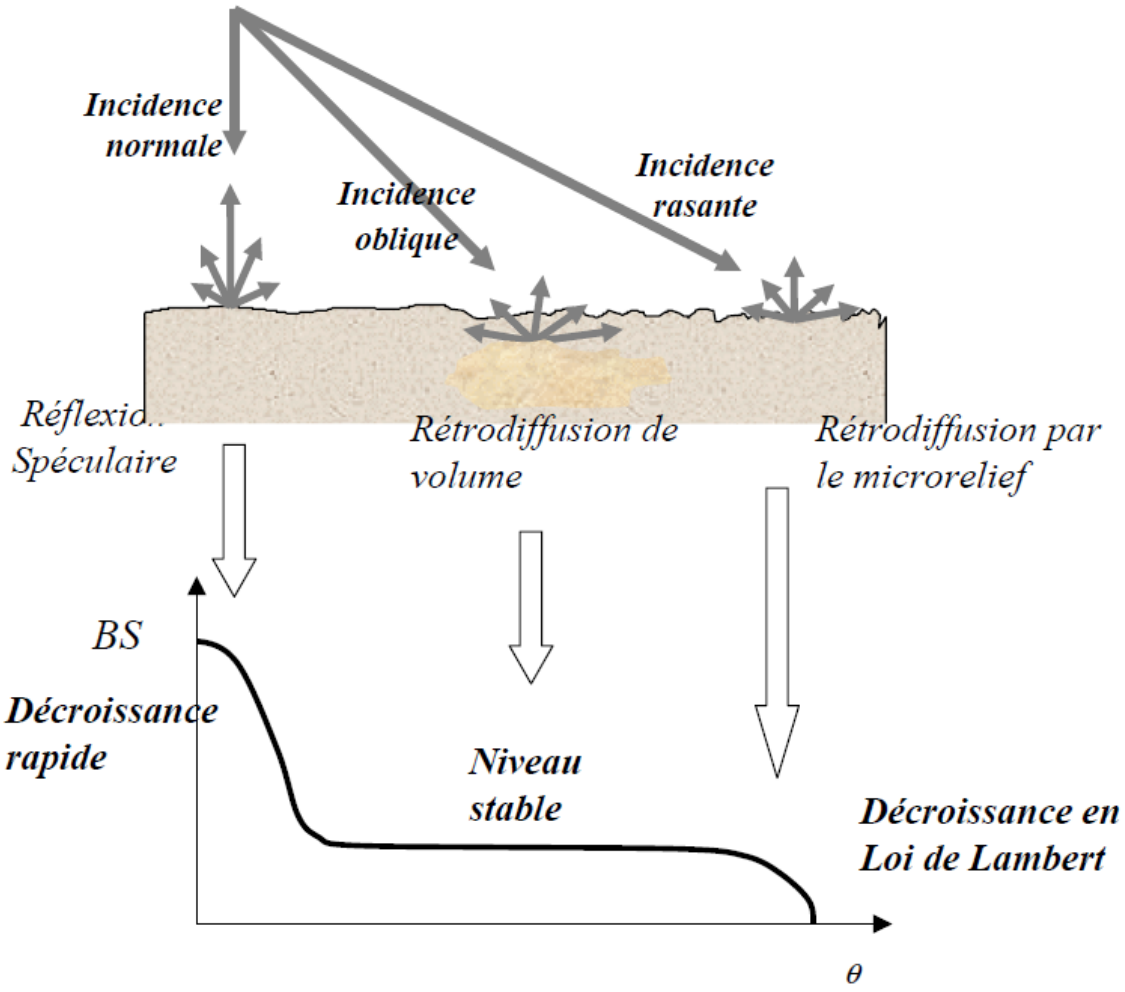
Contrôle de la qualité




9°30'
9°00'
8°30'
8°00'
7°30'
7°00'
6°30'
6°00'
5°30'
48°00'
47°30'
47°00'
46°30'
46°00'
45°30'
exploitation de l'amplitude du signal reçu :
mesure de la capacité réfléchissante du fond

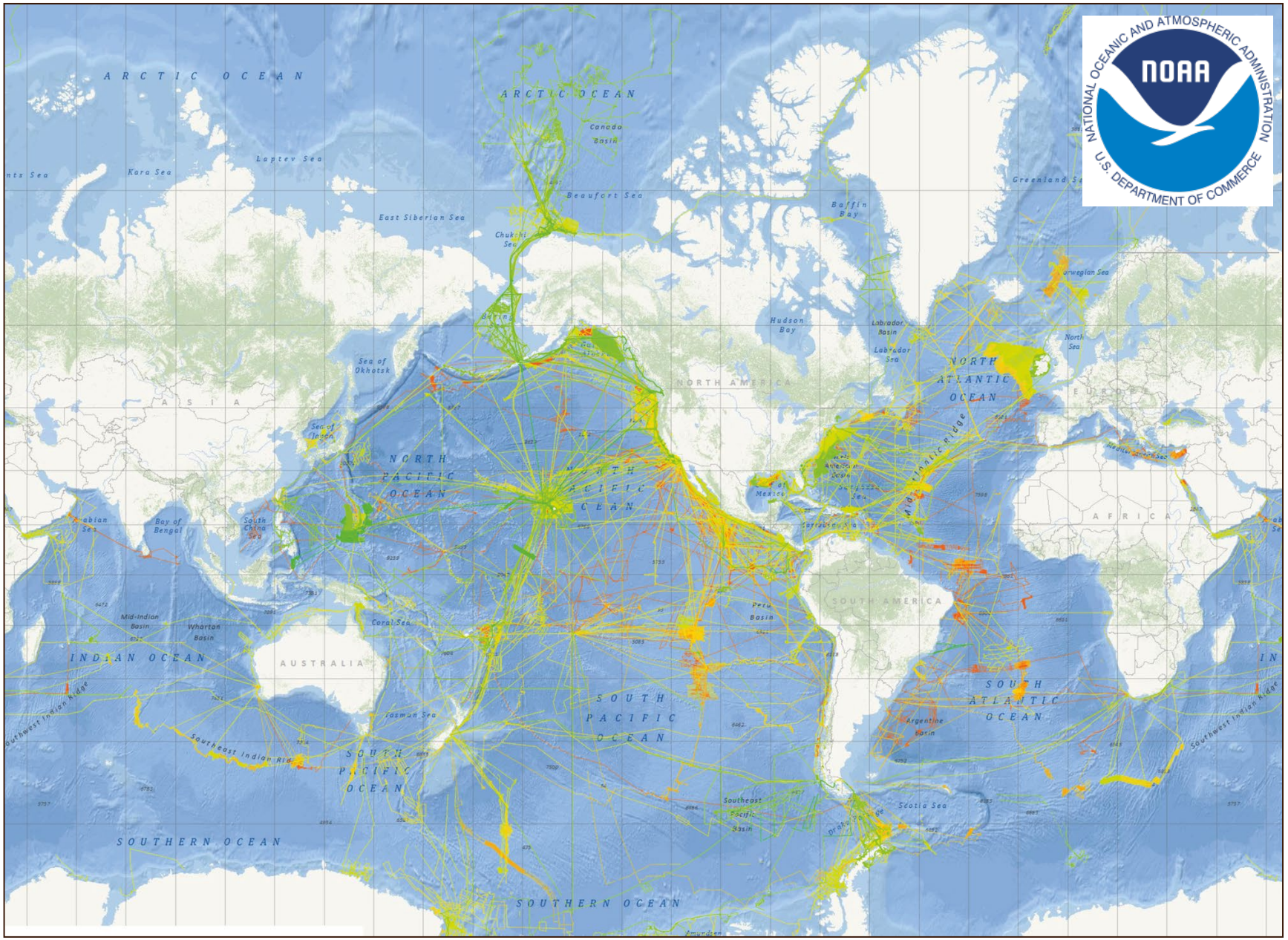
Réflectivité angulaire du fond BS (dB/m²)

BS = f(fréquence, incidence, type de fond)

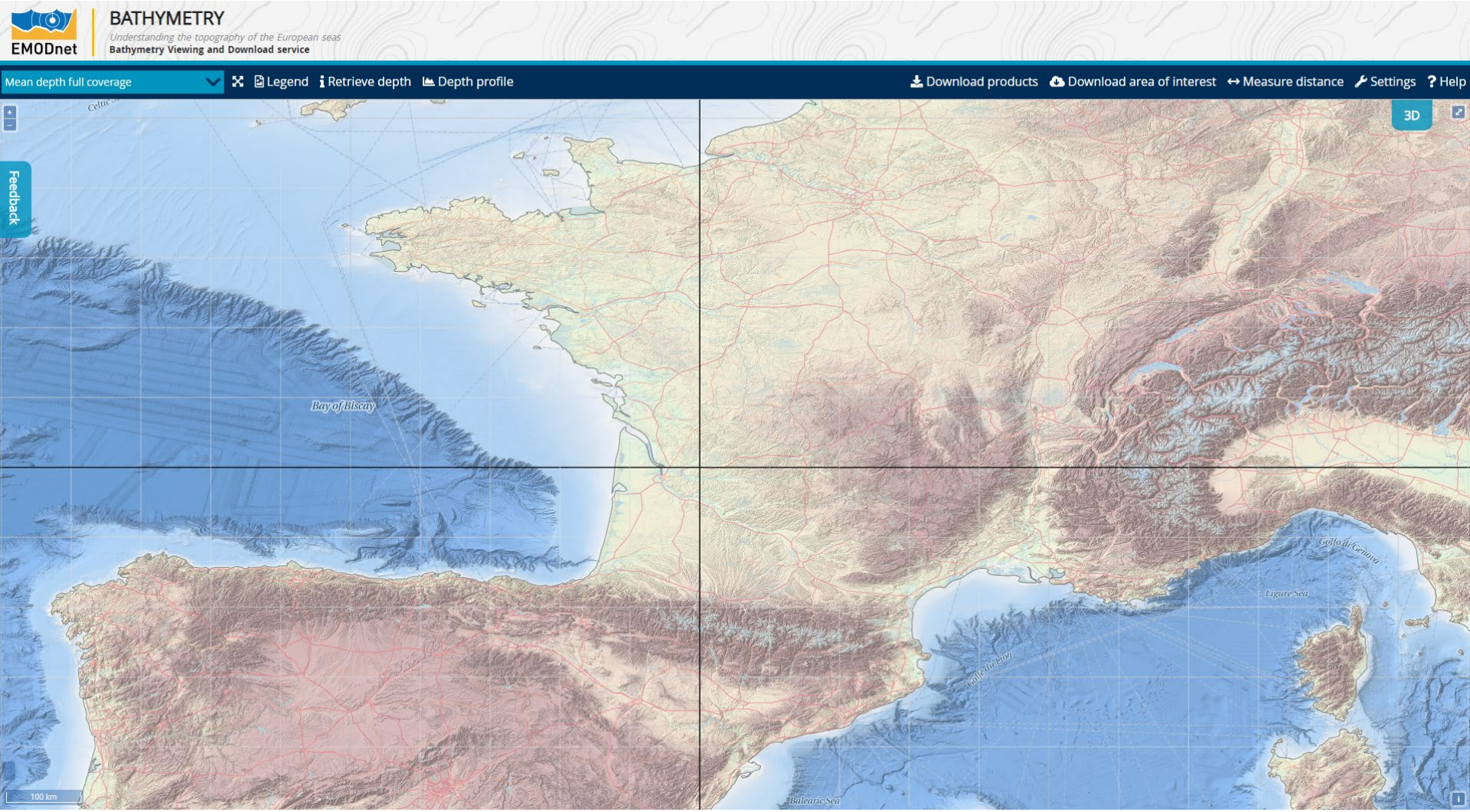


Ifremer

La bathymétrie multifaisceau



La bathymétrie multifaisceau



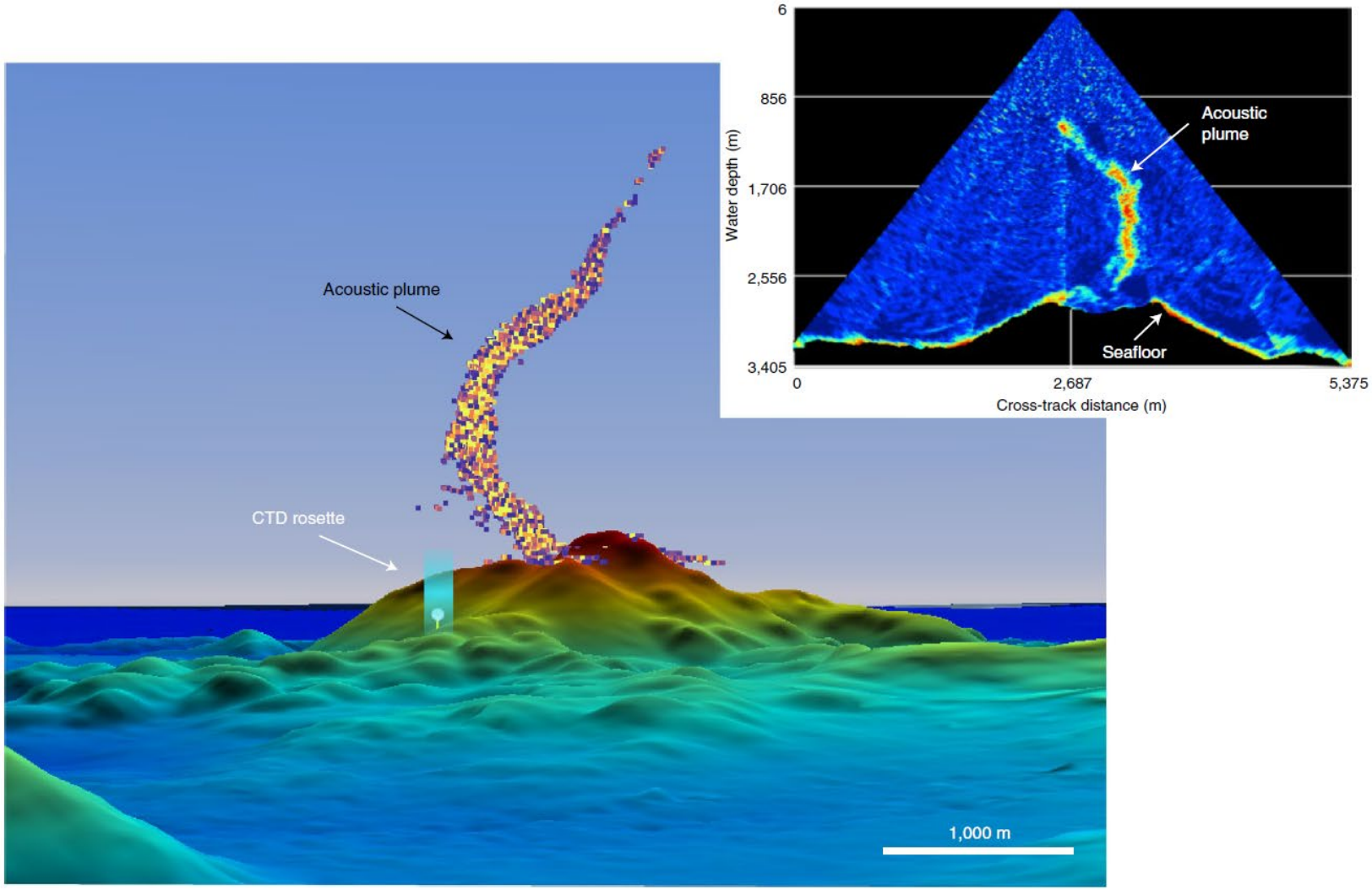
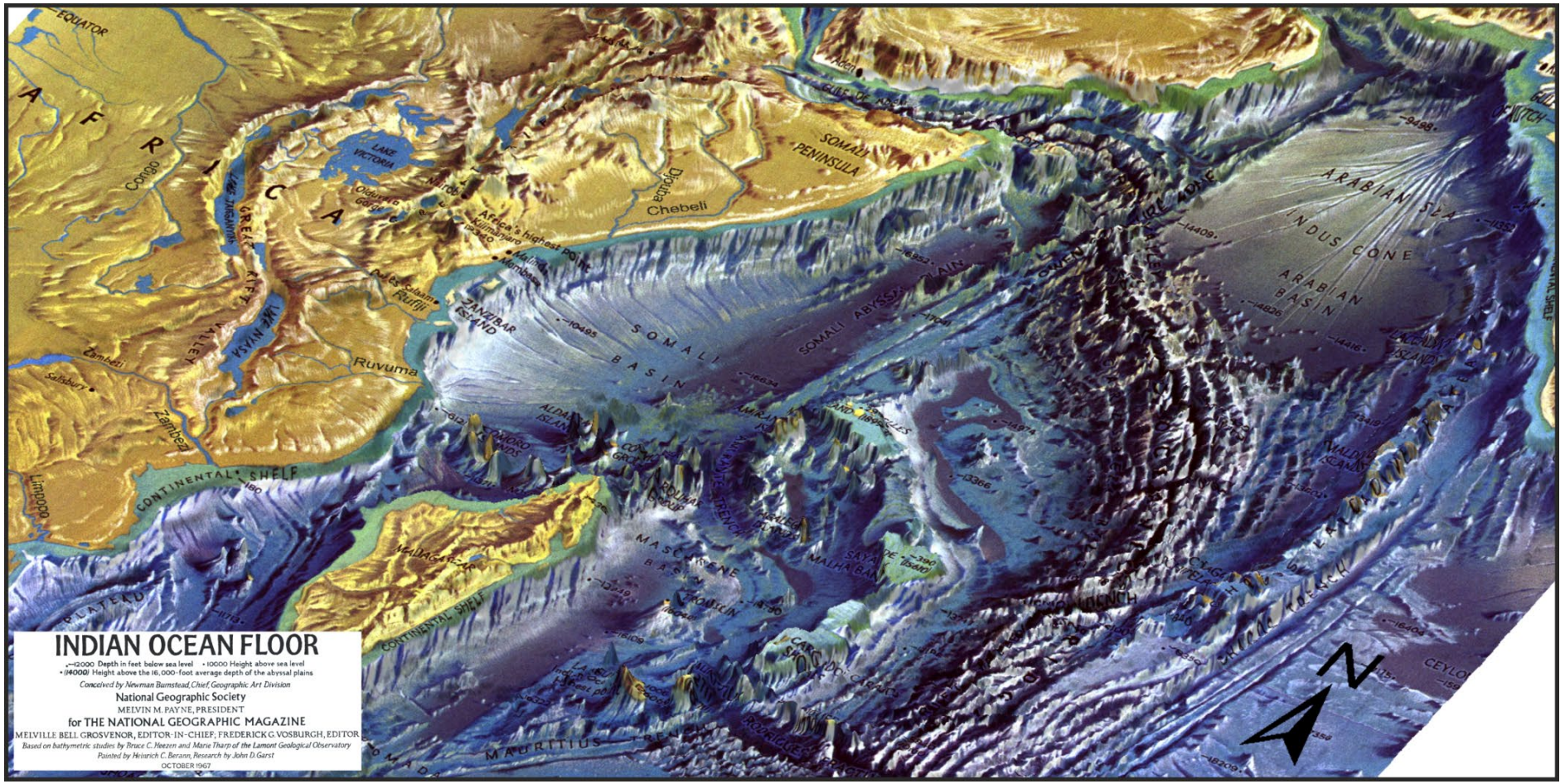


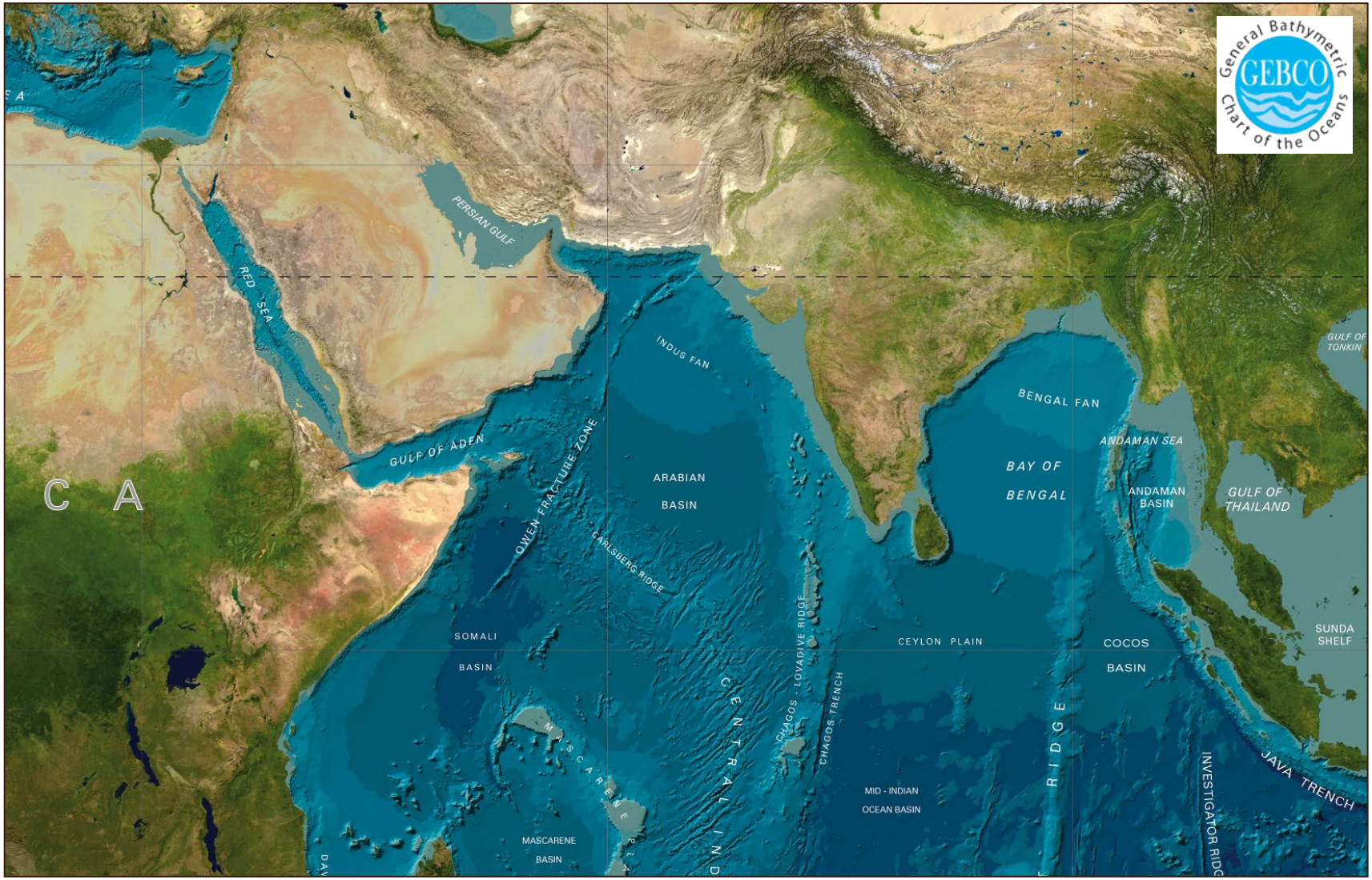
Fig. 3 | The NVE and the acoustic plume. a, Southward 3D view of the NVE and the water-column acoustic plume observed one hour before the CTD rosette on 16 May 2019. The white dot and blue patch indicate the position of the CTD rosette deployment, 1 km from the summit of the volcano. Righ inset: processed polar echogram from one EM122 multibeam ping on 16 May 2019 (13:33 UT).

Feuillet, N. et al. 2021. Birth of a large volcanic edifice offshore Mayotte via lithosphere-scale dyke intrusion. Nat. Geosci. 14, 787–795.

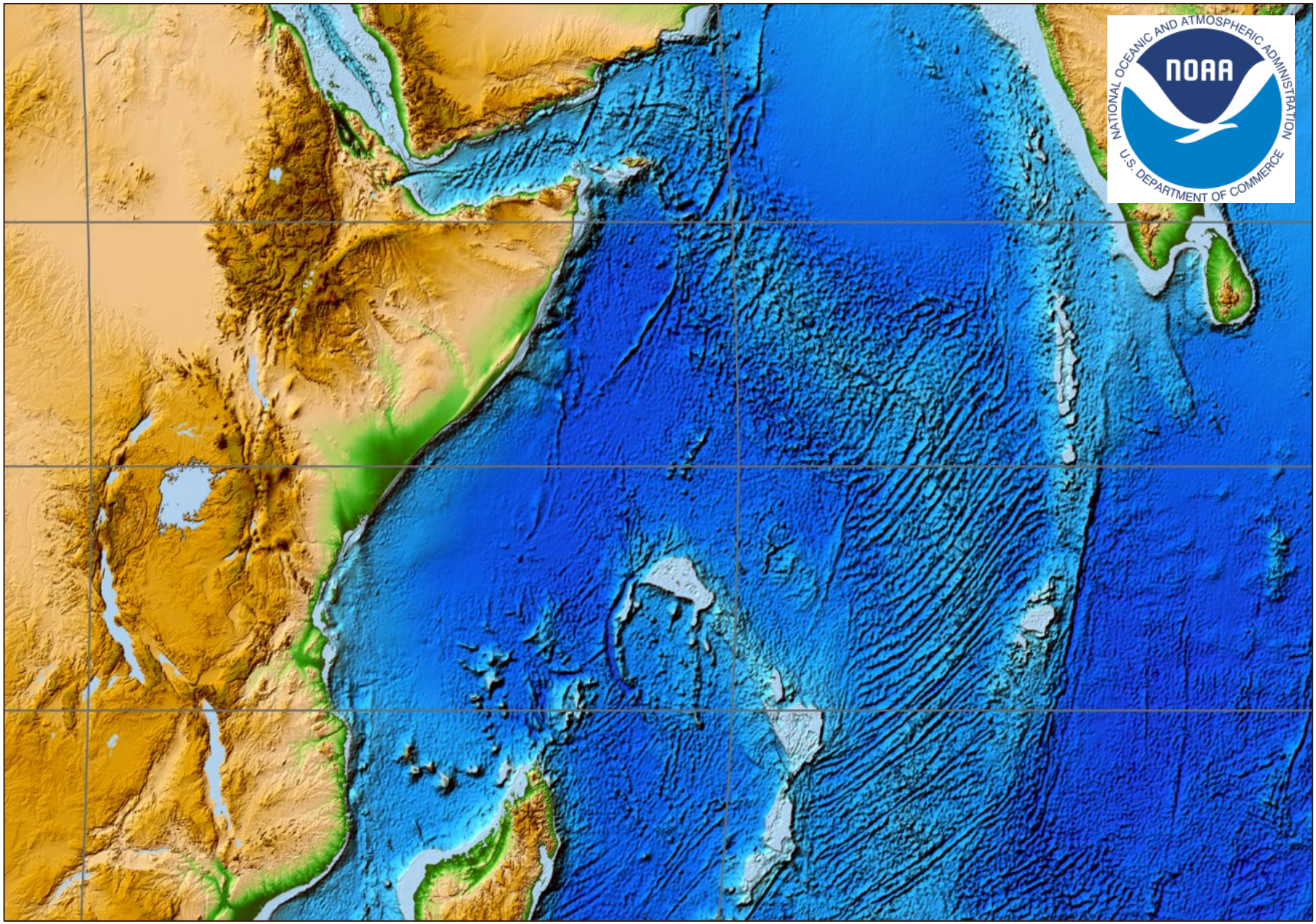
Cas d'étude : le bassin de Somalie

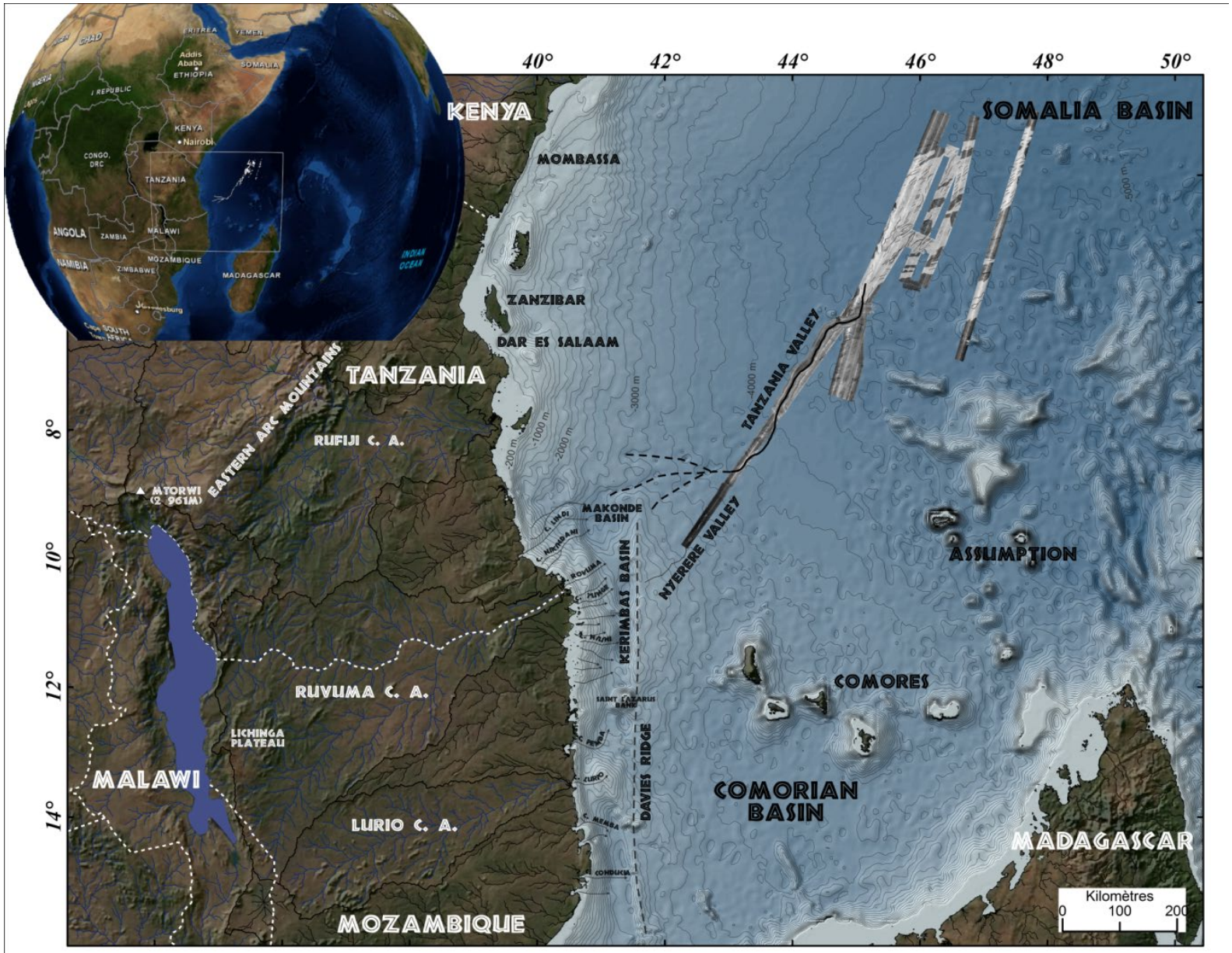


Cas d'étude : le bassin de Somalie

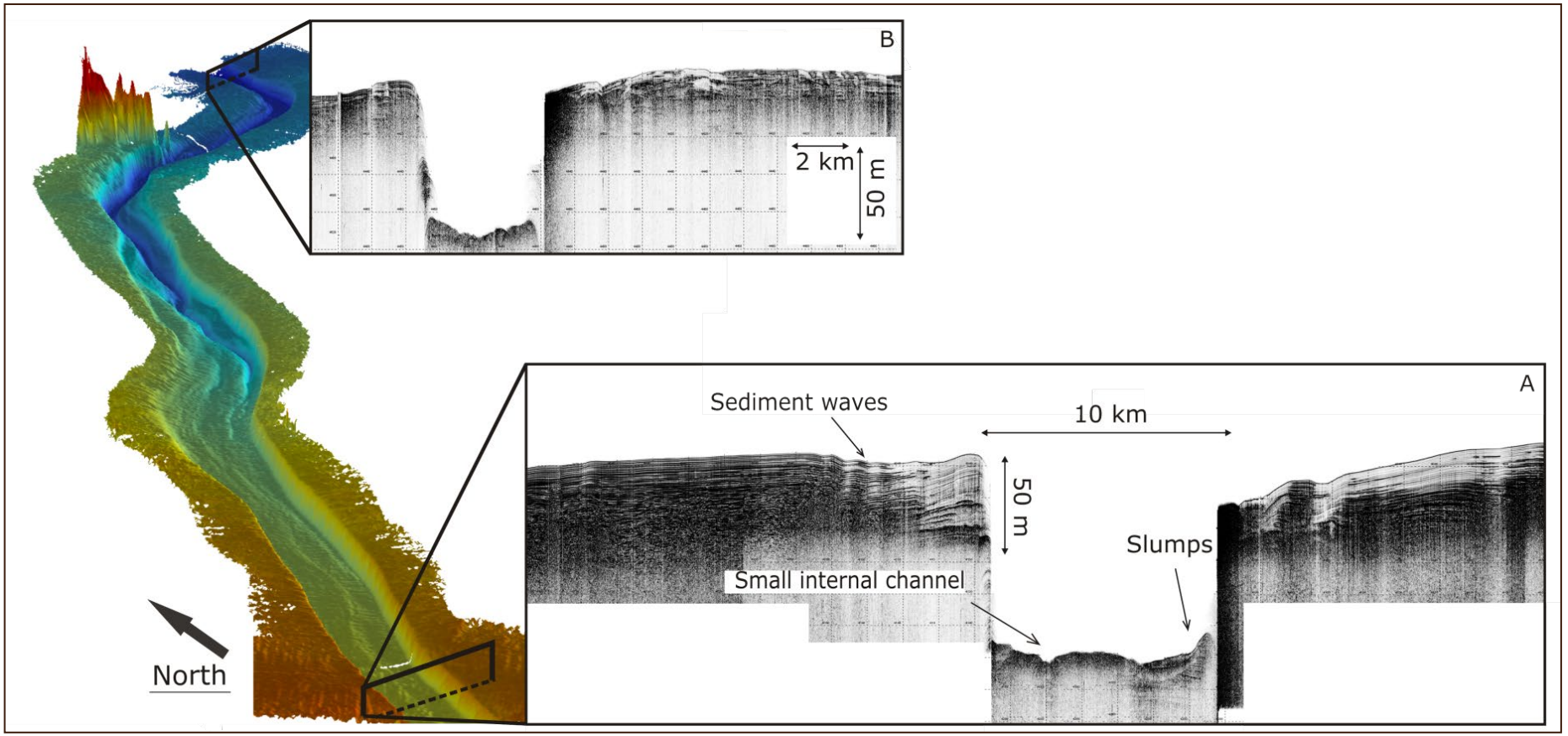


Cas d'étude : le bassin de Somalie

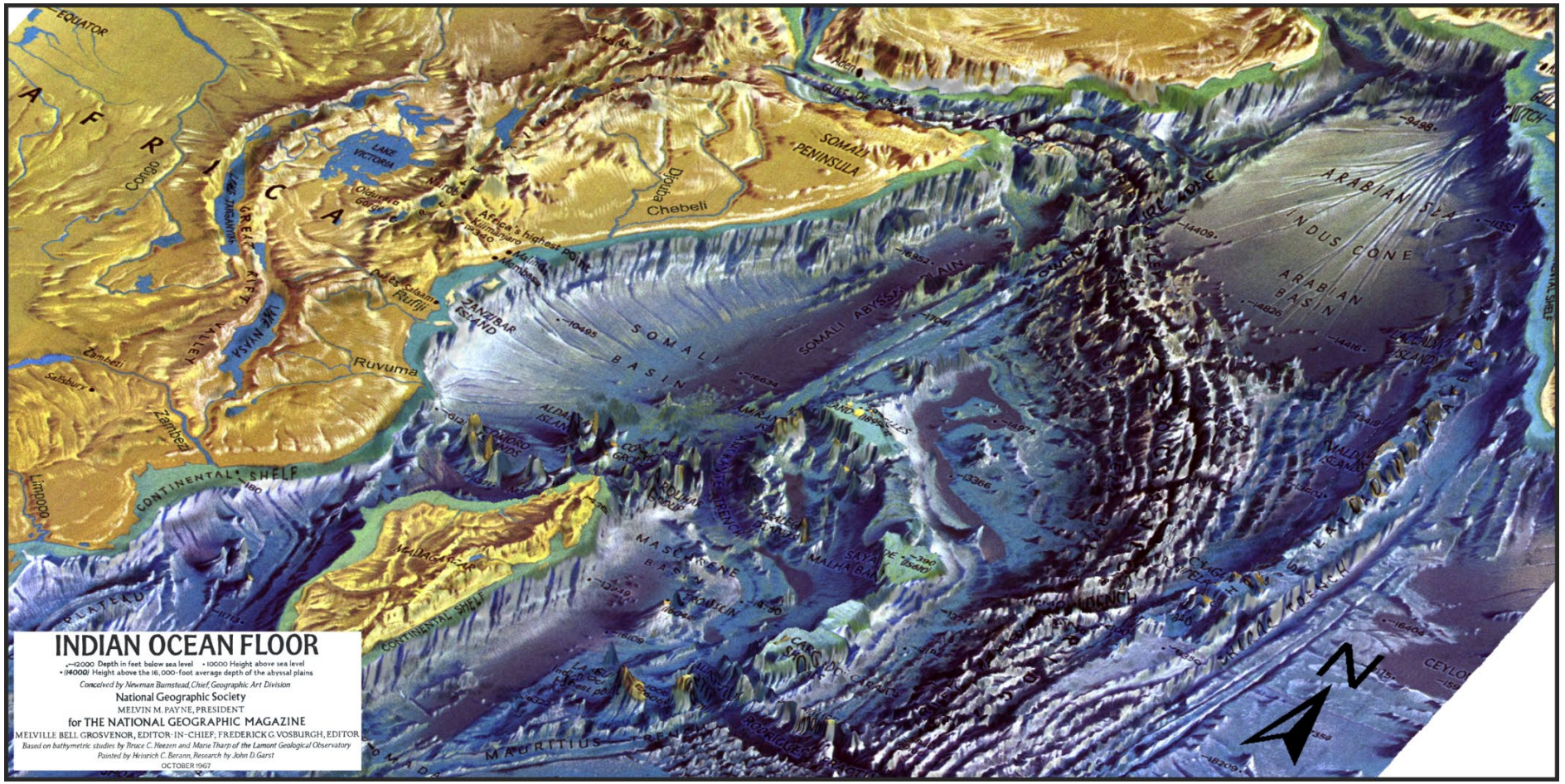



40°
42°
44°
46°
48°
50°
8°
10°
12°
14°
KENYA
MOMBASSA
ZANZIBAR
DAR ES SALAAM
TANZANIA
EASTERN ARC MOUNTAINS
RUFIJI C. A.
MTORWI (2 961M)
RUVUMA C. A.
LICHINGA PLATEAU
MALAWI
LURIO C. A.
MOZAMBIQUE
MAKONDE BASIN
KERIMBAS BASIN
DAVIES RIDGE
TANZANIA VALLEY
NYERERE VALLEY
SOMALIA BASIN
ASSUMPTION
COMORES
COMORIAN BASIN
MADAGASCAR
Kilomètres
0
100
200
Addis Ababa
ETHIOPIA
SOMALIA
ERITREA
YEMEN
CHAD
KENYA
Nairobi
CONGO, DRC
TANZANIA
ANGOLA
ZAMBIA
MALAWI
NAMIBIA
ZIMBABWE
MOZAMBIQUE
MADAGASCAR
INDIAN OCEAN

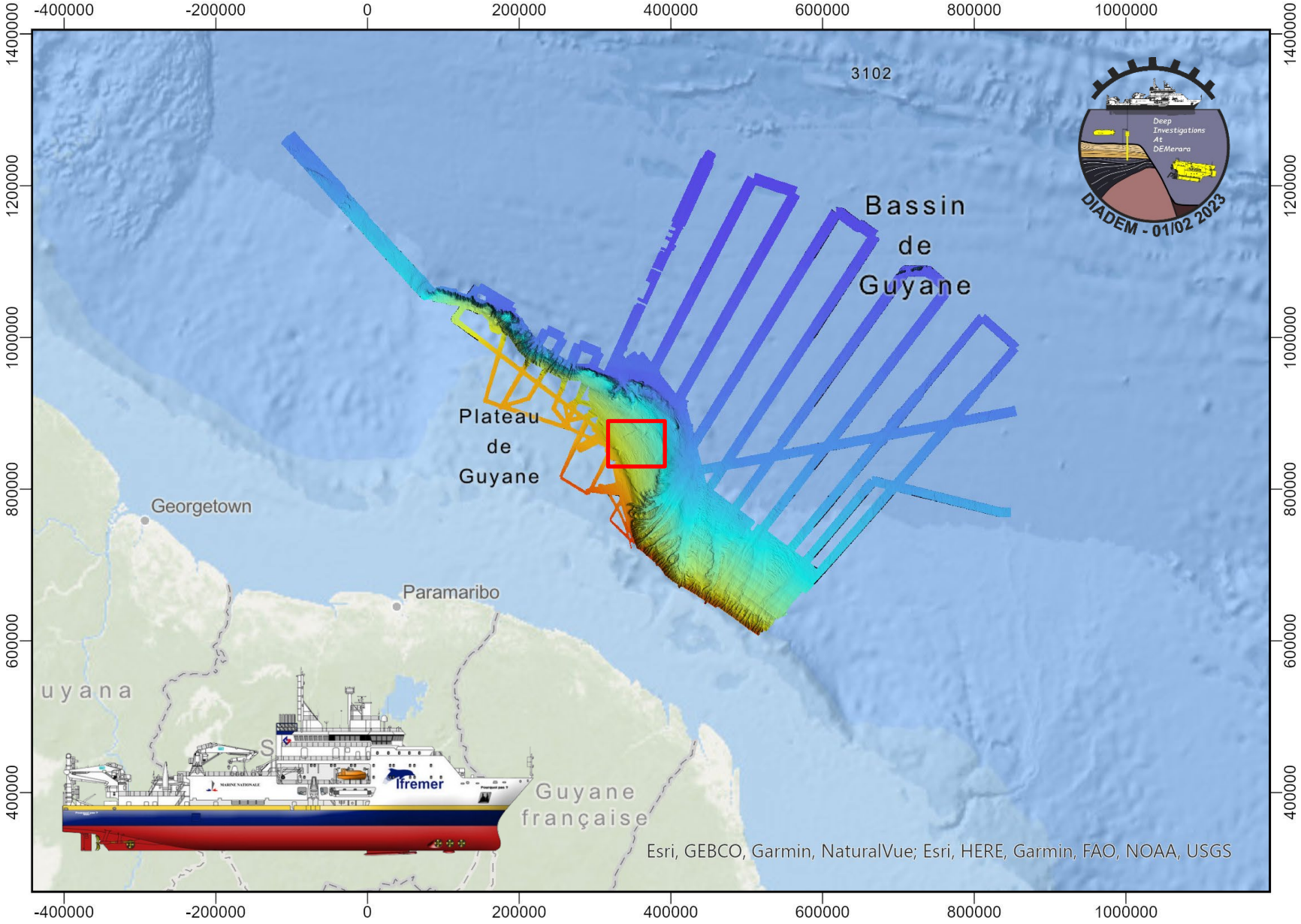
Cas d'étude : le bassin de Somalie



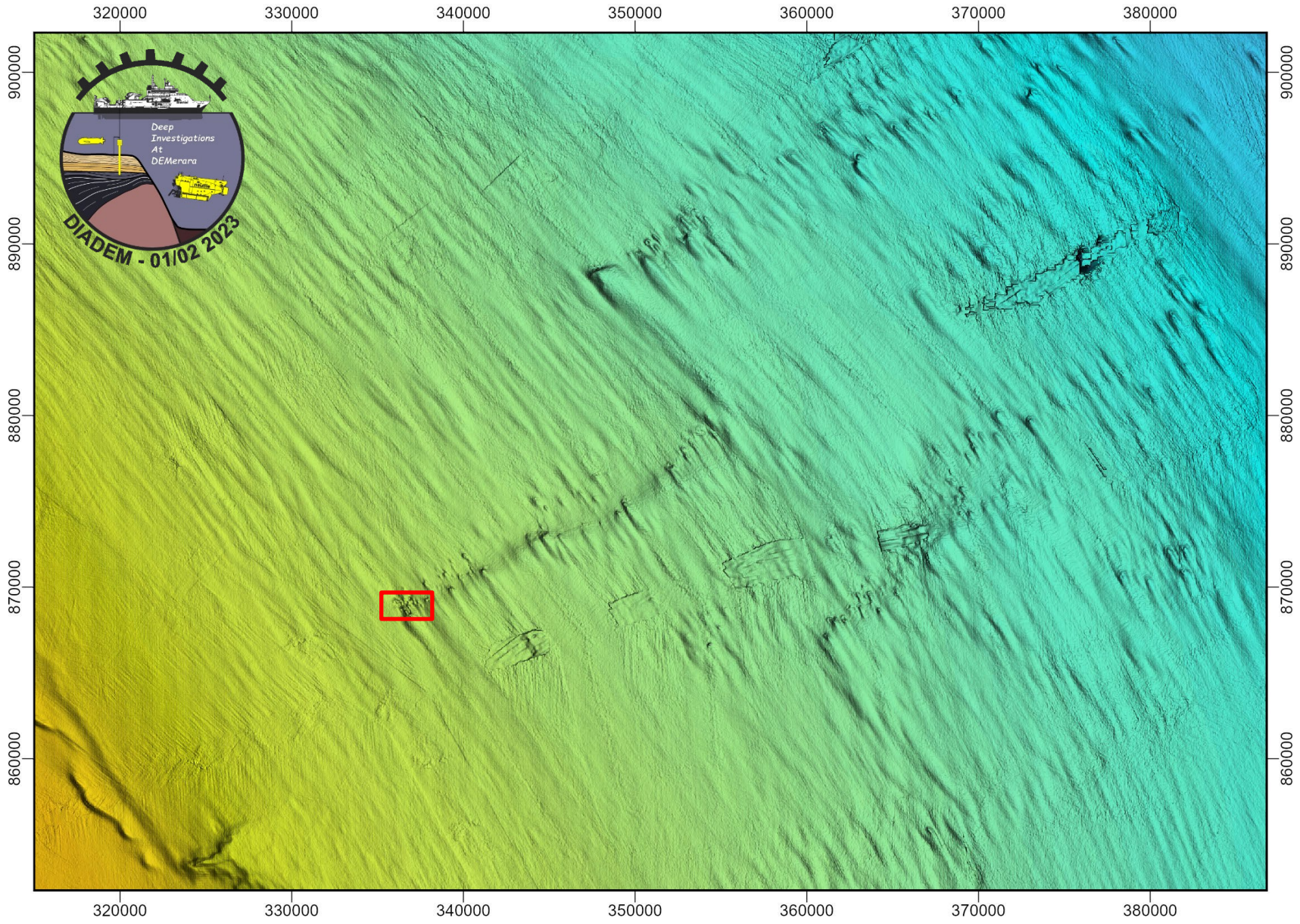
Cas d'étude : le bassin de Somalie

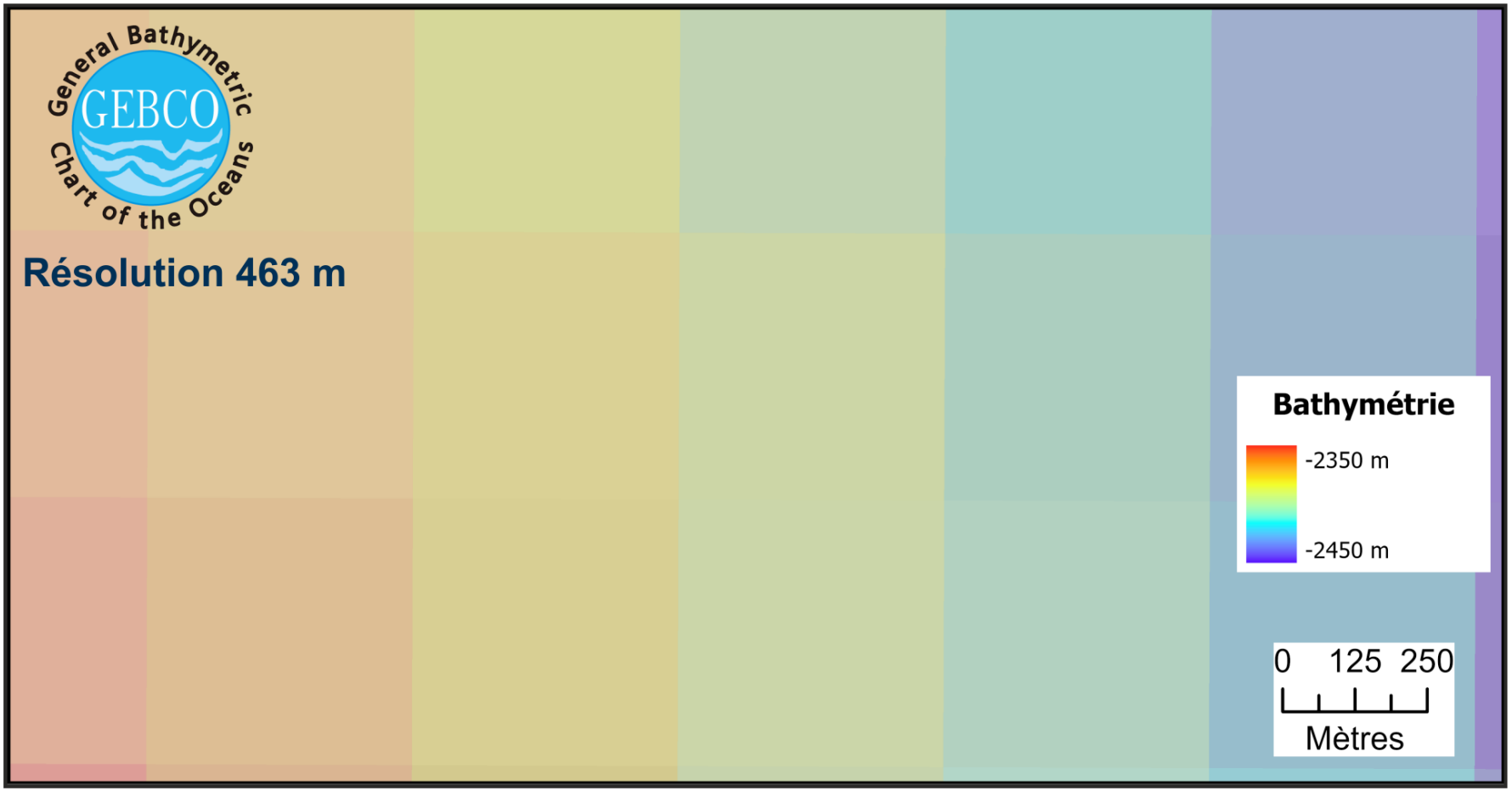


Cas d'étude : marge guyanaise

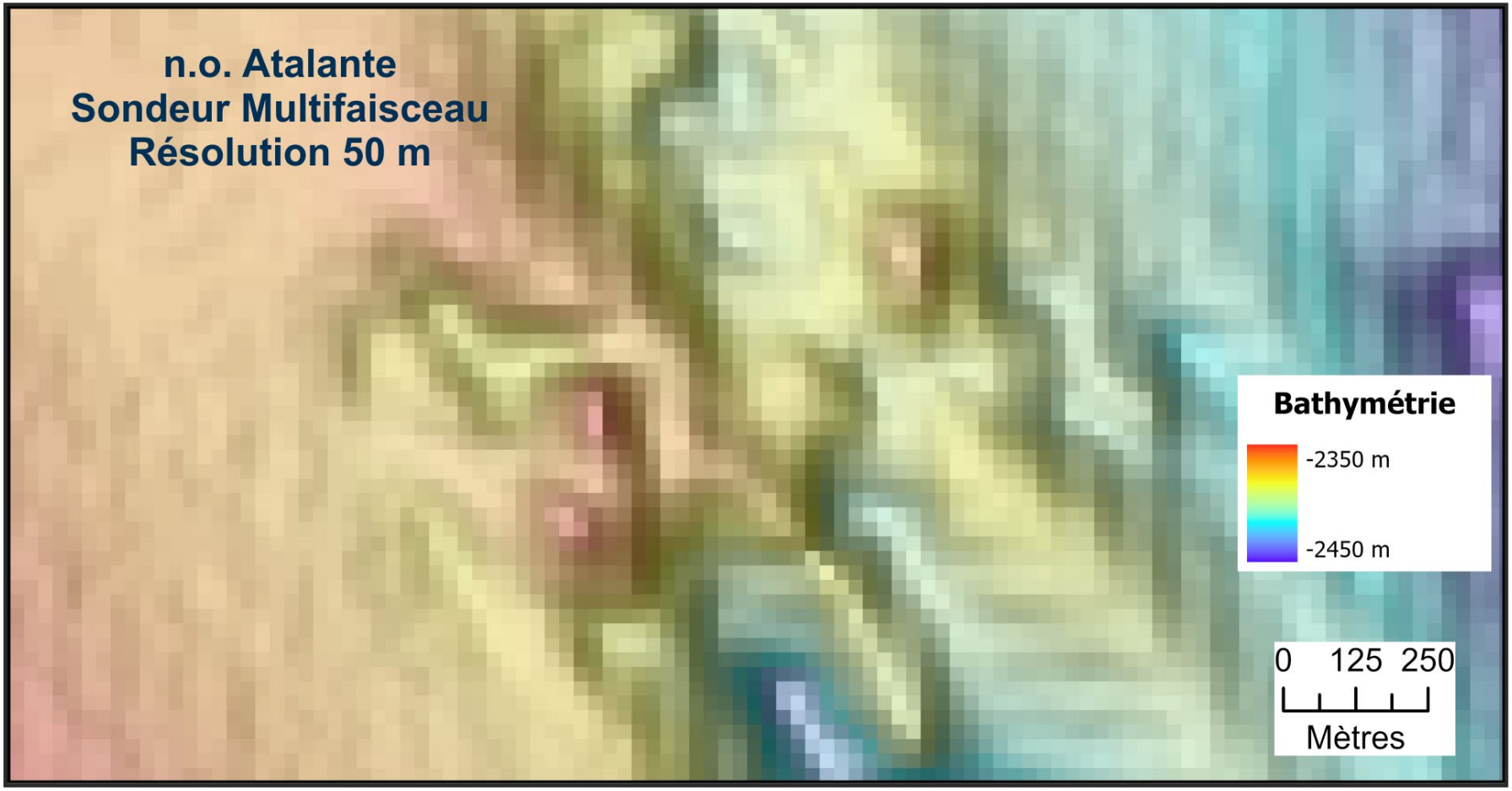


Cas d'étude : marge guyanaise

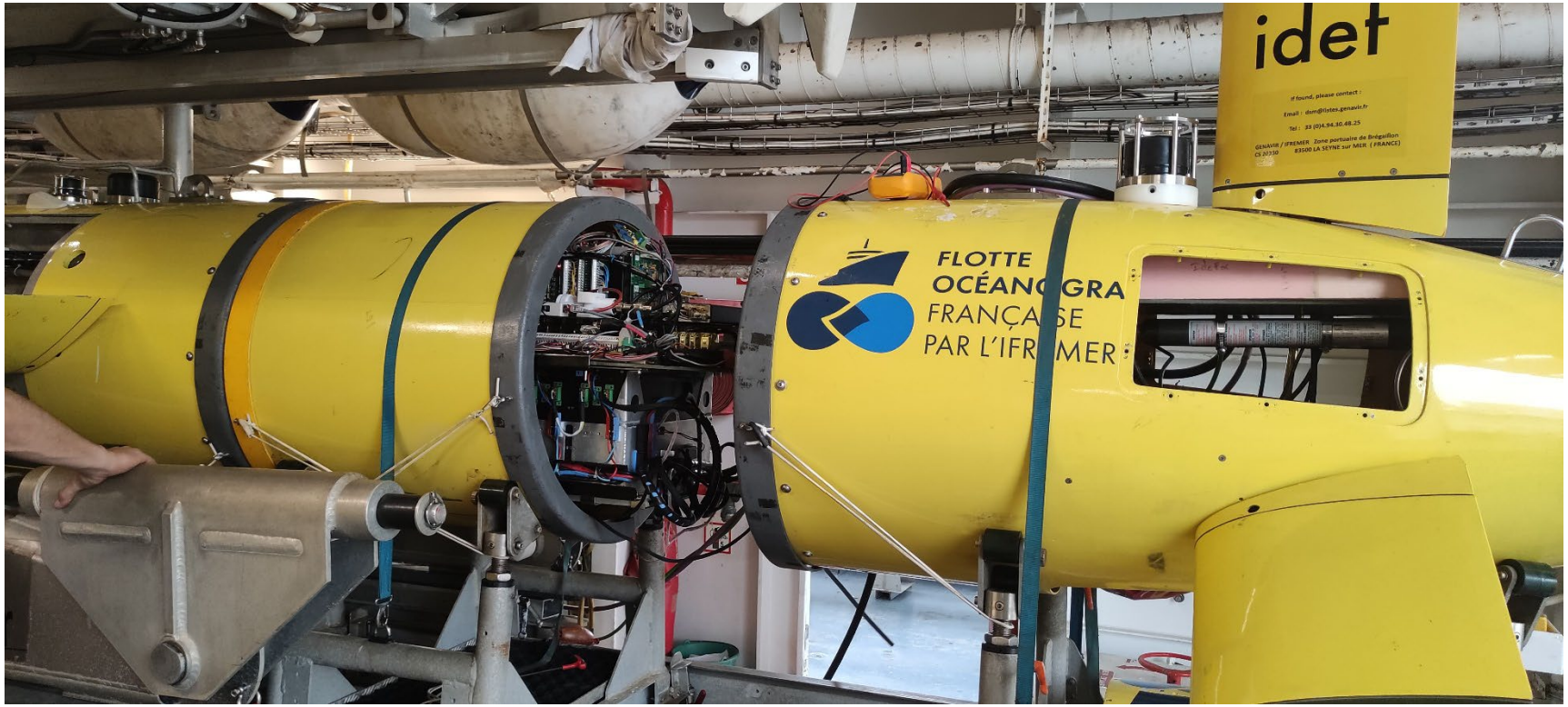


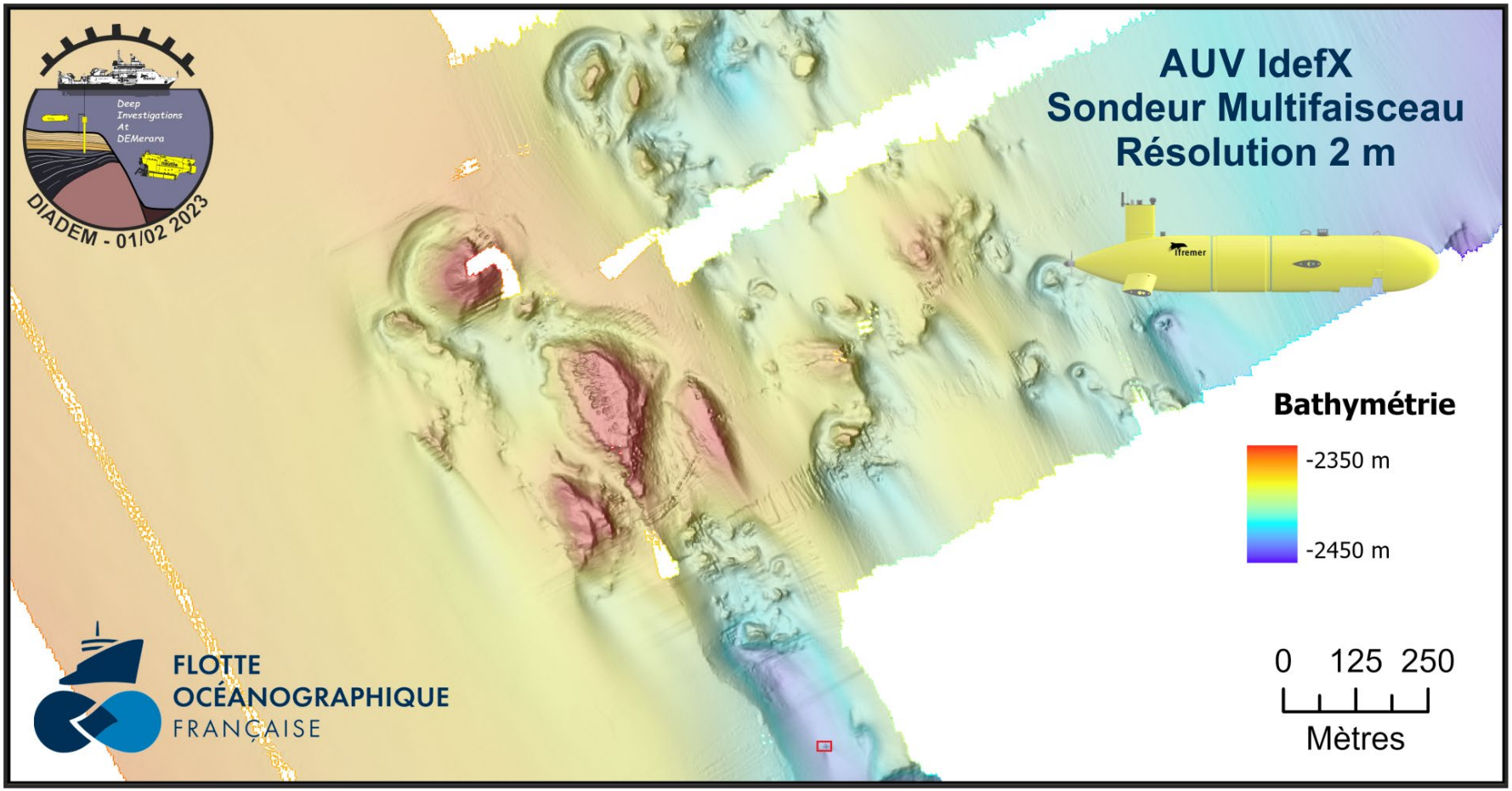

General Bathymetric Chart of the Oceans
GEBCO
Résolution 463 m
Bathymétrie
-2350 m
-2450 m
0 125 250
Mètres

2500 m


n.o. Atalante
Sondeur Multifaisceau
Résolution 50 m
Bathymétrie
-2350 m
-2450 m
0 125 250
Mètres

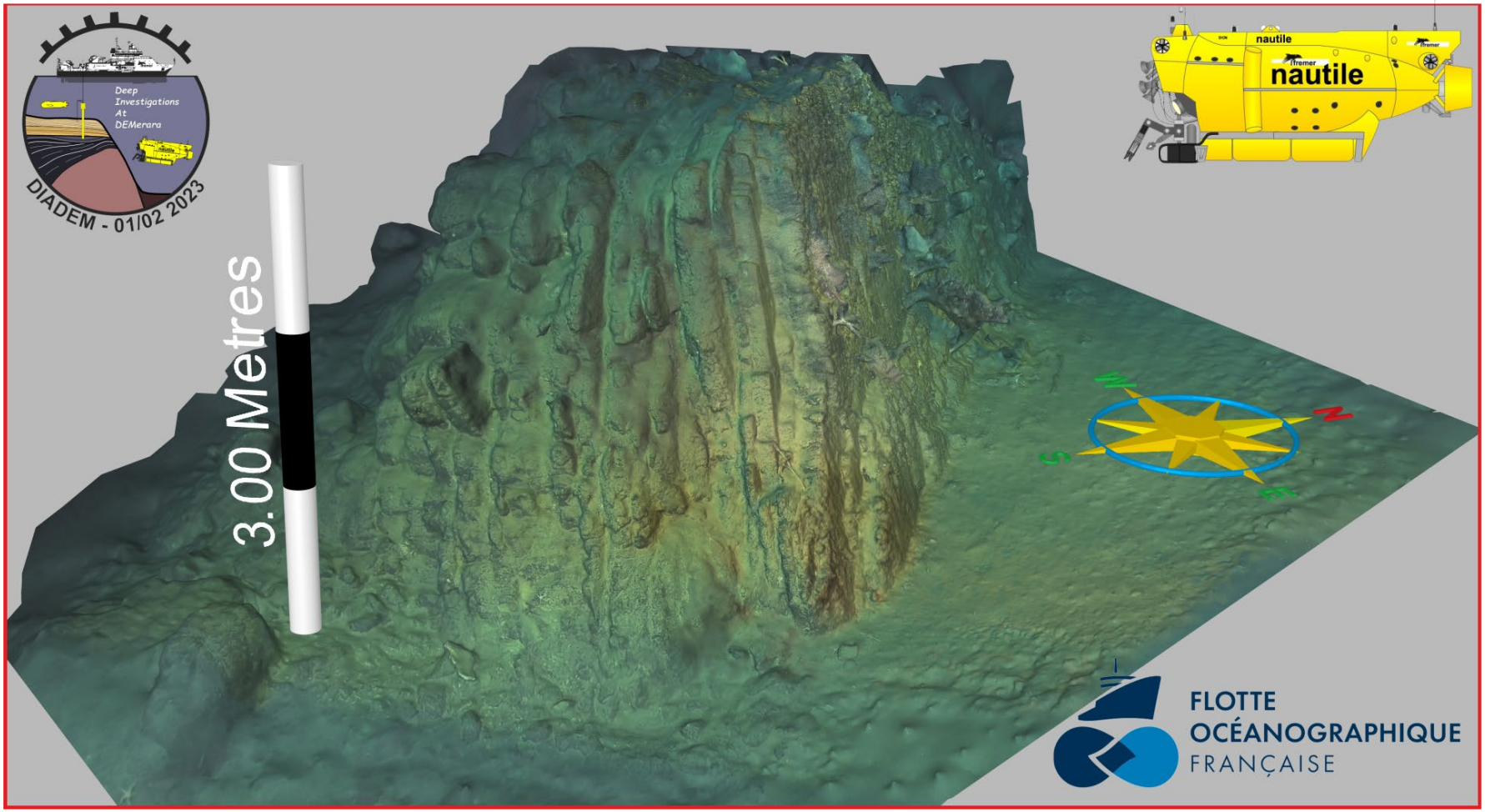
2500 m


idet
FLOTTE
OCÉANOGRA
FRANÇAISE
PAR L'IFREMER


Deep Investigations At DEMerara
DIADEM - 01/02 2023
AUV IdefX
Sondeur Multifaisceau
Résolution 2 m
Ifremer
Bathymétrie
-2350 m
-2450 m
FLOTTE OCÉANOGRAPHIQUE FRANÇAISE
0 125 250
Mètres

2500 m


Ifremer
nautile
ADI CM


Deep
Investigations
At
DEMerara
DIADEM - 01/02 2023
3.00 Metres
nautile
nautile
FLOTTE
OCÉANOGRAPHIQUE
FRANÇAISE

GOOGLE a découvert l'Atlantide !!!

www.google.fr/search?aq=f&gcx=w&ix=c1&sourceid=chrome&ie=UTF-8&q=google+earth+atlantide

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Environ 62 200 résultats (0,26 secondes)

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L'Atlantide découverte via Google Earth ? - YouTube
www.youtube.com/watch?v=oPeqPEDhY5A
21 févr. 2009 - 1 mn - Ajouté par xxxAlethxxx
Serait-ce l'un des vestiges de l'**Atlantide** ? Avec **Google Earth**
31°21'45.10" N ; 24 °24'00.51" O.

Dailymotion - L'Atlantide retrouvée grâce à Google Earth - une vidéo ...
www.dailymotion.com/.../x8qgd7_l-**atlantide**-retrouvee-grace-a...
21 mars 2009 - 1 mn
Via **Google Earth**, à près de 1400 km à l'Ouest du Détroit de Gibraltar - 31°21' 45.10" N ; 24°24'00.51" O - se dessine au fond ...

Autres vidéos pour **google earth atlantide** »

L'Atlantide dans Google Earth ? Google dément... - Actualité ...
actu.abondance.com/2009/.../**atlantide**-dans-**google-earth-google**.ht...
25 févr. 2009 – Paru sur Abondance le mercredi 25 février 2009, Auteur : Olivier Andrieu. Retrouvez ici toute l'actualité des moteurs de recherche majeurs et ...

Actualité > Google Earth a-t-il permis de découvrir l'Atlantide ?
www.futura-sciences.com/.../**google-earth**-a-t-il-permis-de-decouvrir-...
24 févr. 2009 – Après les canaux de Mars, les sillons de l'océan... **Google Earth**, comme chacun peut le constater, montre quelque part au large des îles ...

Images correspondant à google earth atlantide - Signaler des images inappropriées

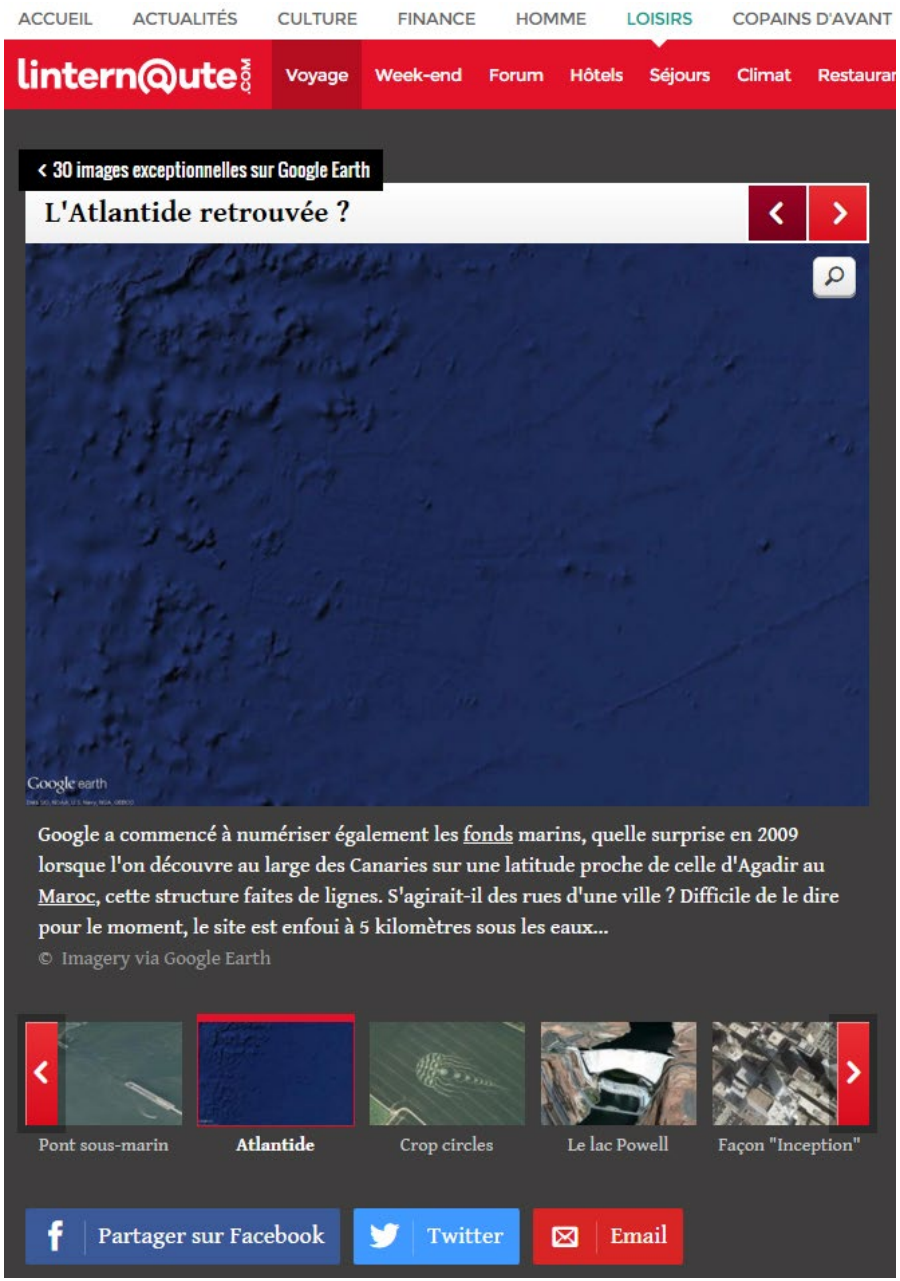
Google dément la découverte de l'Atlantide dans Earth
www.generation-nt.com › Internet
23 févr. 2009 – **Google** dément la découverte de l'**Atlantide** dans **Earth Google** a décidé de couper court à la folle rumeur de la découverte de l'**Atlantide** via ...

Découverte de l'Atlantide sur Google Earth | Korben
korben.info/decouverte-de-l**atlantide**-sur-**google-earth**.html
20 févr. 2009 – L'**Atlantide** (ou **Atlantis** en anglais), mythe ou réalité ? Cette civilation prospère aurait disparue sous les flots en 9700 avant JC, soit il y a 12000.

Atlantis trouvée sur Google Earth | Gizmodo
www.gizmodo.fr/2009/02/22/**atlantis**-trouvee-sur-**google-earth**.html
22 févr. 2009 – Cette image montrerait les ruines de la cité perdue **Atlantis**, trouvées sur **Google Earth**. Évaluons les preuves à charge et à décharge et voyons ...



GOOGLE a découvert l'Atlantide !!!



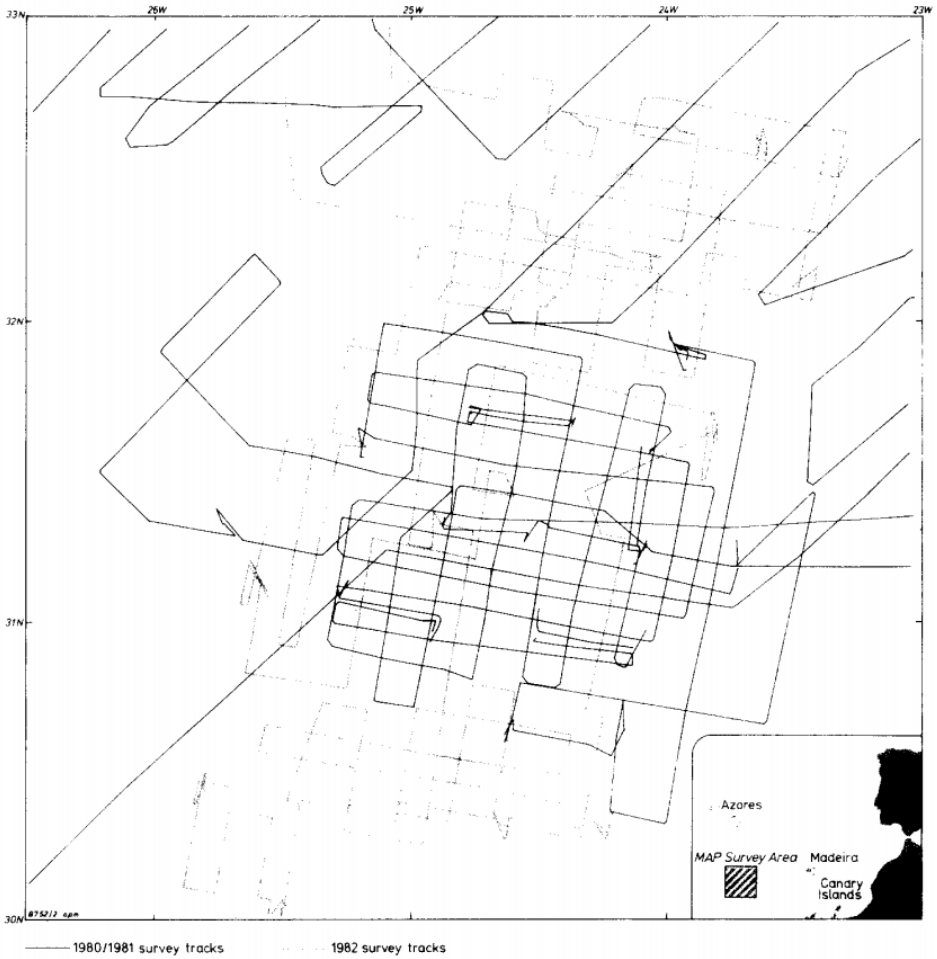


Fig. 1. Recent track lines in the Madeira Abyssal Plain area. The inset shows the location of the area.

Marine Geology, 56 (1984) 299—308
Elsevier Science Publishers B.V., Amsterdam — Printed in The Netherlands

Letter Section

FAULTING IN MADEIRA ABYSSAL PLAIN SEDIMENTS

E.J.Th. DUIN, C.S. MESDAG and P.T.J. KOK

Geological Survey of The Netherlands, P.O. Box 157, 2000 AD Haarlem (The Netherlands)

(Received March 10, 1983; revised and accepted October 4, 1983)

ABSTRACT

Duin, E.J.Th., Mesdag, C.S. and Kok, P.T.J., 1984. Faulting in Madeira Abyssal Plain sediments. Mar. Geol., 56: 299—308.

Interpretation of high-resolution seismic data revealed the occurrence of faults in the sediments of two North Atlantic abyssal plain environments, the Madeira Abyssal Plain (MAP) and the Nares Abyssal Plain (NAP). Most of the data are from the MAP, where faulting appears to be confined to particular locations. From our data individual faults cannot be traced from one seismic section to another. A positive correlation exists between the concentration of faults and the maximum sediment thickness.

Although the mechanism that caused the faulting is still not understood, the faults apparently are related to processes which have been active for a long period of time.

INTRODUCTION

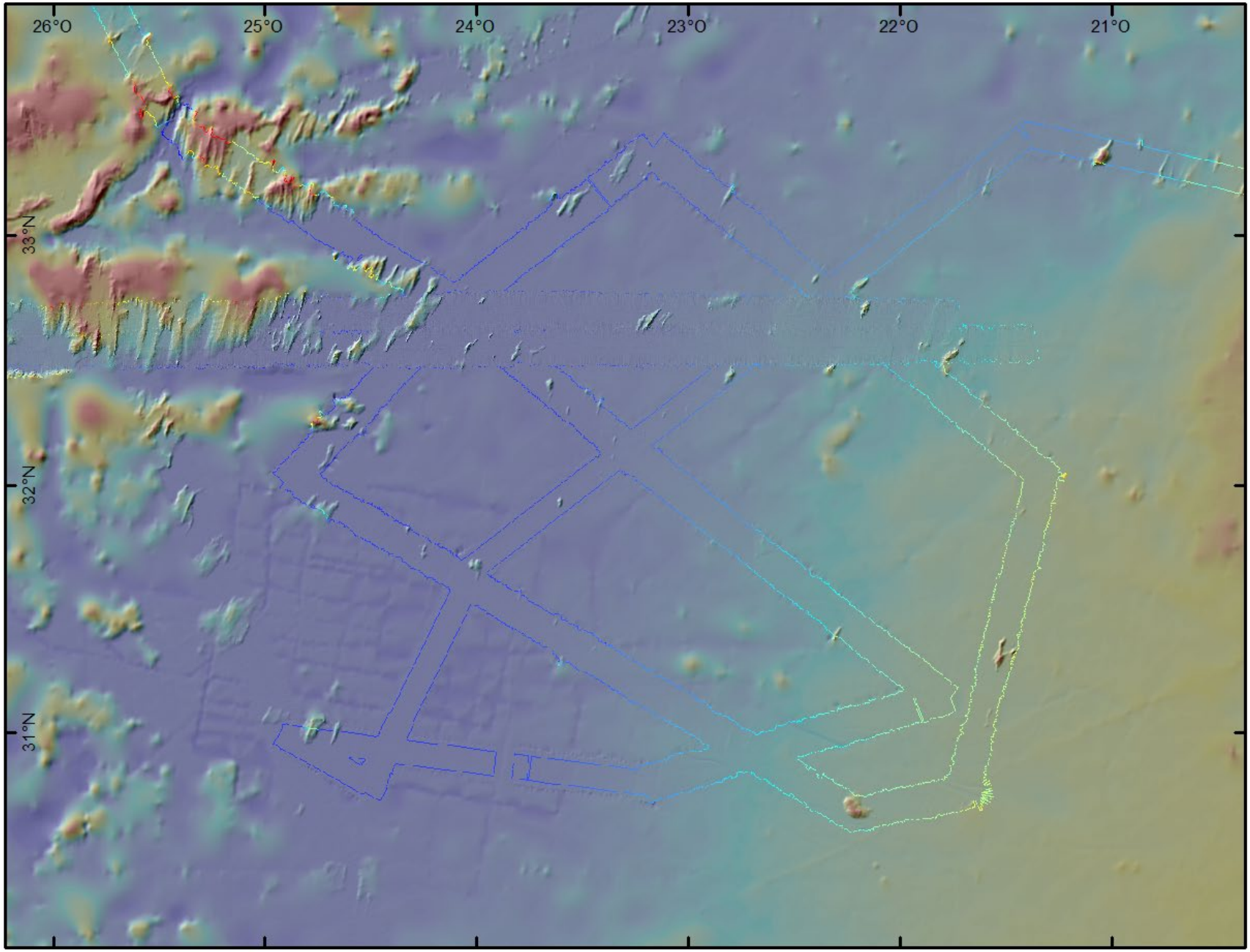
Since 1980 the Geological Survey of The Netherlands (RGD) has been active in applied ocean floor studies. In this context two major cruises (1980 and 1982) were made to the Madeira Abyssal Plain (MAP), situated in the eastern North Atlantic between 30—33°N and 23—26°30'W (Fig. 1). On behalf of RGD the Marine Geophysics Department (VML) of the Utrecht State University carried out a short survey in 1982 in the Nares Abyssal Plain (NAP), situated in the western North Atlantic between 22—24°N and 62—64°W.

Both in the MAP and in the NAP seismic recordings have been made using a 3.5 kHz echosounder and an 80 in.^{3} (1.3 dm^3) watergun as sound sources. From the 3.5 kHz recordings (maximum penetration down to approximately 120 ms) as well as from the watergun recordings (penetration often to the acoustic basement) it appears that well-defined reflectors, which can easily be traced over large distances, display abrupt discontinuities. This is an unexpected feature of these abyssal plain environments with a uniform sedimentation pattern.

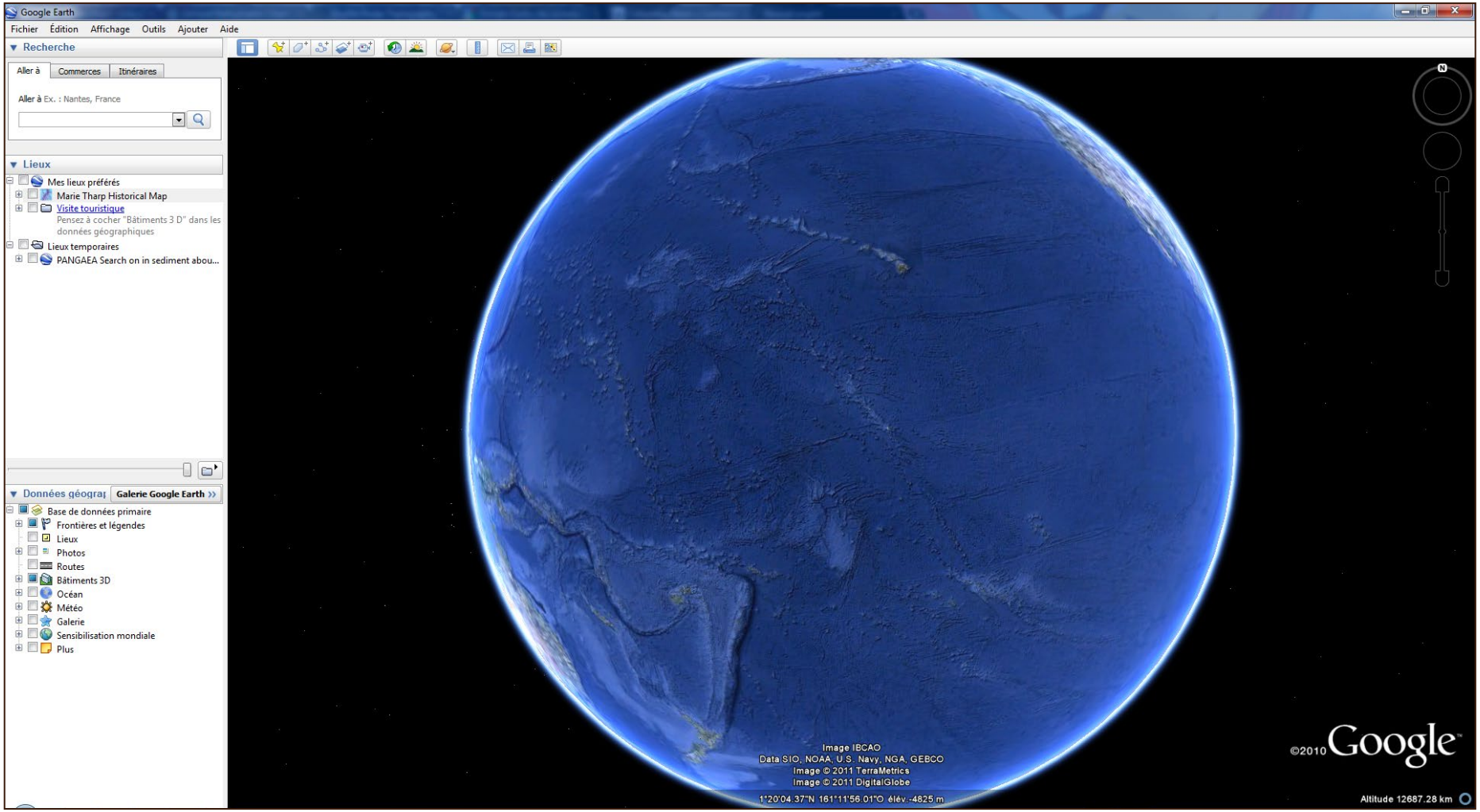
Because the majority of the seismic data come from the MAP we have restricted ourselves in the following to that area. The MAP survey area

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1°20'04.37"N 161°11'56.01"O élév. -4825 m
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Altitude 12687.28 km