

**APPLICATION FOR CONSENT TO CONDUCT MARINE SCIENTIFIC RESEARCH
IN AREAS UNDER NATIONAL JURISDICTION OF
...ICELAND...**

Date : 23/01/2012

1 - GENERAL INFORMATION

1.1. Cruise name and/or number: ICE-CTD on the research vessel *Thalassa*

1.2. Sponsoring institution:

Name : Ifremer
Address : 155, rue Jean-Jacques Rousseau
92138 Issy les Moulineaux - France
Phone : 33 (0)1.46.48.21.00 Fax : 33 (0)1.46.48.22.48
Director : Jean-Yves Perrot

1.3. Scientist in charge of the project:

Name : Dr. Norbert Frank

Address : Bât. 12, Avenue de la Terrasse, F-99190 Gif-sur-Yvette

Phone : 0033169824358 Fax : 0033169823568
Email : Norbert.Frank@ipsl.fr

1.4. Scientist from ...ICELAND... involved in the planning of the project:

Name : Stefán Áki Ragnarsson

Address : Marine Research Institute, Skúlagata 4, 121 Reykjavík

Phone : +354-5752000 Fax : :+354-5752001

1.5. Submitting officer:

Name : Jean-Xavier Castrec

Address : Ifremer Centre de Brest – Secteur Programmation Fleet
B.P. 70 – 29280 Poulzané - France

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Email : Jean.Xavier.Castrec@ifremer.fr

2 - DESCRIPTION OF THE PROJECT

2.1. Nature and objectives of the project :

The cruise will allow investigating cold-water coral reefs off South Iceland and seawater in which those corals bath. To observe and characterize cold-water coral habitats the submersible deep sea observing tool (remotely operated vehicle VICTOR 6000) will be deployed to measure the micro-bathymetry of coral reefs, to take photo snapshots and video transects across the reef and to sample punctuated living and fossil cold-water corals and associated seawater. In between the three investigated areas CTD casts will be performed to measure physical water mass properties and to sample seawater for further geochemical analyses (Radiocarbon, Rare earth isotopes and natural radionuclides of the U-series decay chain. The objective of the research cruise ICE-CTD is three fold. 1) We will characterize the coral reefs and its present day environmental conditions including potential damage from the fishing industry. 2) We will investigate the coral growth time framework and coral genetics to conduct research on reef connectivity across the northeast Atlantic and to determine potential climate influence on the reef development. 3) We will characterize the geochemical composition of seawater and corals to gain insights on the temporal variability of oceanic tracers indicative of ocean circulation and the cycling of trace elements and isotopes.

The cruise is a multi-national and multi-disciplinary effort led by climatologists, geochemists and marine biologists from the Laboratory for Climate and Environmental Research (LSCE), the Laboratory for Environment and Sediment Dynamic (IDES) and from IFREMER and it further includes partners from the Marine Institute of Iceland, the national Museum for natural history of Iceland, the German Marin Research Infrastructure MARUM and it benefits support from the European integrated projects CORALFISH, EPOCA and HERMIONE.

2.2. Relevant previous or future research cruises:

Previous research cruises having similar objectives: This cruise makes use of the expertise gathered through previous research cruises having similar objectives that were carried out in in the canyons of the Bay of Biscay (BOBGEO 2010, BOBECO 2011), along the carbonate mound structures of Procupine Seabight and Rockall Trough (MD01 GEOSCIENCES 2001; CARACOL 2001). The international partners of this project have further participated in a very large number of cruises to investigate coral habitats along the eastern European margin from the Mediterranean Sea, the Gulf of Cadiz, the slopes of Portugal, the Bay of Biscay up to the northern most part of the Norwegian margin. The Icelandic partners of the cruise have conducted one previous research cruise within the framework of the EU integrated research project CORALFISH including the deployment of an ROV in similar areas (B6-2009). Further information can be found on the websites of the EU projects: FP7 HERMES (<http://www.eu-hermes.net/>) FP7 HERMIONE (<http://www.eu-hermione.net/>), and CORALFISH (<http://eu-fp7-coralfish.net/>).

The ICE-CTD cruise as here planned using the French research vessel RV THALASSA and the remotely operated vehicle VICTOR 6000 will unfortunately not be able to collect sediment cores, i.e. we will not be able to access the long term history of reef developments as initially planned throughout the cruise proposal (implying the larger vessel ATALANTE or POURQUOI PAS?). Therefore, it is most likely that the partners of this project will, based on the collected data and in-depth geological survey and preliminary analyses of coral fragments and seawater, demand for a short cruise to collect four to five sediment cores in the surveyed areas at a later stage (presumably in 2014/2015).

2.3. Previously published research data relating to the project:

The following list of publications regarding the research objectives of this cruise is not exhaustive and solely presents the work of the two main involved Laboratories LSCE and IDES.

- A. Mangini, M. Lomitschka, R. Eichstädter, N. Frank, S. Vogler, G. Bonani, I. Hajdas and J. Pätzold: Coral provides way to age deep water, *Nature* 392, 347, (1998)
- N. Frank, M. Paterne, L. Ayliffe, T. Van Weering, J.-P. Henriët, and D. Blamart, Eastern North Atlantic deep-sea corals: Tracing upper intermediate water $\Delta 14C$ during the Holocene, *Earth and Planetary Science Letters* 219, 297-309 (2004)
- H. de Haas, F. Mienis, N. Frank, T. Richter, R. Steinbacher, H. de Stigter, C. van der Land, T. van Weering Morphology and sedimentology of (clustered) cold water coral mounds at the south Rockall Trough margins, NE Atlantic Ocean, *FACIES* 55, 1-26 (2009)
- N. Frank, E. Ricard, A. Paque, C. van der Land, C. Colin, D. Blamart, A. Foubert, D. van Rooij, J.-P. Henriët, H. de Haas, T. van Weering, The Holocene occurrence of cold-water corals in the NE Atlantic: Implications for coral carbonate mound evolution, *Marine Geology* 266, 129-142 (2009)
- C. van de Land, F. Mienis, H. de Haas, N. Frank, R. Swennen, T. van Weering; Diagenetic processes in carbonate mound sediments at the southwest Rockall Trough margin, *Sedimentology*, 57, 912-931 (2010)
- H. Pirlet, L.W. Wehrmann, B. Brunner, N. Frank, J. Dewanckele, D. Van Rooij, A. Foubert, R. Svennen, L. Naudts, M. Boone, V. Cnudde, J.P. Henriët; Diagenetic formation of gypsum and dolomite in a cold-water coral mound in the Porcupine Seabight, off Ireland, *Sedimentology*, 57, 786-805 (2010) doi: 10.1111/j.1365-3091.2009.01119.x
- Douville, E., Sallé, E., Frank, N. Eisele, M., Pons-Branchu, E; Ayrault, S., Rapid and precise $^{230}Th/U$ dating of ancient carbonate using inductively coupled plasma-source quadrupole mass spectrometry, *Chemical Geology*, 272, 1-11, (2010)
- Hans Pirlet, Christophe Colin, Mieke Thierens, Kris Latruwe, David Van Rooij, Anneleen Foubert, Norbert Frank, Dominique Blamart, Veerle A.I. Huvenne, Rudy Swennen, Frank Vanhaecke and Jean-Pierre Henriët: The importance of the terrigenous fraction within a cold-water coral mound: A case study, *Marine Geology*, (2010), doi:10.1016/j.margeo.2010.05.008
- K. Copard, C. Colin, E. Douville, A. Freiwald, G. Gudmundsson, B. de Mol and N. Frank, Nd isotopes in reef forming cold-water corals from the Northeastern Atlantic, *Quaternary Science Reviews* 29, DOI : 10.1016/j.quascirev.2010.05.025 (2010)
- C. Colin, N. Frank, K. Copard, E. Douville, Neodymium isotopic composition of deep-sea corals from the NE Atlantic: implications for past hydrological changes during the Holocene, *Quaternary Science Reviews* 29, doi:10.1016/j.quascirev.2010.05.012 (2010)
- Lies De Mol, David Van Rooij, Hans Pirlet, Jens Greinert, Norbert Frank, Frédéric Quemmerais, Jean-Pierre Henriët, Cold-water coral ecosystems in the Penmarc'h and Guilvinec canyons (Bay of Biscay): deep-water versus shallow water settings, *Marine Geology COCARDE special issue*, doi:10.1016/j.margeo.2010.04.011 (2011)
- D. Van Rooij, Blamart, D., De Mol, L., Mienis, F., Pirlet, H., Wehrmann, L.M., Barbieri, R., Maignien, L., Templer, S.P., de Haas, H., Hebbeln, D., Frank, N., Larmagnat, S., Stadnitskaia, A., Stivaletta, N., van Weering, T., Zhang, Y., Hamoumi, N., Cnudde, V., Duyck, P., Henriët, J.-P. & the MICROSISTEMS MD 169 shipboard party, Cold-water coral mounds on the Pen Duick Escarpment, Gulf of Cadiz: the MICROSISTEMS approach, *Marine Geology*, doi:10.1016/j.margeo.2010.08.012 (2010)
- Claudia Wienberg, Norbert Frank, Kenneth N. Mertens, Jan-Berend Stuu, Furu Mienis, Margarita Marchant, Dierk Hebbeln, Glacial occurrence of cold-water corals in the Gulf of Cádiz - Implications of bottom current intensity and productivity, in press *Earth and Planetary Science Letters* 298, (3-4), 405-416 (2010)
- Hans Pirlet, Christophe Colin, Mieke Thierens, Kris Latruwe, David Van Rooij, Anneleen Foubert, Norbert Frank, Dominique Blamart, Veerle A.I. Huvenne, Rudy Swennen, Frank Vanhaecke and Jean-Pierre Henriët: The importance of the terrigenous fraction within a cold-water coral mound: A case study, *Marine Geology*, doi:10.1016/j.margeo.2010.05.008 (2011)
- Frank, N., Freiwald, A., Lopez-Correa, M., Eisele, M., Hebbeln, D., Wienberg, C., van Rooij, D., Colin, C., van Weering, T., de Haas, H., Roberts, M., Buhl-Mortensen, P., B. de Mol, Douville, P., Blamart, D., and Hatté, C., North Atlantic coral reefs and climate change, *Geology* 39, 743-746 (2011)
- M. Eisele, N. Frank, C. Wienberg, D. Hebbeln, M. López Correa, E. Douville, A. Freiwald, Periodical cold-water coral growth during the last glacial controlled by productivity, *Marine Geology* 280, 143-149 (2011)
- K. Copard, C. Colin, N. Frank, C. Jeandel, Montero Serrano J.-C, G. Reverdin and B. Ferron, Nd isotopic composition of water masses and dilution of the Mediterranean outflow along the South-West European margin, *G3*, 12, doi:10.1029/2011GC003646, 1-14 (2011)
- K. Copard, C. Colin, G. Henderson, J. Scholten, E. Douville, N. Frank, Millennium scale intermediate water variability in the Northeast Atlantic as recorded by deep-sea corals, in press by EPSL
- J.C. Montero-Serrano, N. Frank, C. Wienberg, M. Eisele, C. Colin, The climate influence on the mid-depth east Atlantic gyres viewed by cold-water corals, *Geophysical Research Letters*, 36, doi:10.1029/2011GL048733, 1-6 (2011)
- C. Rollion-Bard, N. Vigier, A. Meibom, D. Blamart, S. Reynaud, R. Rodolfo-Metalpa, S. Martin, J.-P. Gattuso (2009) Effect of environmental conditions and skeletal ultrastructure on the Li isotopic composition of scleractinian corals, *Earth and Planetary Science Letters*, 286, 63-70
- Thierry, V., E de Boissésou, H. Mercier (2008) Interannual variability of the Subpolar Mode Water properties over the Reykjanes Ridge during 1990-2006. *J. Geophys. Res.* 113, doi:10.1029/2007JC004443
- Blamart, D., Rollion-Bard C., Meibom A., Cuif J. P., Juillet-Leclerc A., and Dauphin Y. (2007) Boron isotopic composition correlates with ultra-structure in the deep-sea coral *Lophelia pertusa*: Implications for biomineralization processes and paleo-pCO₂ reconstruction. *G3*, 8, 12, doi:10.1029/2007GC001686

3 - METHODS AND MEANS TO BE USED

3.1. Particular of vessel:

Name : *Thalassa*
 Nationality : French
 Owner : Ifremer
 Operator : Genavir
 Overall length : 74,5 m
 Maximum draught : 6,10 m
 Gross tonnage : 2 803 UMS
 Propulsion : Diesel Electric
 Average operating cruising speed and survey speed : 11 knots
 Call sign : FNNP
 Method and capability of communication (including telex, frequencies) :
 - GSM : 33.6.07.32.44.87 (bridge) - 33.6.16.87.10.69 (captain)
 Fax : 33.6.20.18.50.20
 Inmarsat :Tel : 00.870.7.731.600.16 (bridge) - Fax : 00.870.7.831.600.57
 - Vsat : Tel : 33.2.98.22.48.05 (bridge) - Fax : 33.2.98.22.48.06
 - Telex Inmarsat C1 : 058x.4.227.297.10 - Telex Inmarsat C2 : 058x.4.227.297.11
 (Codes: East Atlantic: 0581 - West Atlantic: 0584 - Pacific : 0582 -
 Indian Ocean: 0581)
 email : TL.Commandant@thalassa.ifremer.fr
 Email Telex C1 : ThalassaC1@skyfile-c.com
 Email Telex C2 : ThalassaC2@skyfile-c.com
 Name of master : Xavier GUILCHER
 Number of crew : 25
 Number of scientists on board : 25

3.2. Aircraft or other craft to be used in the project:

None

3.3. Particulars of methods and scientific instruments:

Types of samples and data	Methods to be used	Instruments to be used
Bathymetry	Multi-beam echo sounding	ROV based RESON SeaBat 7125® multi-beam echo sounder (400kHz) for high resolution mapping (Bathymetry Module en route) / EK60 SIMRAD® vertical echo sounder
Seafloor Imagery	High resolution CCD cameras and black and white long range photos	ROV based high resolution CCD cameras and OTUS black and white long range Camera and flashes (1200 joules)
Cold-water corals <i>Lophelia pertusa</i> / <i>Madrepora oculata</i> / <i>Desmophyllum dianthus</i> / and other specimens	Remotely operated clamp of the ROV	ROV Victor 6000 clamp

Seawater	CTD with niskin bottles and sampling via pumping	Ship based CTD Rosette with 24 Niskin bottles and ROV based pumping system (19x200 ml)
Seawater properties: temperature, salinity, oxygen, pH, turbidity, and possibly current strength and vertical sheer.	Ship and ROV CTD	CTD Seabird® SBE911 + LADCP ROV Seabird® SBE 25 CTD
Surface Sediments including fossil coral framework	Box corer	Box corer (to be defined according to the ships infrastructure)

3.4. Indicates whether harmful substances will be used :

On board acids (HCL and HNO₃) will be used to acidify seawater samples and to perform chemical cleaning and trace isotope purification of fossil coral fragments / Alcohol is used to store coral samples in cases.

3.5. Indicate whether drilling will be carried out :

NO

3.6. Indicate whether explosives will be used :

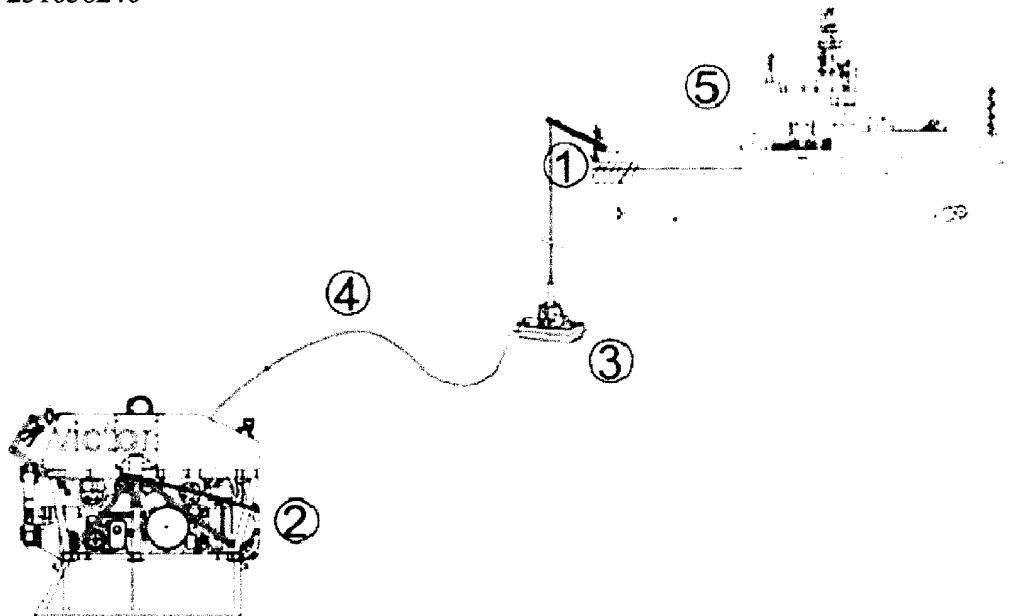
NO

4 - INSTALLATIONS AND EQUIPMENTS

Details of installations and equipment (dates of laying, servicing, recovery, exact locations and depth)

No lander or long-term equipment laying or recovery is planned. The cruise only includes punctuated seawater sampling and property measurements and temporal transects of the submersible tool Victor 6000 as detailed below.

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The VICTOR 6000 gear includes:

- A direct-winding hydraulic winch, the 8,500 m 20 mm umbilical, weighing in all: 30 tons (1)
- The vehicle 3.1 x 1.8 x 2.1 m, weight 4 tons and 600 kg for the module (2)
- The hard ballast 1.5 x 0.8 x 0.5 m, weight 1.2 tons (3)
- The tether measuring from 100 to 300 m 35 mm (4)

5 - GEOGRAPHICAL AERAS

5.1. Indicate geographical areas in which the project is to be conducted (with reference in latitude and longitude) :

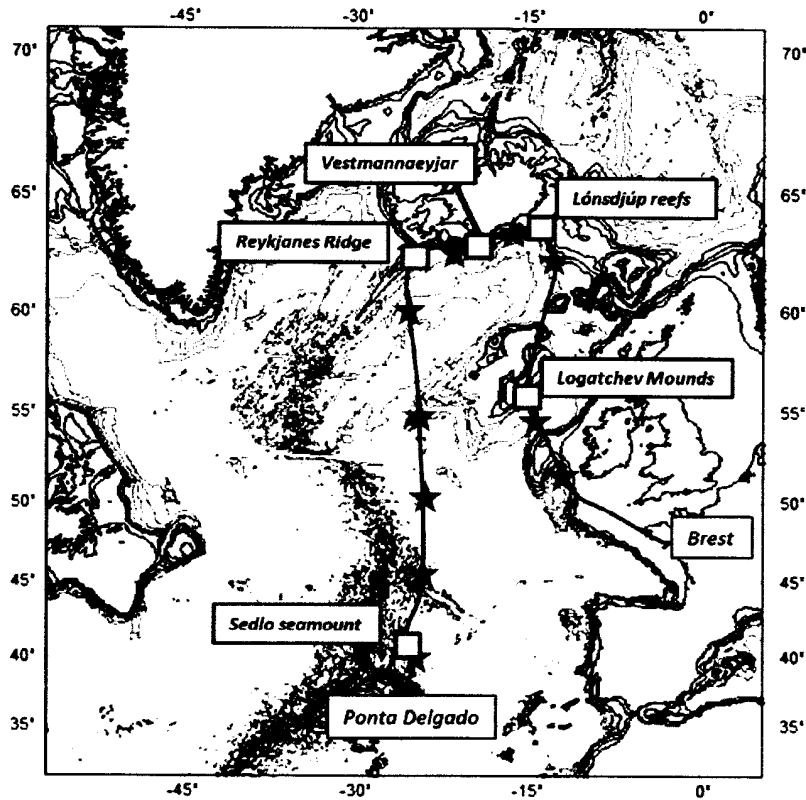
The work areas and program within Iceland territorial waters is outlined in the table and maps below:

<i>ICE-CTD</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Program</i>	<i>Depth</i>
Lónsdjúp				
Station 5	13,920°W	63,7500°N	CTD	0 – 1500m
Station 6	14,080°W	63,9200°N	CTD and ROV survey	200 – 1500m
South off Vatnajökull				
Station 7	17,000°W	63,5000°N	CTD	0 – 200m
Station 7b	17,000°W	63,2500°N	CTD	0 – 1500m
South off Vestmannaeyjar Island				
Station 8	19,750°W	63,0000°N	CTD	0 – 2500m
Station 9	20,000°W	63,2500°N	CTD and ROV survey	200 – 1500m
Possible Stopover at Heimaey Habor				
Reykjanes Ridge				
Station 10	22,000°W	63,0000°N	CTD	0 – 2500m
Reykjanes Ridge				
Station 11	24,500°W	62,7500°N	CTD	0 – 1500m
Station 12	24,000°W	63,0000°N	CTD and ROV survey	200 – 1500m

Geographical areas to be explored are Lónsdjúp reefs and slopes the Vatnajökull outflow the potential coral occurrences south off Vestmannaeyjar Island and one exploratory area on the Reykjanes Ridge.

5.2. Attach chart(s) at an appropriate scale showing the geographical areas of the intended work and, as far as practicable, the positions of intended stations, the tracks of survey lines, and the locations or installations and equipment :

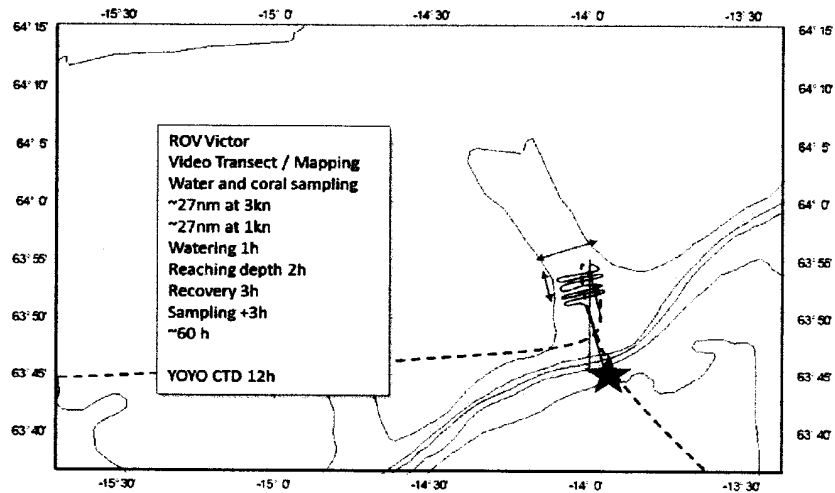
The proposed complete cruise track of ICE-CTD is shown in Figure 1: Blue stars correspond to CTD stations, red stars correspond to CTD stations and areas for ROV surveys and coral sampling. The areas and proposed ROV surveys in Icelandic waters are detailed below.



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Figure 1 : Proposed cruise track of the research cruise ICE-CTD using RV Thalassa and the submersible remotely operated vehicle VICTOR 6000.

Area 2: Lónsdjúp reefs and slopes



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Figure 2: Study area Lónsdjúp reefs

Bathymetric maps are provided from the Marine Institute of Iceland. Operations will include high resolution bathymetry using VICTOR 6000 multi beam echo-sounder module in on route mode, followed by a YOYO CTD cast of 12 hours, followed by a video transect and coral

sampling using the VICTOR 6000 clamp. During the operations the lift (see figure 3) needed to store samples as the ROV continues to survey will be moored on the seafloor for 48h.

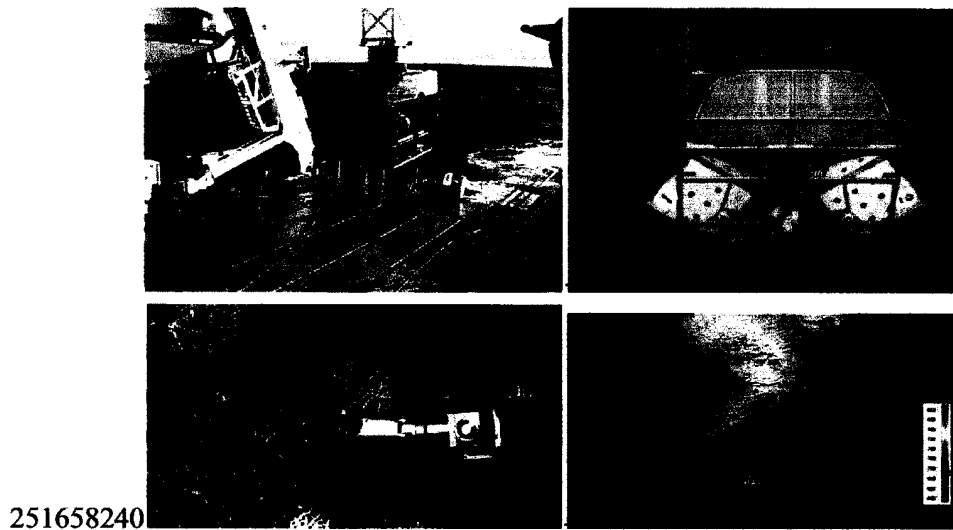


Figure 3: VICTOR 6000 ROV and sample hosting lift on seafloor to the right. Below: Coral sampling using the clamp and example high resolution bathymetry from Logatchev Mound (Rockall Bank).

Station 7a and b: Vatnajökull discharge area

Through two shallow CTD casts we will sample seawater and particulate matter close to the glacier discharge area, however also close to the shelf break as shown in figure 4.

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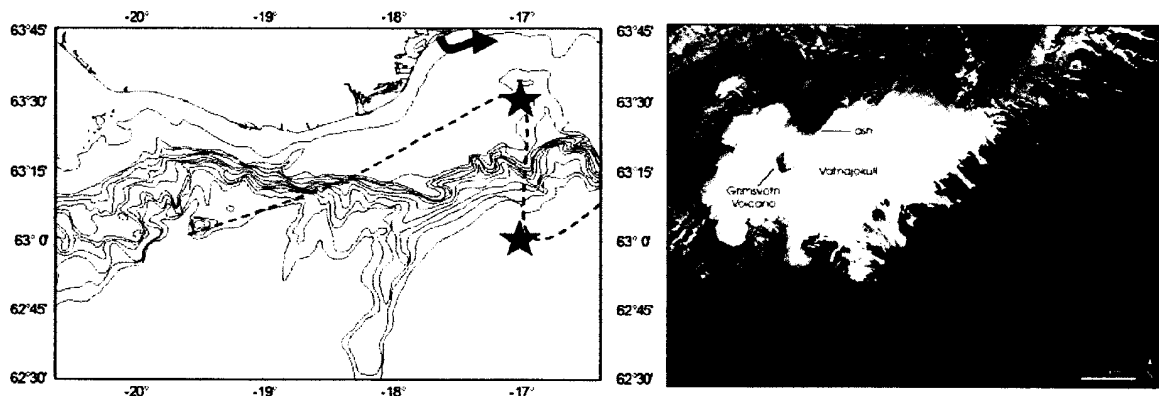
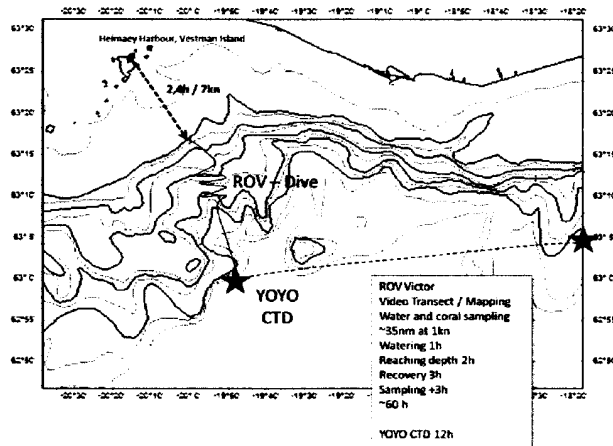


Figure 4 : Seawater and particulate matter sampling close to the discharge of the Vatnajökull glacier. Satellite photo represents a zoom on the Vatnajökull glacier and the shelf topography.

Area 3: South off Vestmannaeyjar Island

Bathymetric maps are provided from the Marine Institute of Iceland. Operations will include high resolution bathymetry using VICTOR 6000 multi beam echo-sounder module in on route mode, followed by a YOYO CTD cast of 12 hours, followed by a video transect and coral sampling using the VICTOR 6000 clamp. During the operations the lift (see figure 3) will be moored on the seafloor for 48h.



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Figure 5 : Location of CTD (blue star) and proposed track of VICTOR 6000 for high resolution bathymetry and videos imaging and sampling (red line). This station is closest to the Heimaey harbor and a short term stoppover may be envisioned prior to the dives to embark journalists willing to follow the operations over two days.

Station 10: CTD cast southeast of the Reykjanes Ridge
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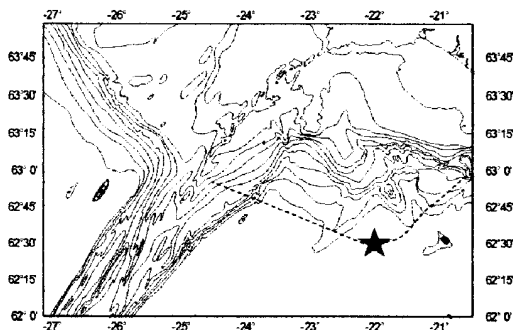
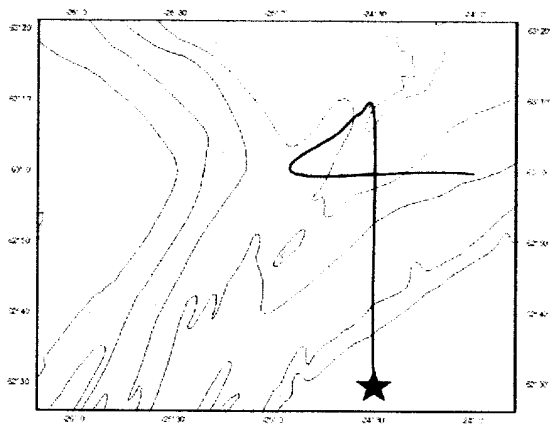


Figure 6: CTD station southeast of the Reykjanes Ridge and within the Iceland Basin.

Area 4: Reykjanes Ridge

Bathymetric maps are provided from the Marine Institute of Iceland. Operations will include high resolution bathymetry using VICTOR 6000 multi beam echo-sounder module in on route mode, followed by a CTD casts, followed by a video transect and coral sampling using the VICTOR 6000 clamp. Here the lift (see figure 3) will not be moored given the exploratory character of the roughly 40 hours dive.



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Figure 7: Location of CTD (blue star) and proposed track of VICTOR 6000 for videos imaging and sampling (red line).

A detailed description of the work-plan, equipment, timing and participants will be available before the cruise via the ICE-CTD website (<http://newton-anr.lsce.ipsl.fr/icectd/index.htm>)

6 - DATES

6.1 Expected dates of first entry into and final departure from the research area of the research vessel :

entry date : 11/06/2012

departure date : 06/07/2012

6.2 Indicate if multiple entry is expected :

7 - PORTS CALLS

7.1. Dates and names of intended ports of call in Iceland.

Heimaey (Vestmannaeyjar Island)

7.2. Any special logistical requirements at ports of call :

None

7.3. Name/Address/Telephone of shipping agent (if available)

8 - PARTICIPATION

8.1. Extent of which Icelandic researchers will be enabled to participate or to be represented in the research project :

Two scientific partners are identified in the cruise and research proposals and are invited to participate in the cruise

* Institute for Marine Research Reykjavik

* Natural History Museum of Iceland Reykjavik

8.2. Proposed dates and ports for embarkation/disembarkation :

Start date : 10.06.2012 Brest (France)

End date : 07.07.2012 Ponta Delgada (Azores – Portugal)

9 - ACCESS TO DATA, SAMPLES AND RESEARCH RESULTS

9.1. Expected dates of submission to Icelandic partners of preliminary reports which should include the expected dates of submission of the final results :

Two months after the cruise

9.2. Proposed means for access by the Icelandic partners to data and samples :

Data: Via international database PANGEA and websites of the partner institutes: IFREMER and LSCE

Samples: Via the cold-water coral collection of LSCE (open access to well dated coral specimens for further research).

Please note that particular well preserved coral specimens will be sent to the Icelandic Museum of Natural History of Reykjavik for storage and possible exposure to the larger public

9.3. Proposed means of making research internationally available :

International peer-review publications and web sites of the partner institutes (LSCE, IDES, IFREMER)

ANNEX

List of the scientific team (to be confirmed)

LAST NAME First name Email	Sex	Nationality	Institution Laboratoire	Responsibility and role on board
FRANK Norbert Norbert.Frank@lsce.ipsl.fr	M	GERMAN	LSCE / Gif-sur Yvette	Geochronology and Marine Geochemistry Chief Scientist
ARNAUD-HAON Sophie sarnaud@ifremer.fr	F	FRENCH	Ifremer Brest	Marine Biology and Genetics Co-Chief Scientist
COLIN Christophe christophe.colin@u-psud.fr	M	FRENCH	IDES University Paris Sud	Sedimentology / Paleoceanography
DOUVILLE Eric Eric.Douville@lsce.ipsl.fr	M	FRENCH	LSCE / Gif-sur-Yvette	Marine Geochemistry
TISNERAT-LABORDE Nadine Nadine.Tisnerat@lsce.ipsl.fr	F	FRENCH	LSCE / Gif-sur-Yvette	Geochronology and Marine Geochemistry
THIL François fthil@lsce.ipsl.fr	M	FRENCH	LSCE / Gif-sur-Yvette	Engineer
BORDIER Louise louise.bordier@lsce.ipsl.fr	F	FRENCH	LSCE / Gif-sur-Yvette	Technician
MONTAGNA Paolo paolo.montagna@lsce.ipsl.fr	M	ITALIAN	CRS Bologna	Marine Geochemistry
WIENBERG Claudia cwberg@marum.de	F	GERMAN	MARUM Bremen	Sedimentology / Marine Biology
RAGGNARSON Stéphan A. steara@hafro.is	M	ICELANDIC	MRI Reykjavik	Marine Biology
GUDMUNSON Gudmundur gg@ni.is	M	ICELANDIC	Icelandic Institute of natural History Reykjavik	Conservation / Geology / Marine Biology
To be specified			Ifremer Brest	Marine Biology
To be specified			Ifremer Brest	Marine Biology
To be specified			Ifremer Brest	Marine Biology