CLUBE ROTÁRIO DE ANGRA

OBSERVATÓRIO VULCANOLÓGICO E GEOTÉRMICO AÇORES

CENTROS DE CIÊNCIA DOS AÇORES
GOVERNO DOS AÇORES

EXTENSÃO DA PLATAFORMA CONTINENTAL
Actualidade e Perspectivas

COMUNICAÇÃO: EXPLORAÇÃO DOS RECURSOS MARINHOS DOS AÇORES

APRESENTAÇÃO: PROF. DOUTOR VICTOR HUGO FORJAZ,
Catedrático de Vulcanologia, UAc, OVGAçores

17.FEVEREIRO.2017

TABELA PERIÓDICA DOS ELEMENTOS (TABELA DE MENDELEIEV)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	1A	2A	3B	4B	5B	6B	7B	8B			1B	2B	3A	4A	5A	6A	7A	8A
1	1 H Hidrogênio 1,00794 (1)																	2 He Hélio 4,002602 (2) K
2	3 Li Lítio 6,941 (2 1)	4 Be Berílio 9,012182 (2 2)											5 B Boro 10,811 (2 3)	6 C Carbono 12,0107 (2 4)	7 N Nitrogênio 14,0067 (2 5)	8 O Oxigênio 15,9994 (2 6)	9 F Flúor 18,9984032 (2 7)	10 Ne Neônio 20,1797 (2 8) K L
3	11 Na Sódio 22,98976... (2 8 1)	12 Mg Magnésio 24,305 (2 8 2)											13 Al Alumínio 26,9815386 (2 8 3)	14 Si Silício 28,0855 (2 8 4)	15 P Fósforo 30,973762 (2 8 5)	16 S Enxofre 32,065 (2 8 6)	17 Cl Cloro 35,453 (2 8 7)	18 Ar Argônio 39,948 (2 8 8) K L M
4	19 K Potássio 39,0983 (2 8 8 1)	20 Ca Cálcio 40,078 (2 8 8 2)	21 Sc Escândio 44,955912 (2 8 9 2)	22 Ti Titânio 47,867 (2 8 10 2)	23 V Vanádio 50,9415 (2 8 11 2)	24 Cr Crômo 51,9961 (2 8 13 1)	25 Mn Manganês 54,938045 (2 8 13 2)	26 Fe Ferro 55,845 (2 8 14 2)	27 Co Cobalto 58,933195 (2 8 15 2)	28 Ni Níquel 58,6934 (2 8 16 2)	29 Cu Cobre 63,546 (2 8 18 1)	30 Zn Zinco 65,38 (2 8 18 2)	31 Ga Gálio 69,723 (2 8 18 3)	32 Ge Germânio 72,63 (2 8 18 4)	33 As Arsênio 74,9216 (2 8 18 5)	34 Se Selênio 78,96 (2 8 18 6)	35 Br Bromo 79,904 (2 8 18 7)	36 Kr Cripitônio 83,798 (2 8 18 8) K L M N
5	37 Rb Rubídio 85,4678 (2 8 18 8 1)	38 Sr Estrôncio 87,62 (2 8 18 8 2)	39 Y Ítrio 88,90585 (2 8 18 9 2)	40 Zr Zircônio 91,224 (2 8 18 10 2)	41 Nb Nióbio 92,90638 (2 8 18 12 1)	42 Mo Molibdênio 95,96 (2 8 18 13 1)	43 Tc Tecnécio (98) (2 8 18 13 2)	44 Ru Rutênio 101,07 (2 8 18 15 1)	45 Rh Ródio 102,9055 (2 8 18 16 1)	46 Pd Paládio 106,42 (2 8 18 18)	47 Ag Prata 107,8682 (2 8 18 18 1)	48 Cd Cádmio 112,411 (2 8 18 18 2)	49 In Índio 114,818 (2 8 18 18 3)	50 Sn Estanho 118,71 (2 8 18 18 4)	51 Sb Antimônio 121,76 (2 8 18 18 5)	52 Te Telúrio 127,6 (2 8 18 18 6)	53 I Iodo 126,90447 (2 8 18 18 7)	54 Xe Xenônio 131,293 (2 8 18 18 8) K L M N O
6	55 Cs Césio 132,9054... (2 8 18 18 8 1)	56 Ba Bário 137,327 (2 8 18 18 8 2)	57-71 *	72 Hf Háfnio 178,49 (2 8 18 32 10 2)	73 Ta Tântalo 180,94788 (2 8 18 32 11 2)	74 W Tungstênio 183,84 (2 8 18 32 12 2)	75 Re Rênio 186,207 (2 8 18 32 13 2)	76 Os Ósmio 190,23 (2 8 18 32 14 2)	77 Ir Irídio 192,217 (2 8 18 32 15 2)	78 Pt Platina 195,084 (2 8 18 32 17 1)	79 Au Ouro 196,966569 (2 8 18 32 18 1)	80 Hg Mercúrio 200,59 (2 8 18 32 18 2)	81 Tl Tálio 204,3833 (2 8 18 32 18 3)	82 Pb Chumbo 207,2 (2 8 18 32 18 4)	83 Bi Bismuto 208,9804 (2 8 18 32 18 5)	84 Po Polônio (209) (2 8 18 32 18 6)	85 At Astato (210) (2 8 18 32 18 7)	86 Rn Radônio (222) (2 8 18 32 18 8) K L M N O P
7	87 Fr Frâncio (223) (2 8 18 32 18 8 1)	88 Ra Rádio (226) (2 8 18 32 18 8 2)	89-103 **	104 Rf Rutherfórdio (267) (2 8 18 32 32 10 2)	105 Db Dúbnio (268) (2 8 18 32 32 11 2)	106 Sg Seabórgio (271) (2 8 18 32 32 12 2)	107 Bh Bóhrio (272) (2 8 18 32 32 13 2)	108 Hs Hássio (270) (2 8 18 32 32 14 2)	109 Mt Meitnério (276) (2 8 18 32 32 15 2)	110 Ds Darmstádio (281) (2 8 18 32 32 17 1)	111 Rg Roentgênio (280) (2 8 18 32 32 18 1)	112 Cn Copernício (285) (2 8 18 32 32 18 2)	113 Uut Ununtrio (284) (2 8 18 32 32 18 3)	114 Uuq Ununquádio (289) (2 8 18 32 32 18 4)	115 Uup Ununpentio (288) (2 8 18 32 32 18 5)	116 Uuh Ununhéxio (293) (2 8 18 32 32 18 6)	117 Uus Ununséptio (294) (2 8 18 32 32 18 7)	118 Uuo Ununóctio (294) (2 8 18 32 32 18 8) K L M N O P Q
*				57 La Lantânio 138,90547 (2 8 18 18 9 2)	58 Ce Cério 140,116 (2 8 18 19 9 2)	59 Pr Praseodímio 140,90765 (2 8 18 21 8 2)	60 Nd Neodímio 144,242 (2 8 18 22 8 2)	61 Pm Promécio (145) (2 8 18 23 8 2)	62 Sm Samário 150,36 (2 8 18 24 8 2)	63 Eu Európio 151,964 (2 8 18 25 8 2)	64 Gd Gadolínio 157,25 (2 8 18 25 9 2)	65 Tb Térbio 158,92535 (2 8 18 27 8 2)	66 Dy Disprósio 162,5 (2 8 18 28 8 2)	67 Ho Hólmio 164,93032 (2 8 18 29 8 2)	68 Er Érbio 167,259 (2 8 18 30 8 2)	69 Tm Túlio 168,93421 (2 8 18 31 8 2)	70 Yb Itérbio 173,054 (2 8 18 32 8 2)	71 Lu Lutécio 174,9668 (2 8 18 32 9 2) K L M N O P
**				89 Ac Actínio (227) (2 8 18 32 18 9 2)	90 Th Tório 232,03806 (2 8 18 32 18 10 2)	91 Pa Protactínio 231,03588 (2 8 18 32 20 9 2)	92 U Urânio 238,02891 (2 8 18 32 21 9 2)	93 Np Neptúnio (237) (2 8 18 32 22 9 2)	94 Pu Plutônio (244) (2 8 18 32 24 8 2)	95 Am Amerício (243) (2 8 18 32 25 8 2)	96 Cm Cúrio (247) (2 8 18 32 25 9 2)	97 Bk Berquélio (247) (2 8 18 32 27 8 2)	98 Cf Califórnio (251) (2 8 18 32 28 8 2)	99 Es Einstênio (252) (2 8 18 32 29 8 2)	100 Fm Férmio (257) (2 8 18 32 30 8 2)	101 Md Mendelévio (258) (2 8 18 32 31 8 2)	102 No Nobélio (259) (2 8 18 32 32 8 2)	103 Lr Laurêncio (262) (2 8 18 32 32 8 3) K L M N O P Q

Metais alcalinos
Metais alcalino-terrosos
Metais de transição
Lantanídeos
Actinídeos

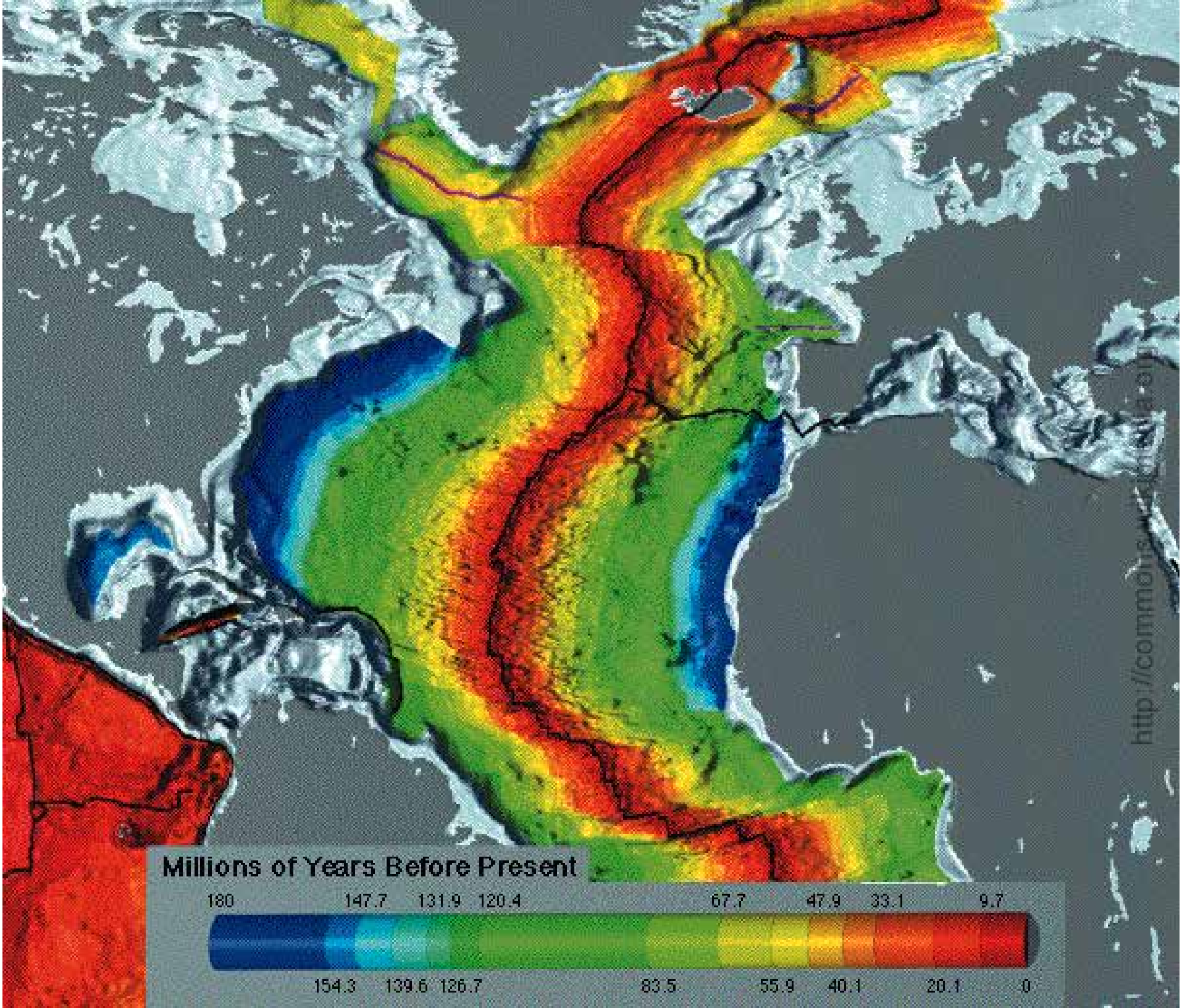
Metais representativos
Semi-metais
Não-metais
Halogênios
Gases nobres

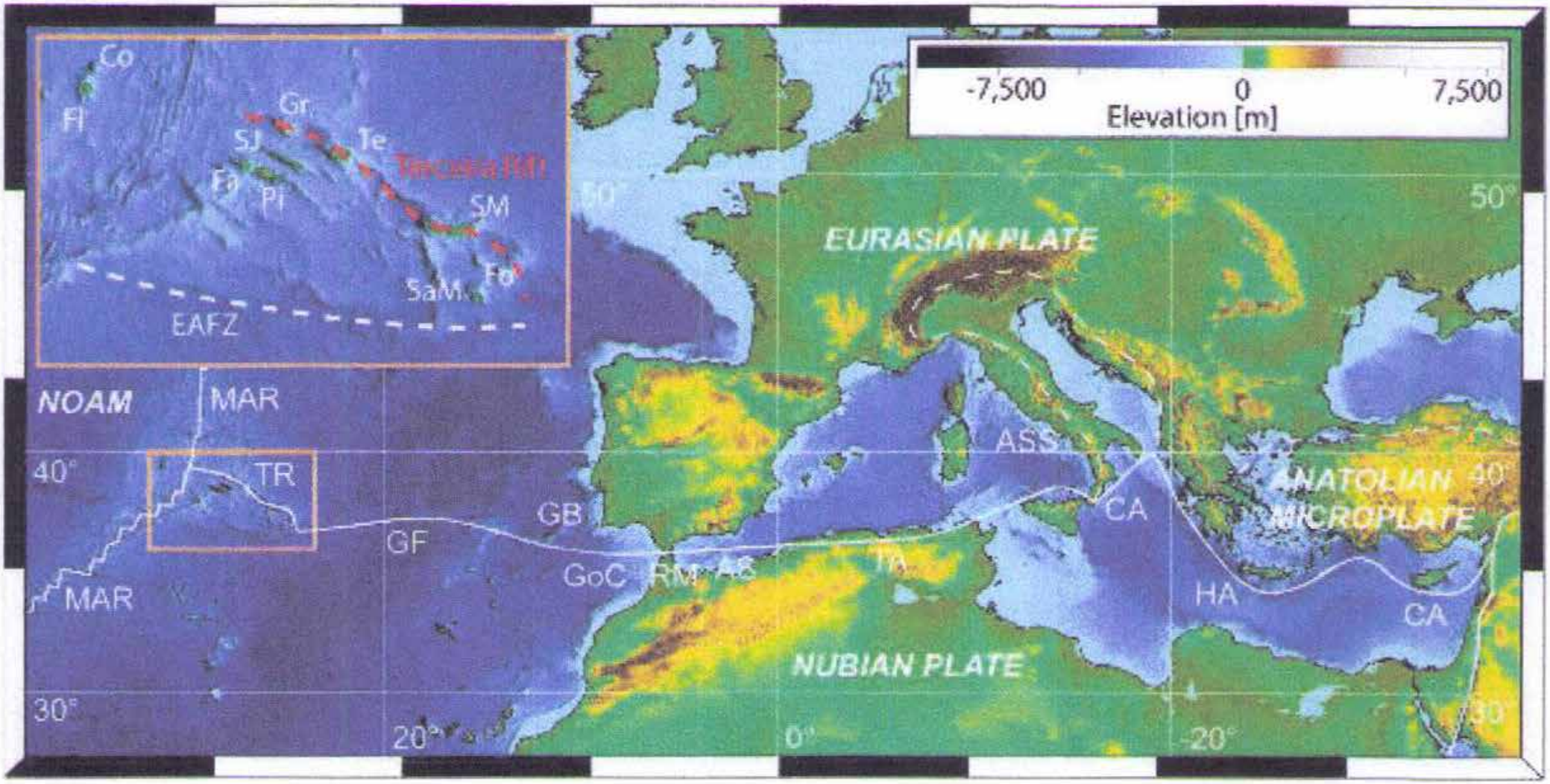
C Sólido
Hg Líquido
H Gasoso
Rf Desconhecido

Nº Atômico
Simbolo
Nome
Massa Atômica

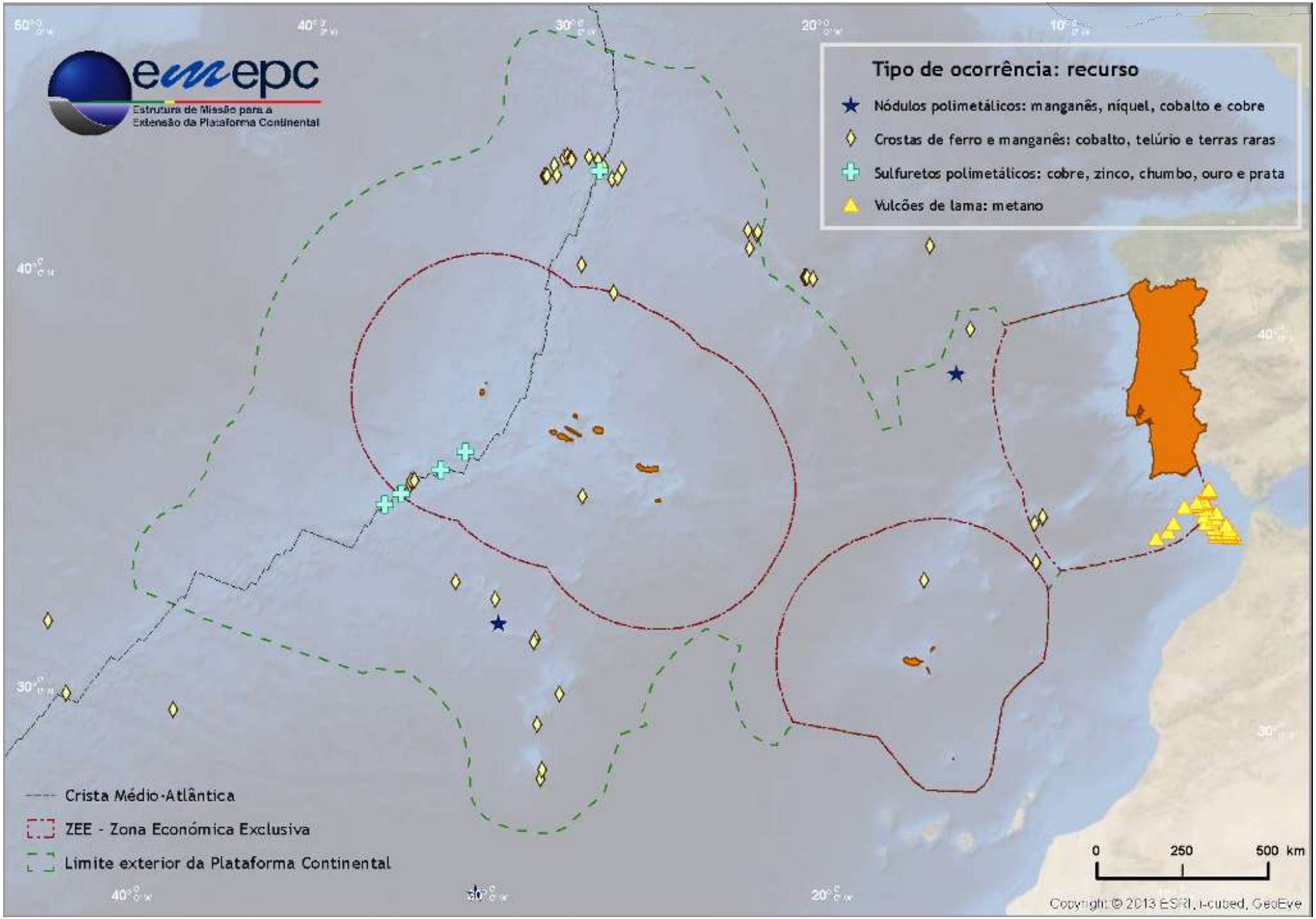
DISTRIBUIÇÃO

DOUGLAS VIEIRA


Millions of Years Before Present
180
147.7
131.9
120.4
67.7
47.9
33.1
9.7
154.3
139.6
126.7
83.5
55.9
40.1
20.1
0



Eurasian-Nubian plate boundary. Location of Mid-Atlantic Ridge (MAR)


emepc
Estrutura de Missão para a Extensão da Plataforma Continental
Tipo de ocorrência: recurso
Nódulos polimetálicos: manganês, níquel, cobalto e cobre
Crostas de ferro e manganês: cobalto, telúrio e terras raras
Sulfuretos polimetálicos: cobre, zinco, chumbo, ouro e prata
Vulcões de lama: metano
Crista Médio-Atlântica
ZEE - Zona Económica Exclusiva
Limite exterior da Plataforma Continental
0
250
500 km
Copyright:© 2013 ESRI, i-cubed, GeoEye

VEI VOLCANIC EXPLOSIVITY INDEX	0	1	2	3	4	5	6	7	8
Descrição geral	não explosivo	baixo	moderado	moderado--alto	alto	muito alto			
Volume de tefra (m^3)	$1x10^4$	$1x10^6$	$1x10^7$	$1x10^8$	$1x10^9$	$1x10^{10}$	$1x10^{11}$	$1x10^{12}$	
Altura da coluna eruptiva (km)									
acima da cratera	<0.1	0.1 - 1	1 - 5						
acima do nível do mar				3 - 15	10 - 25	←	>25	→	
Descrição qualitativa	"brando"	"efusivo" ←	"explosivo" →	←	"cataclísmico"	"paroxismal"	"colossal" →		
			←		"severo" "violento" "terrífico"	→			
Tipo de Erupção:									
Erupção terrestre		← Stromboliana →		←	Pliniana	→			
	← Hawaiiana →		←	Vulcaniana	←	Ultra-Pliniana	→		

retirado de: Chris Newhall & Steve Self, 1982

Erupção submarina		← Surtseyana →	
	← Serretiana →		
	p i l l o w s		

Proposta de V.H. Forjaz, OVGA, 2015

Hawaiiana

Stromboliana

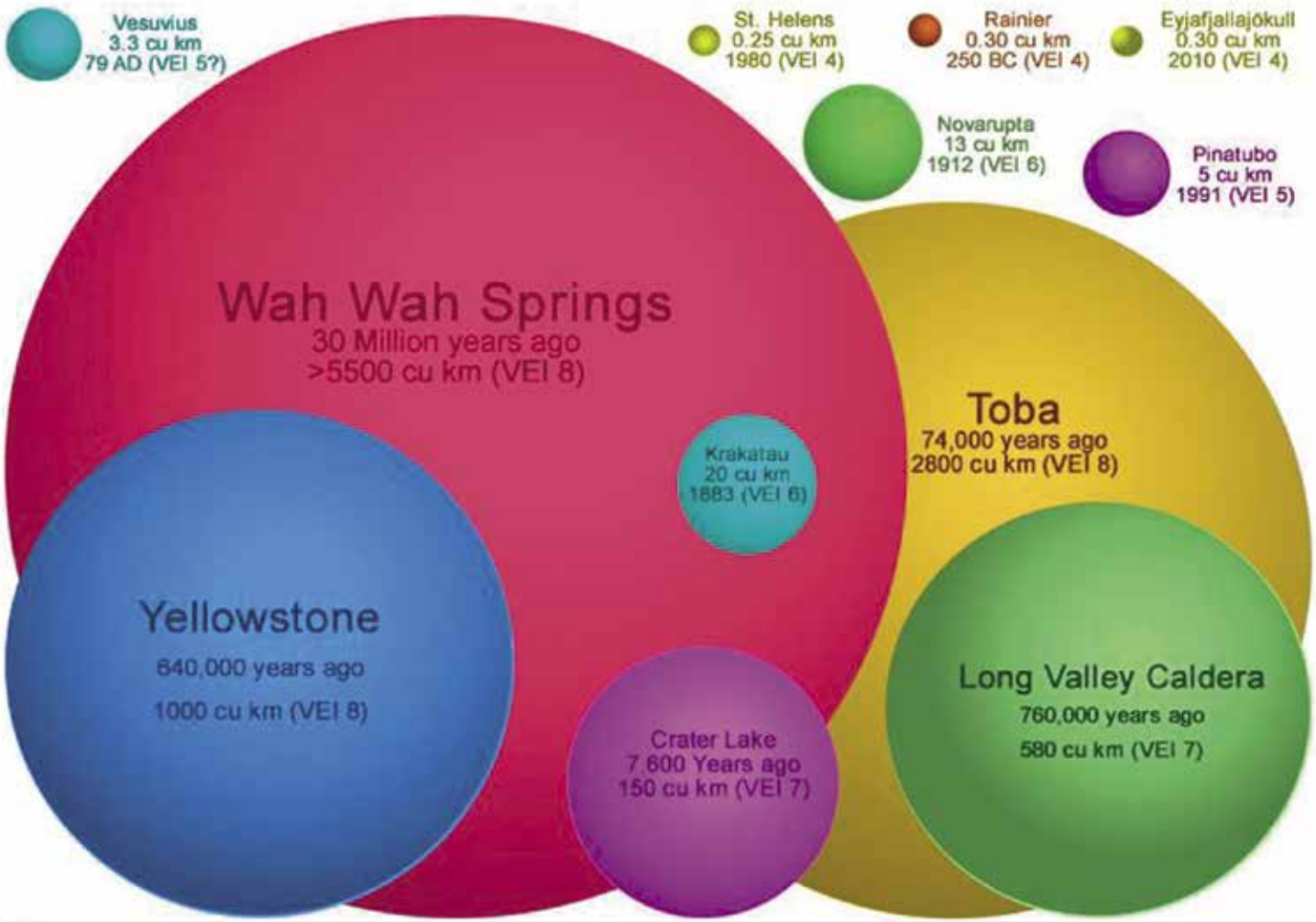
Vulcaniana

Pliniana

Pillow

Serretiana

Surtseyana--Capeliniana



Vulcão do Fogo

S. Miguel, Açores

(VEI ~5)

Vulcão das Sete Cidades

S. Miguel, Açores

(VEI ~4-5)

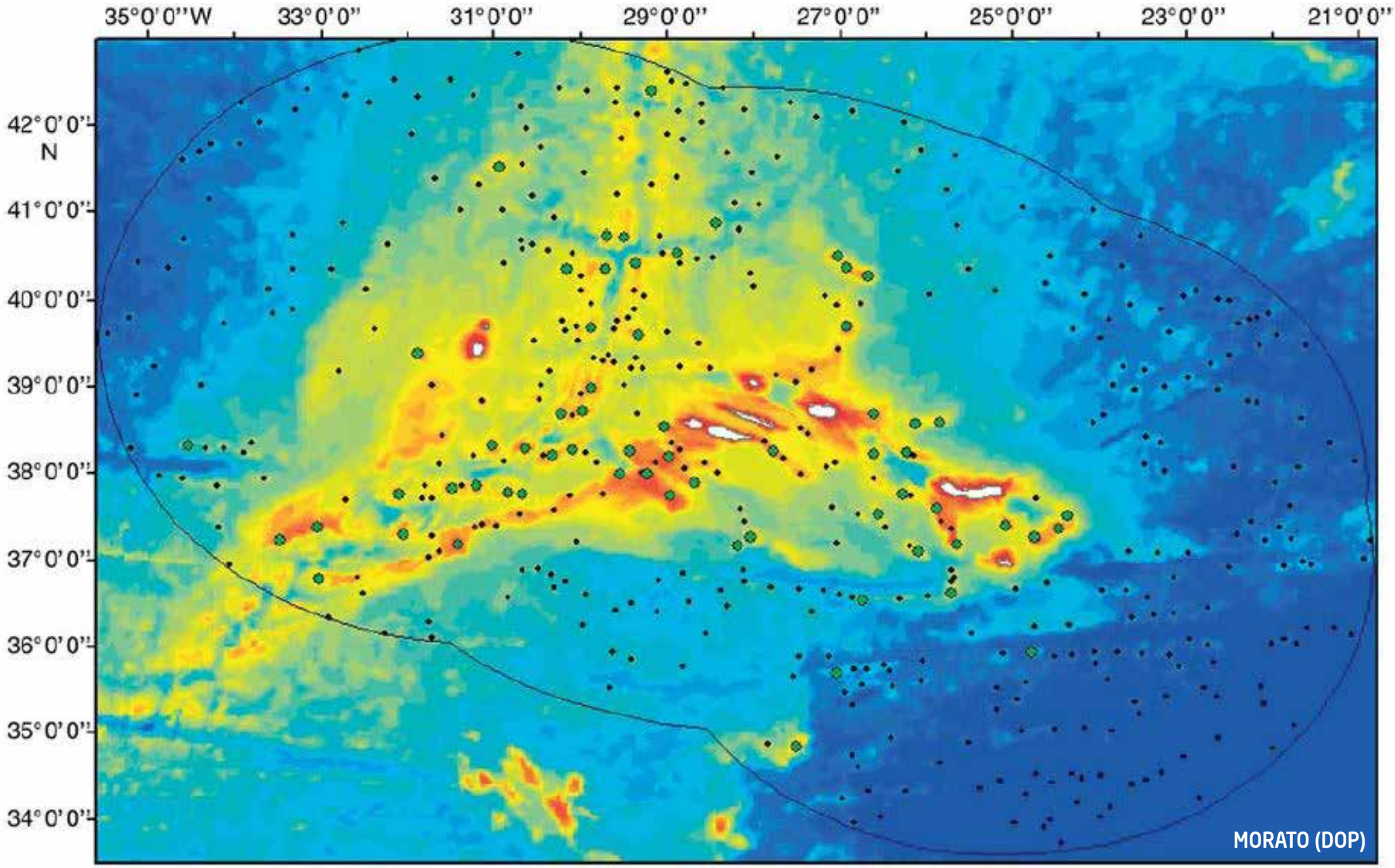
The spheres in the illustration above represent the volume of erupted tephra for some of the most widely-known explosive volcanic eruptions. Although most people believe that Vesuvius (79 AD - the Pompeii eruption), Mount St. Helens (1980) and Mount Pinatubo (1991) were enormous, they are very small compared to ancient eruptions such as Wah Wha Springs, Toba, Yellowstone or Long Valley Caldera. ***Fonte: Geology.com***

St. Helens - Seattle

Vesúvio - Pompeia

Eyjafjallajokull - Islândia

Pinatubo - Filipinas


35°0'0"W
33°0'0"
31°0'0"
29°0'0"
27°0'0"
25°0'0"
23°0'0"
21°0'0"
42°0'0" N
41°0'0"
40°0'0"
39°0'0"
38°0'0"
37°0'0"
36°0'0"
35°0'0"
34°0'0"
MORATO (DOP)

Ilhas e relevos submarinos
Islands and submarine topography

1. Santa Maria
2. Ilhotas das Formigas
3. São Miguel
4. Bacia Hirondelle
5. B. D. João de Castro
6. Terceira
7. Graciosa
8. São Jorge
9. Pico
10. Faial
11. Flores
12. Corvo

Campos hidrotermais submarinos
Submarine hydrothermal fields

- 13. Menez Gwen
- 14. Lucky Strike
- 15. Saldanha
- 16. Rainbow

17. Mid-Atlantic Ridge – M.A.R.
(Crista Média do Atlântico)

Hipsobatimetria
Hypsobathymetry

High:1828m

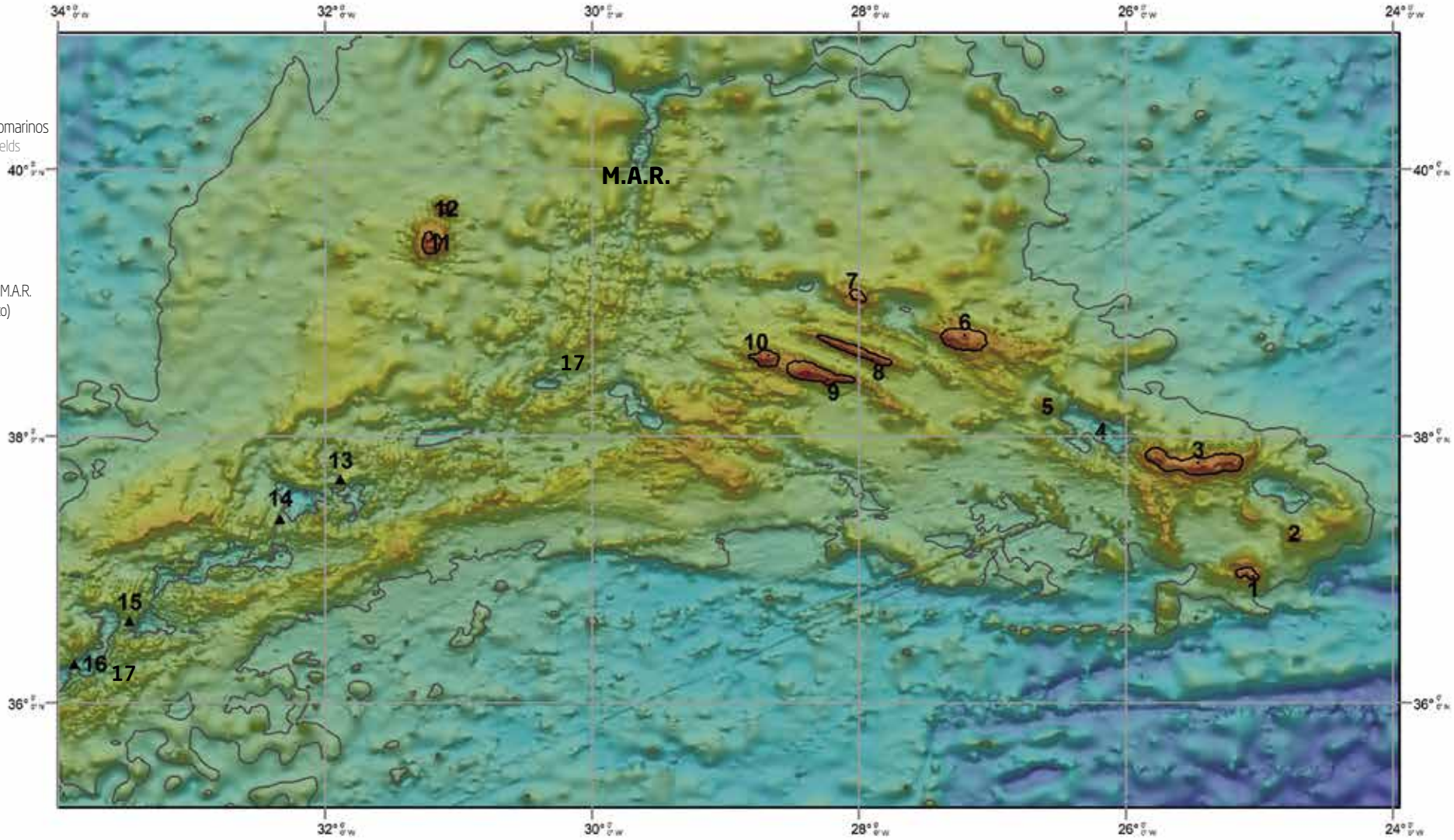
Low: -5821m

in Dos Vulcões dos Açores
From the Azores Volcanoes
V. H. Forjaz et allia, 2010

OBSERVATÓRIO VULCANOLÓGICO E GEOTÉRMICO AÇORES
www.ovga-azores.eu

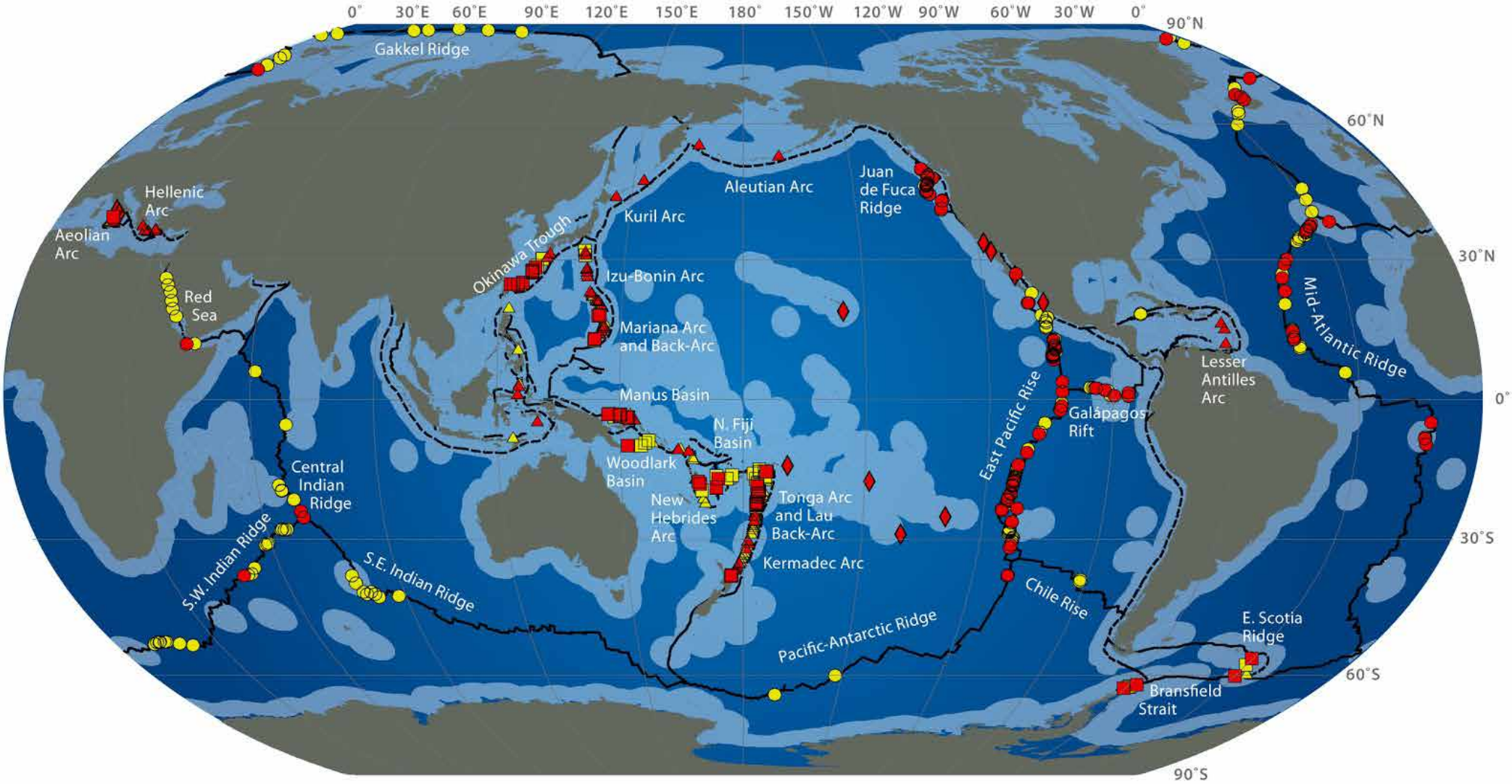
Referências principais
Main references

Luisa Pinto Ribeiro (2008) (1) EMEPC; (2) OVGA (PIC-CHRONOS)
Smith, W. H. F., and D. T. Sandwell, Global seafloor topography from satellite altimetry and ship depth soundings, Science, v. 277, p. 1957-1962.



Black smoker

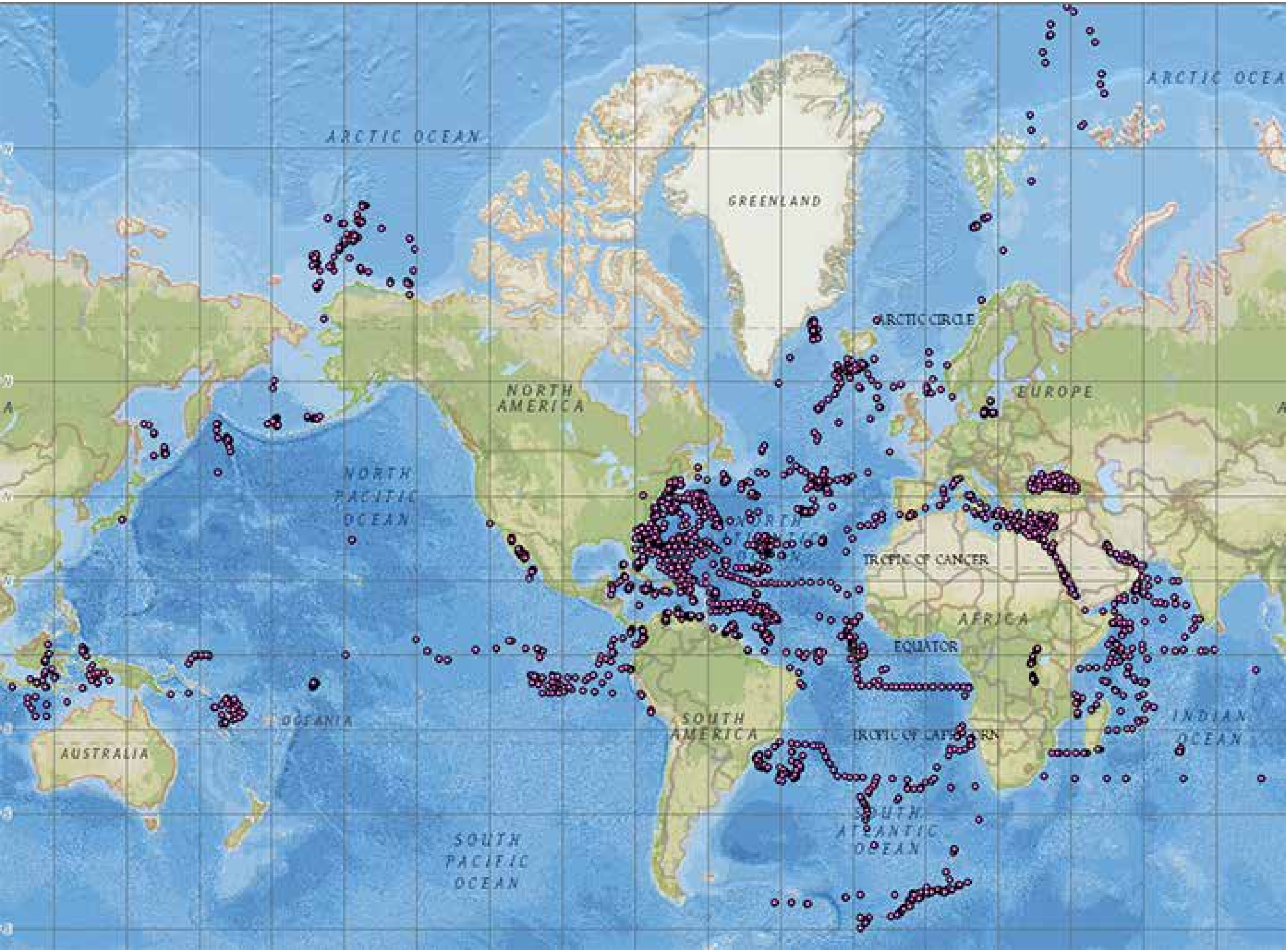
Global Distribution of Hydrothermal Vent Fields



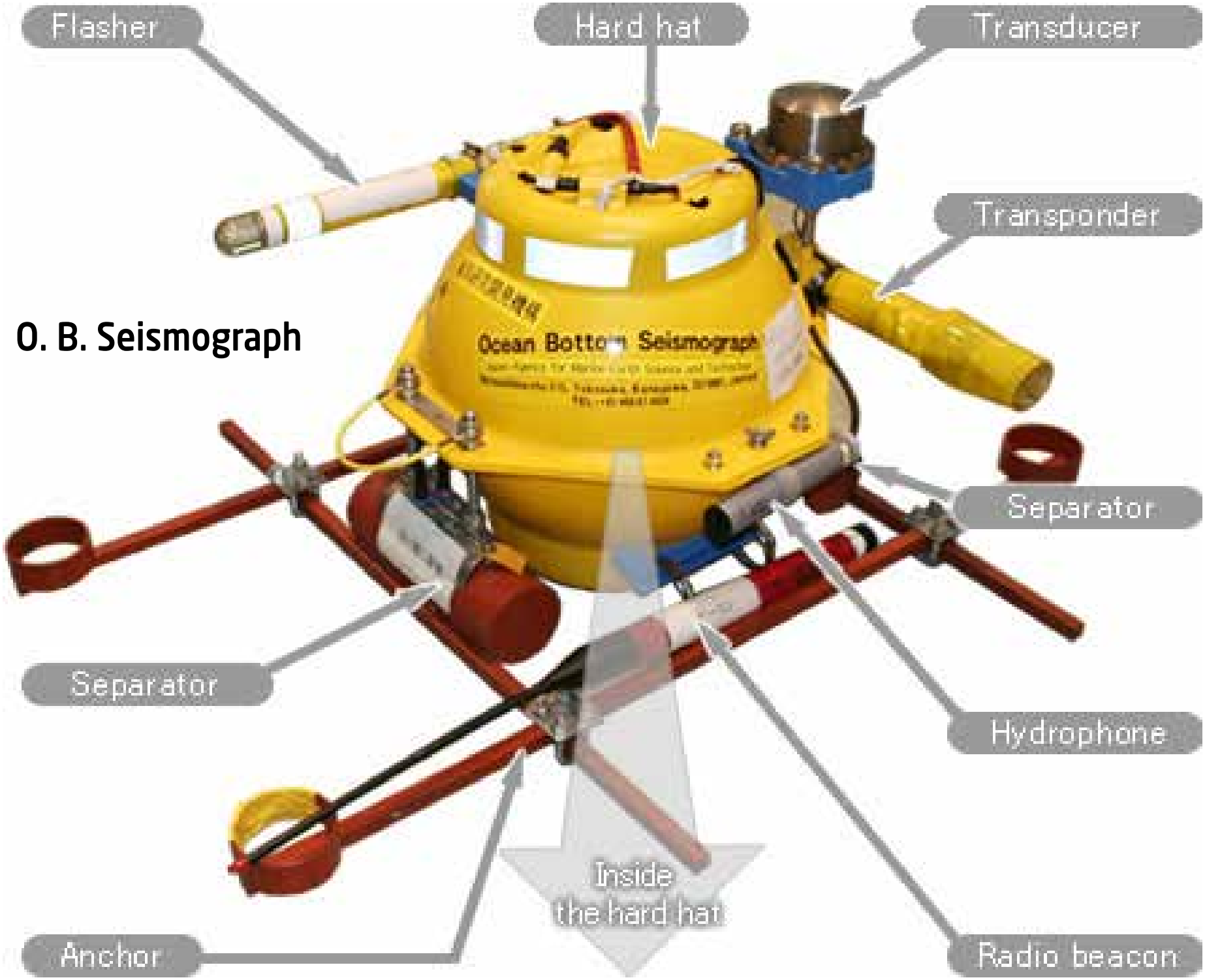
Mid-ocean ridge	Arc volcano	Back-arc spreading center	Intra-plate volcano & Other	
● Active	▲ Active	■ Active	♦ Active	—— Ridge & Transform
○ Unconfirmed	△ Unconfirmed	□ Unconfirmed		---- Trench
				Exclusive Economic Zones

INTER RIDGE
International cooperation in ridge-crest studies

WOODS HOLE OCEANOGRAPHIC INSTITUTION
1930

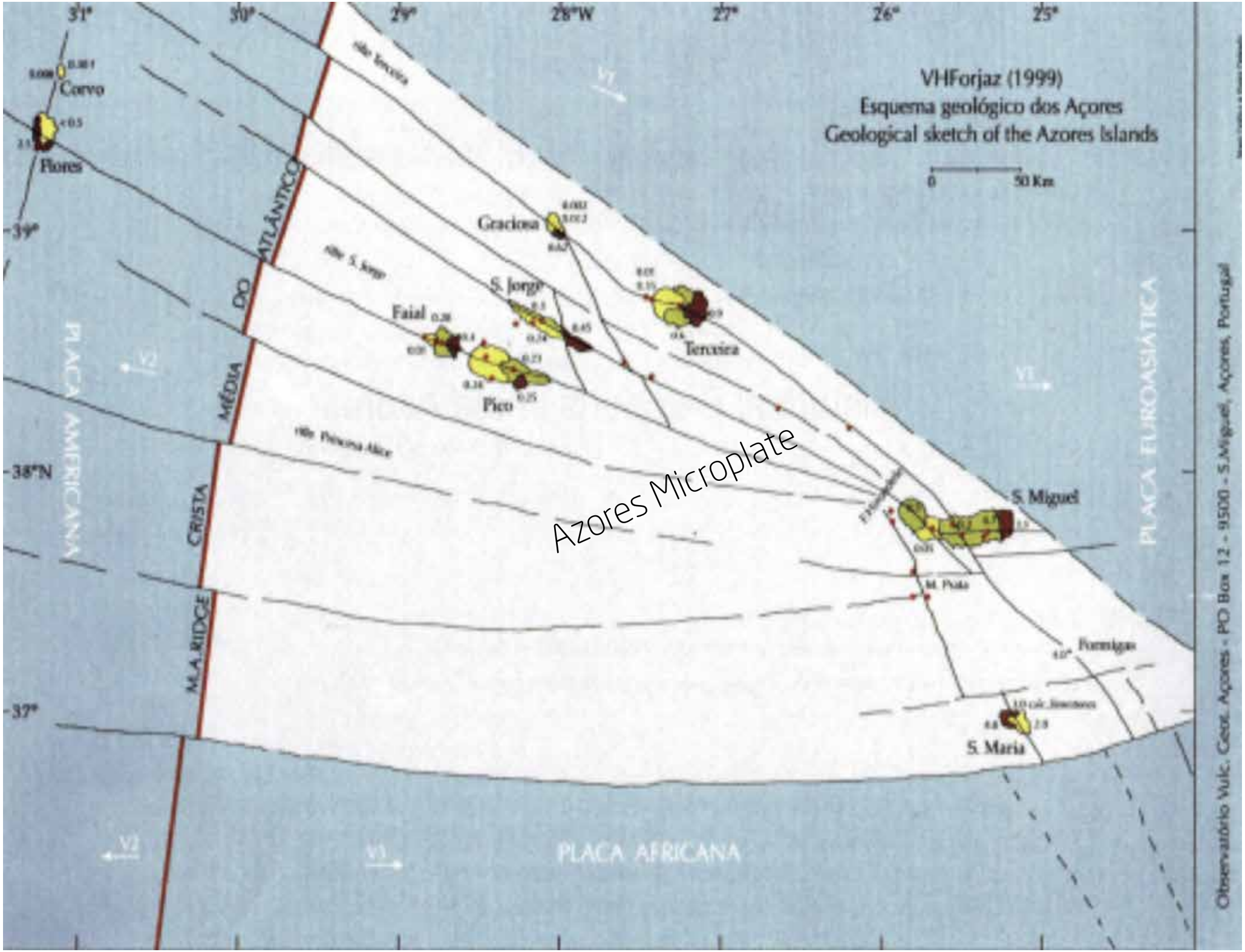

ARCTIC OCEAN
ARCTIC OCEAN
GREENLAND
ARCTIC CIRCLE
NORTH AMERICA
EUROPE
NORTH PACIFIC OCEAN
TROPIC OF CANCER
AFRICA
EQUATOR
OCEANIA
AUSTRALIA
SOUTH AMERICA
INDIAN OCEAN
SOUTH ATLANTIC OCEAN
SOUTH PACIFIC OCEAN

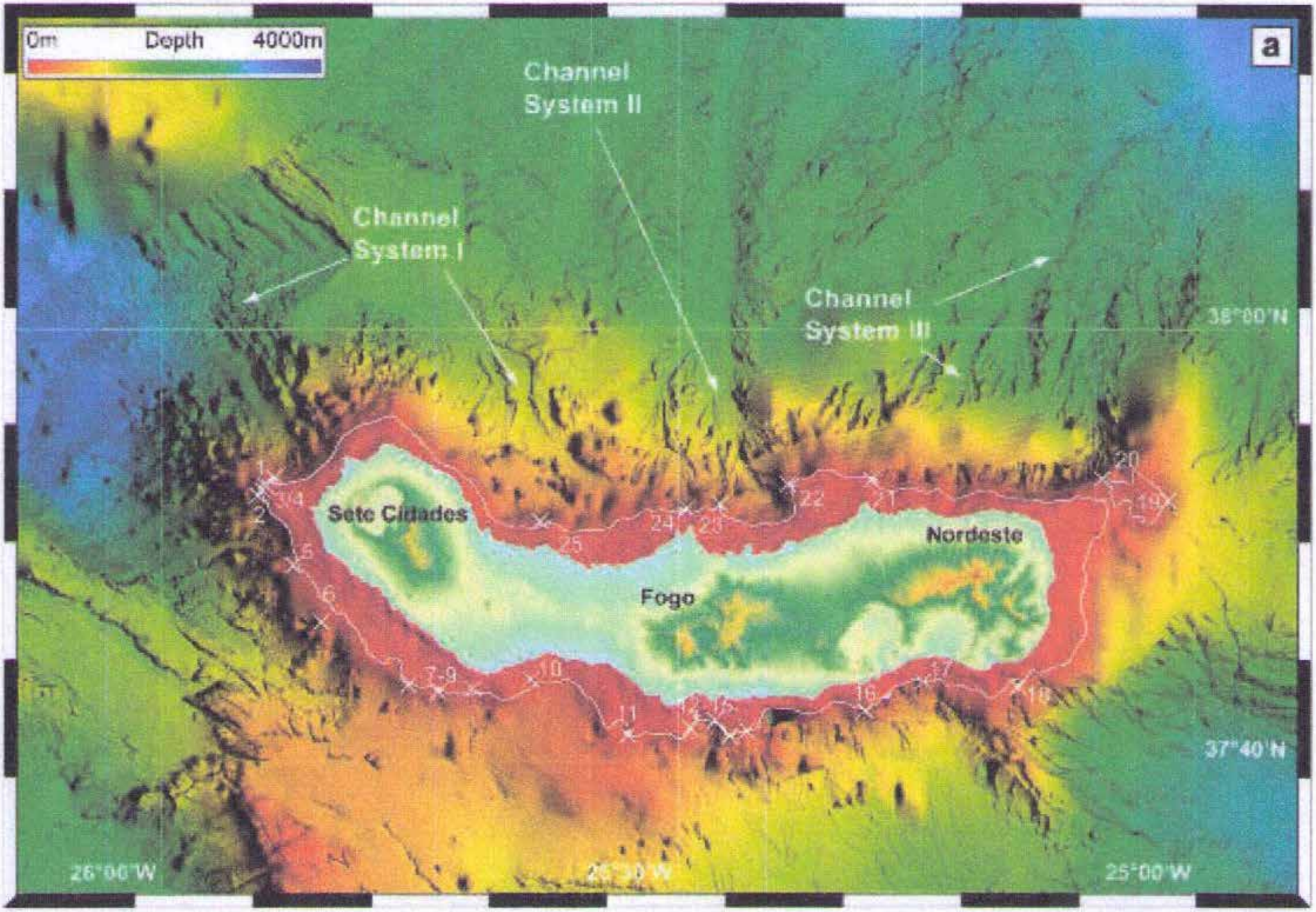
O. B. Seismograph

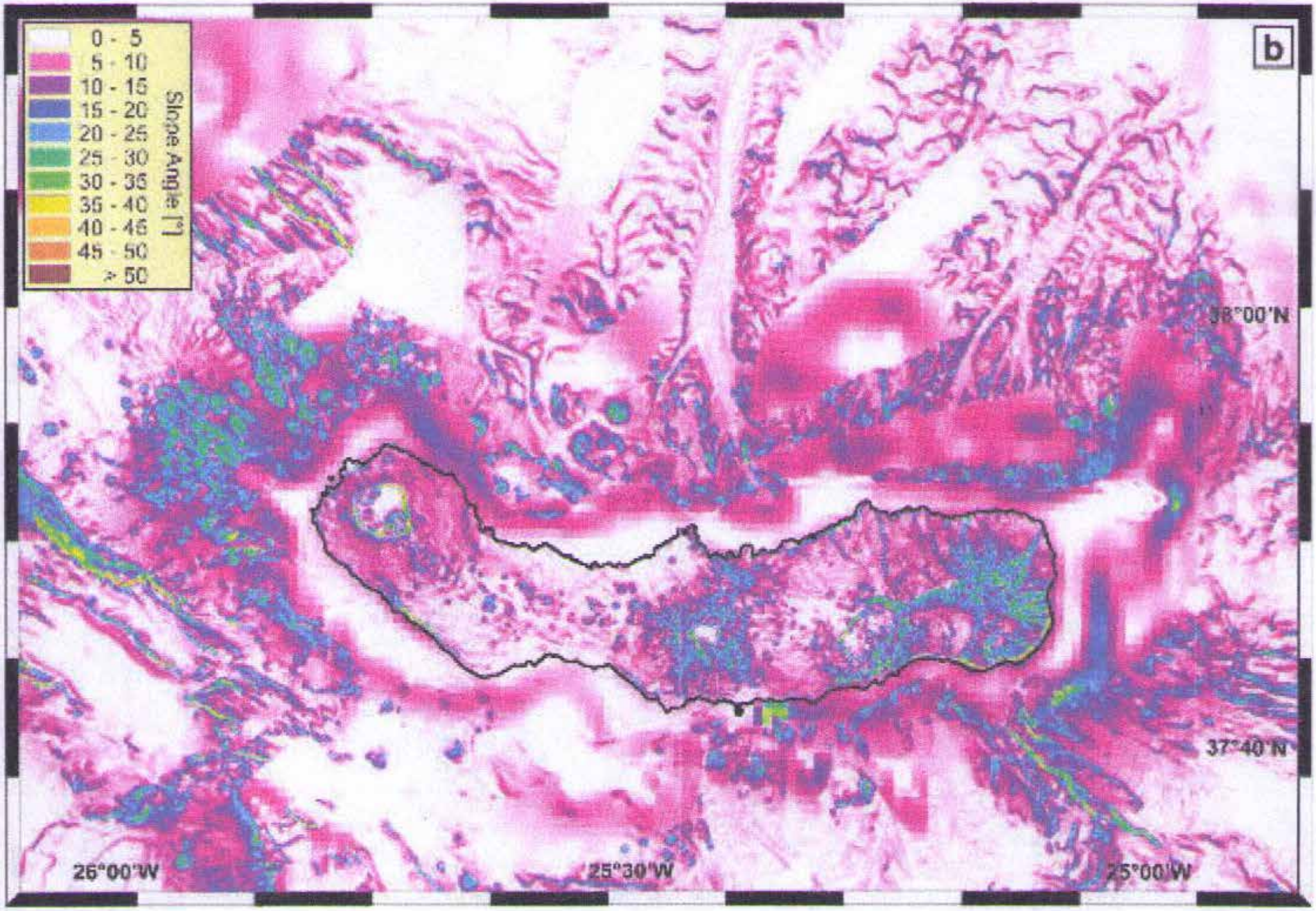


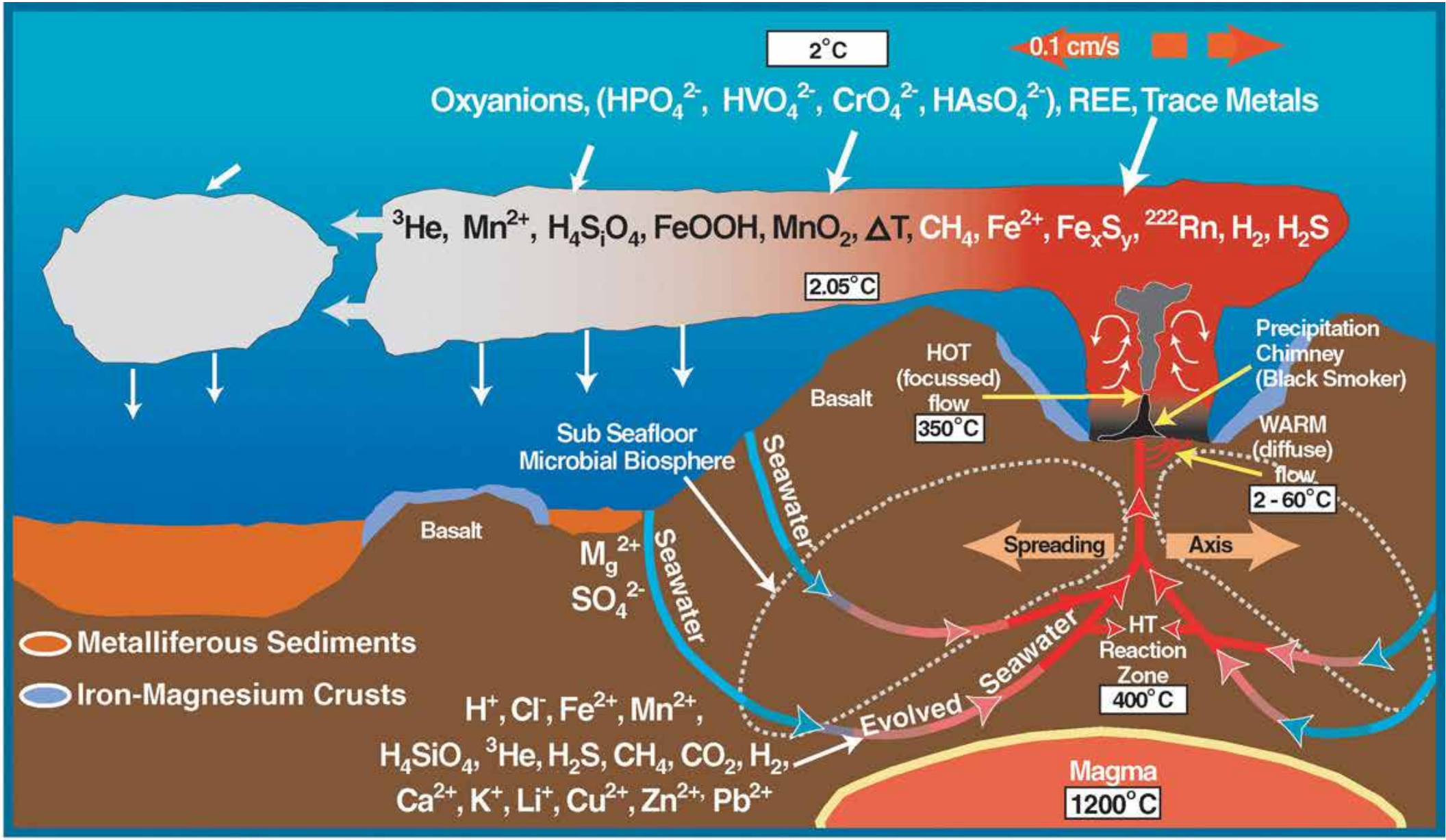
ROV

pillows

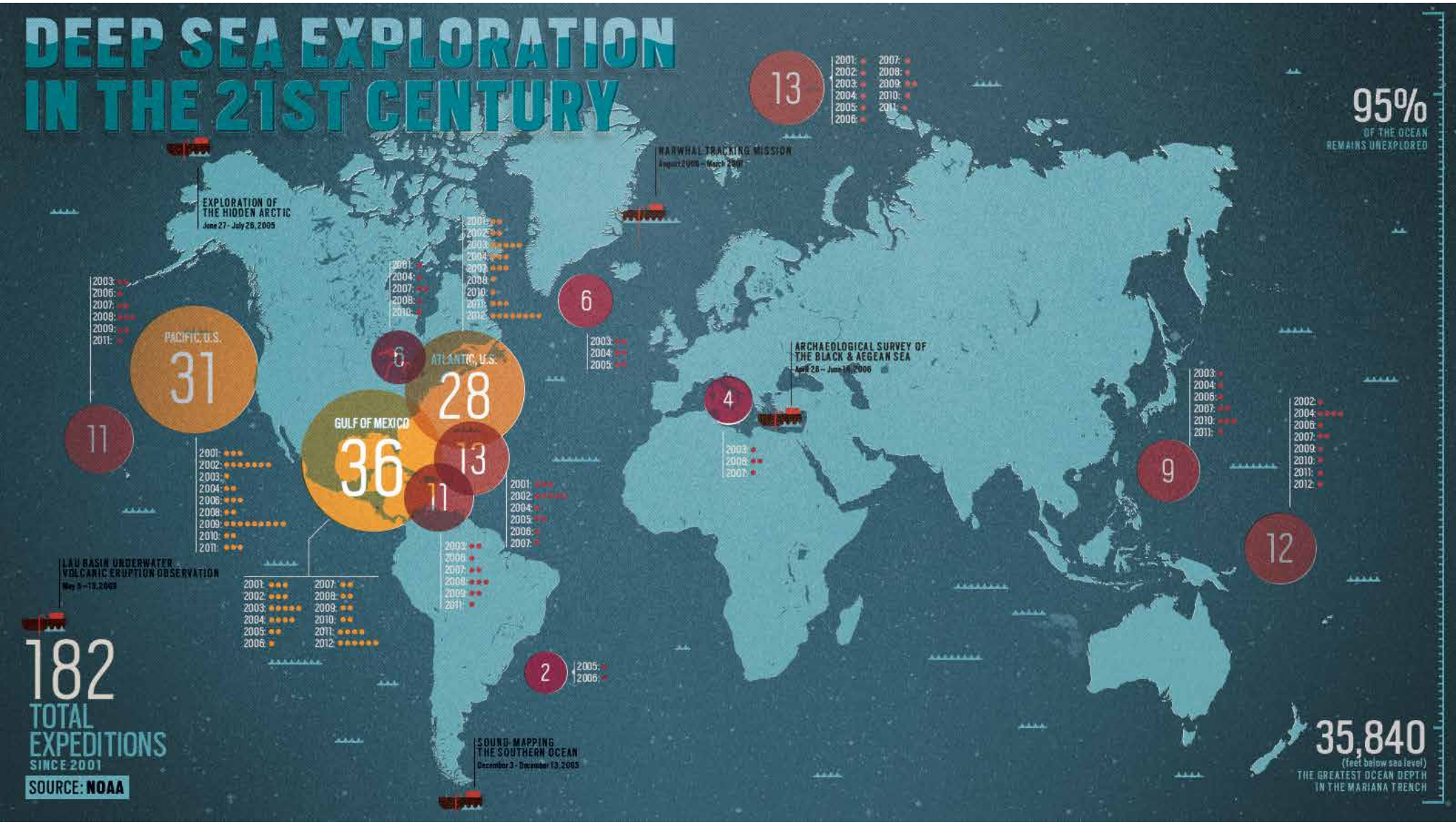

VHForjaz (1999)
Esquema geológico dos Açores
Geological sketch of the Azores Islands
0
50 Km
31°
30°
29°
28°W
27°
26°
25°
39°
38°N
37°
Corvo
Flores
Graciosa
S. Jorge
Faial
Pico
Terceira
S. Miguel
Formigas
S. Maria
M. Prata
Ilha Terceira
Ilha S. Jorge
Ilha Princesa Alice
PLACA AMERICANA
PLACA EUROASIÁTICA
PLACA AFRICANA
CRISTA MÉDIA DO ATLÂNTICO
M.A. RIDGE
Azores Microplate
Observatório Vulc. Cent. Açores - PO Box 12 - 9500 - S.Miguel, Açores, Portugal


0m
Depth
4000m
a
Channel System II
Channel System I
Channel System III
38°00'N
Sete Cidades
Nordeste
Fogo
37°40'N
26°00'W
25°00'W


b
Slope Angle [°]
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 35
35 - 40
40 - 45
45 - 50
> 50
38°00'N
37°40'N
26°00'W
25°30'W
25°00'W


2°C
0.1 cm/s
Oxyanions, (HPO_4^{2-}, HVO_4^{2-}, CrO_4^{2-}, $HAsO_4^{2-}$), REE, Trace Metals
^3He, Mn^{2+}, $H_4S_iO_4$, FeOOH, MnO_2, ΔT, CH_4, Fe^{2+}, Fe_xS_y, ^{222}Rn, H_2, H_2S
2.05°C
Precipitation Chimney (Black Smoker)
HOT (focussed) flow
350°C
Basalt
WARM (diffuse) flow
2 - 60°C
Sub Seafloor Microbial Biosphere
Seawater
Basalt
Mg^{2+}
SO_4^{2-}
Seawater
Spreading
Axis
Metalliferous Sediments
Iron-Magnesium Crusts
HT Reaction Zone
400°C
Evolved Seawater
H^+, Cl^-, Fe^{2+}, Mn^{2+},
H_4SiO_4, ^3He, H_2S, CH_4, CO_2, H_2,
Ca^{2+}, K^+, Li^+, Cu^{2+}, Zn^{2+}, Pb^{2+}
Magma
1200°C

DEEP SEA EXPLORATION IN THE 21ST CENTURY



182
TOTAL EXPEDITIONS
SINCE 2001

SOURCE: NOAA

SPTs Taking Shape

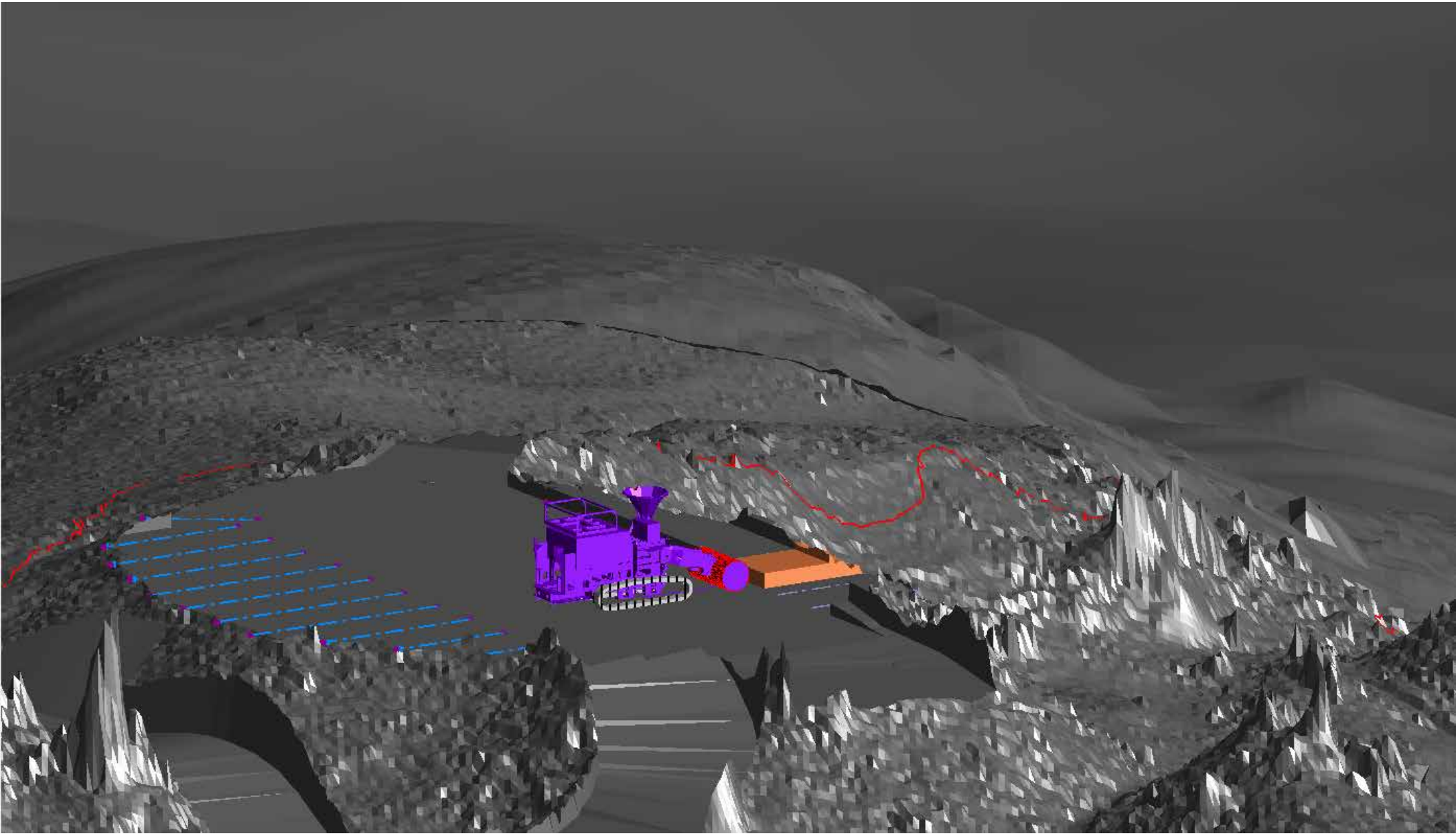
NAUTILUS Minerals

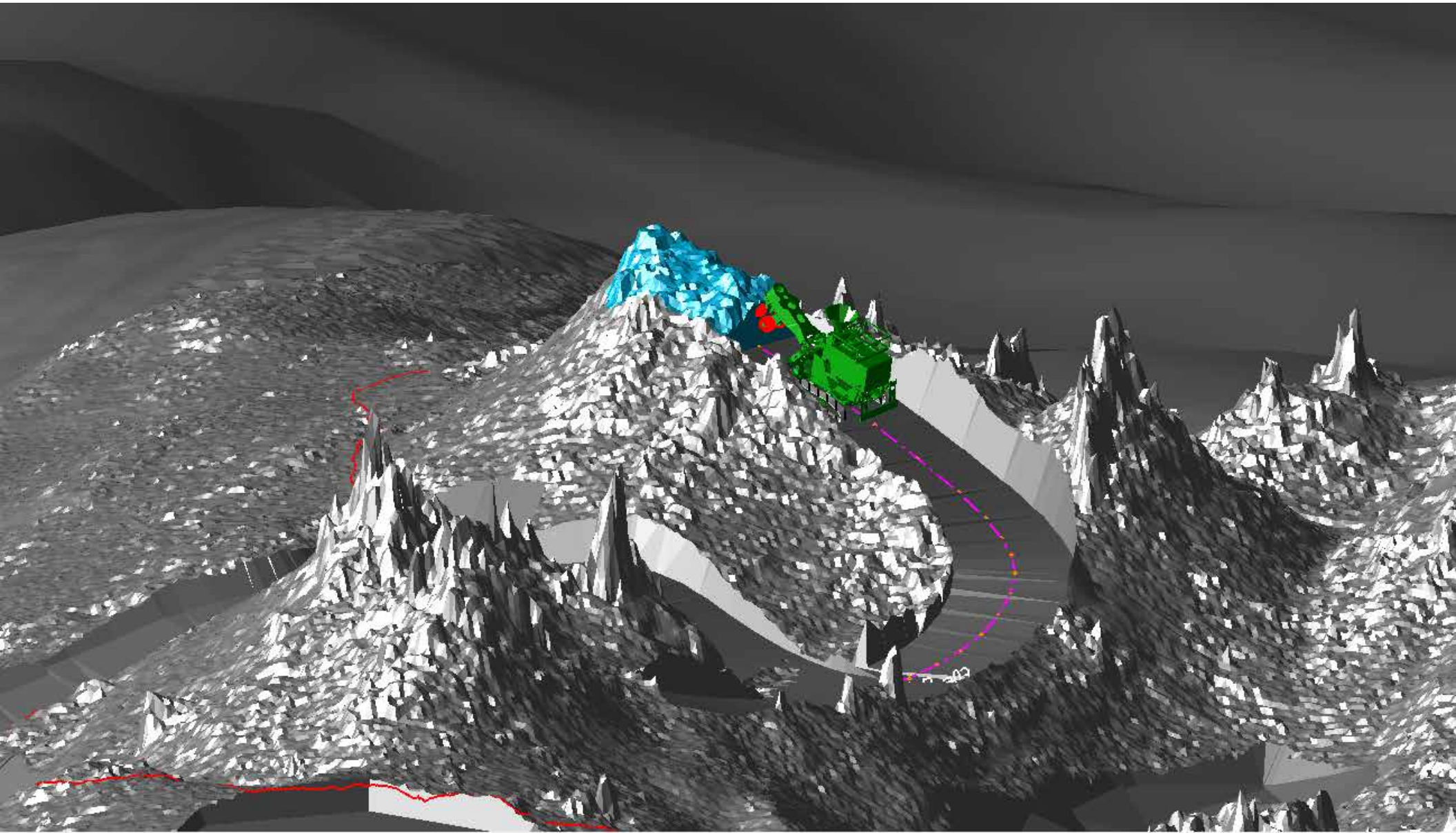
BC Chassis

CM Chassis

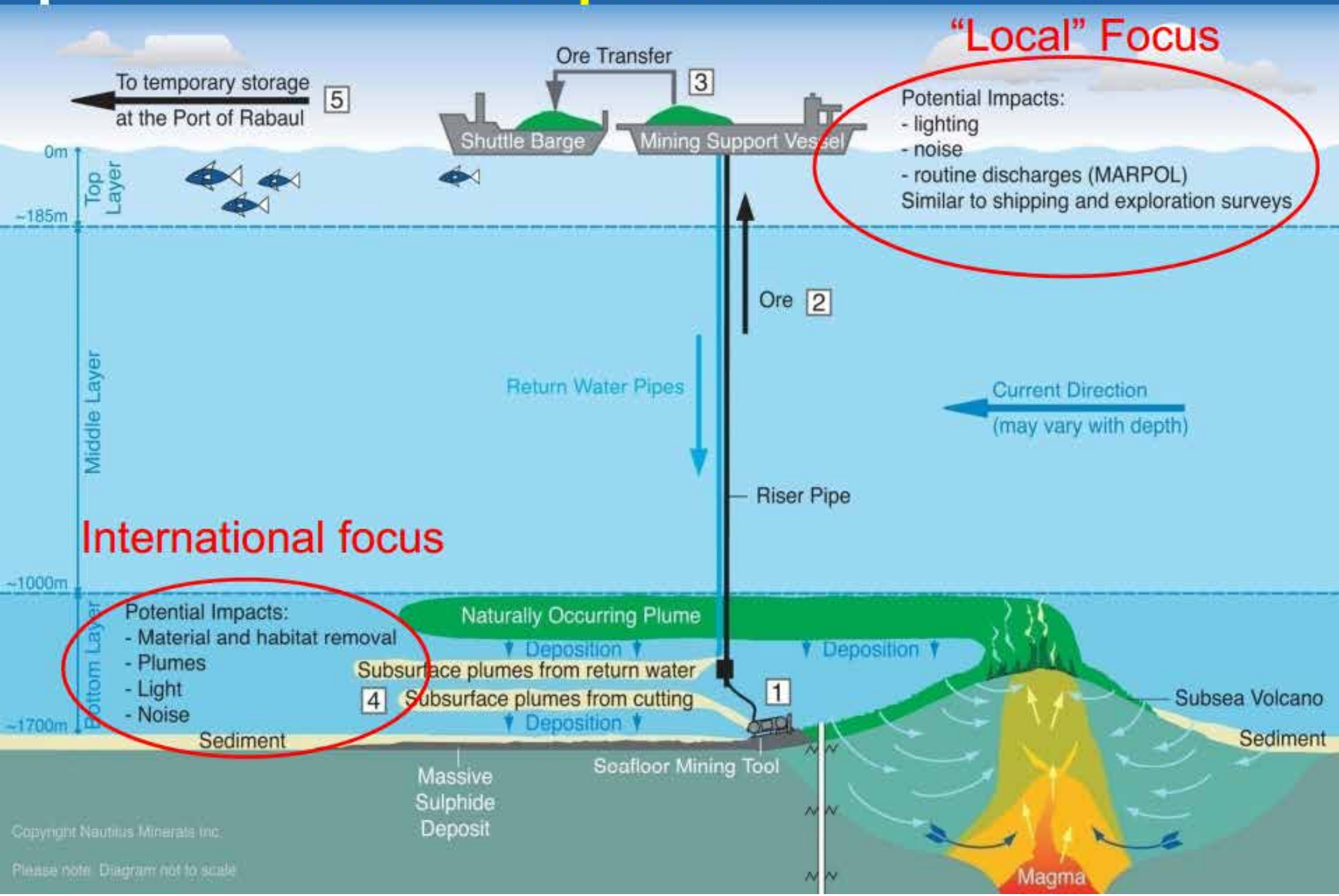
Seafloor Production Tool track unit now at SMD facility in Newcastle built by Caterpillar

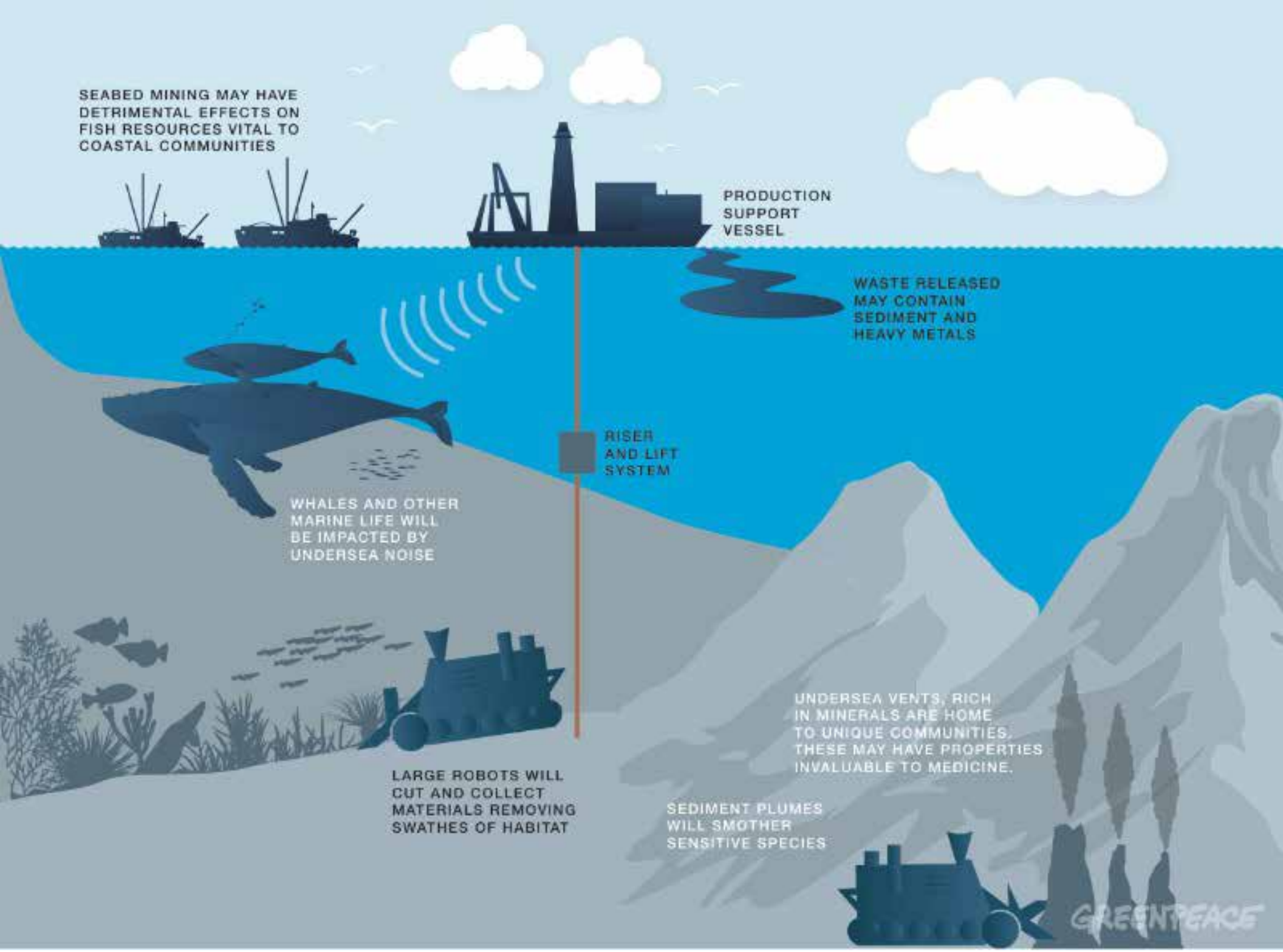
AC Cutter Head





Potential Impacts




SEABED MINING MAY HAVE DETRIMENTAL EFFECTS ON FISH RESOURCES VITAL TO COASTAL COMMUNITIES
PRODUCTION SUPPORT VESSEL
WASTE RELEASED MAY CONTAIN SEDIMENT AND HEAVY METALS
RISER AND LIFT SYSTEM
WHALES AND OTHER MARINE LIFE WILL BE IMPACTED BY UNDERSEA NOISE
UNDERSEA VENTS, RICH IN MINERALS ARE HOME TO UNIQUE COMMUNITIES. THESE MAY HAVE PROPERTIES INVALUABLE TO MEDICINE.
LARGE ROBOTS WILL CUT AND COLLECT MATERIALS REMOVING SWATHES OF HABITAT
SEDIMENT PLUMES WILL SMOTHER SENSITIVE SPECIES
GREENPEACE

OBSERVATÓRIO VULCANOLÓGICO E GEOTÉRMICO AÇORES

CENTROS DE CIÊNCIA DOS AÇORES
GOVERNO DOS AÇORES

FICHA TÉCNICA

POWERPOINT:
PRODUÇÃO - OVGA
Victor H. Forjaz
Luis M. Almeida
MONTAGEM - Pedro Melo, Nova Gráfica, Lda.

Fevereiro, 2017