



Roinn Cumarsáide,
Fuinnimh & Acmhainní Nádurtha
Department of Communications,
Energy & Natural Resources



**Geological Survey of Ireland Research Programme
- Short Call 2015, Final Report -**

Name of Lead Investigator	Aggeliki Georgiopolou
Email	Aggie.georg@ucd.ie

Organisation name	University College Dublin
Organisation type:	☒ HEI ☐ Public Sector (other) ☐ Private Sector
Department/section	School of Earth Sciences

Project Title	Frequency of slope collapses on Rockall and mechanical characterisation of the sediments
Contract No.	2015-sc-036



2. Project information:

Title of project	Frequency of slope collapses on Rockall and mechanical characterisation of the sediments
Did you make any formal amendment to the project workplan / budget?	☐ yes ☒ no If yes, please specify:

Project Report (max 1500 words, excluding figures and headings):

- (i) Objectives and scientific/engineering targets beyond the state of the art

All of the objectives were achieved to large extent.

- 1) To date the sequence of events that took place on Rockall Bank: radiocarbon dates were obtained from selected stratigraphic intervals that a) confirm a major slide event took place nearly 21ka ago, b) a more recent event may have taken place 8,760 years ago, and c) an even more recent event may have taken place since then, found directly on the seabed within the complex scarps of the lower scar at about 1800 m water depth (Fig. 1).
- 2) To establish a reliable sedimentation rate for the eastern Rockall Bank: the radiocarbon dates reveal that the sedimentation rate for the current interglacial has been 3-3.5 cm/ka.
- 3) To analyse the sediment properties and feed that to the study of their mechanical behaviour: out of 18 gravity cores, ten were split and described and assigned for sedimentological analyses

and 8 were kept whole in order to establish their mechanical properties with geotechnical analyses. The geotechnical analyses need inputs such as pore water content and grain size but those are impossible to acquire when the cores are kept whole. All the cores were logged at Maynooth University with the multi-sensor core logger (MSCL) for physical properties, namely sediment p-wave velocity, gamma-ray density and magnetic susceptibility. The physical properties allowed correlations of the whole and split cores. 113 samples were taken from the split cores for pore water measurements and 250 samples for grain size analysis. Based on the MSCL correlations the pore water content and grain size measurements can be used in the geotechnical analysis of the whole cores, which will be conducted in Delft University in the coming months.

Progress beyond the state of the art:

Analysis of rock samples collected with the Remotely Operated Vehicle during the same expedition that collected the cores was not part of the original proposal. However, Niall Finch who was employed as research assistant for this project had a keen interest in analysing them and he has provided an analytical report with photos from the collection of the rocks and corresponding thin section images and descriptions of the rocks (Fig. 2). This work will facilitate the construction of a geological map for the study area. As part of this same task, forward-looking bathymetric imaging was performed on one of the slide scarps. Niall started to create photomosaics based on the video imaging and the bathymetry (Fig. 3), but his contract finished before the work was finalised. However I am visiting the National Oceanography Centre in mid-December to meet with the SORBEH project partners and progress this part of the project.

(ii) Implementation (including reference to timelines, milestones, management)

The vast majority of the work that was described and planned in the proposal run smoothly and no deviations were necessary. The only element that could not be completed was generating a map of shear strength measurements. The pocket penetrometer that I have in my lab proved inappropriate for such soft sediments. Shear strengths however will be generated as part of the geotechnical analysis which was not part of the proposal but it had been hoped that the analyses could run in parallel. However, at the beginning of the project, the collaborator responsible for this aspect, moved away from UCD to take up a new position at Delft University. We have now made arrangements for the progression of the project and the whole cores will be shipped to his lab in Delft University for the analysis that will incorporate the pore water and grain size measurements.

(iii) Outputs (please use bullet points)

- 10 gravity cores, split and described
- 18 cores logged in the Multi-sensor core logger in University of Maynooth
- Pore water content (113 samples) (Map 1 in Appendix 2) and grain size analyses (250 samples) (Map 2 in Appendix 2) and from the 10 cores that were split
- 17 radiocarbon dates (Appendix 2)
- 29 thin sections from seafloor rock samples described and photographed (Appendix 2)
- Correlations of the split and whole cores have been made on the basis of the MSCL curves, so the pore water and grain size analyses can be used in the mechanical analyses of the whole cores

Impact/value of the project (Max 500 words):

We can already see that most of the severe collapses have taken place in the areas of the slope occupied by medium sand (Map 2). Further investigation of the shear strength of the sediments will allow us to assess whether the grain size distribution has any significance. The radiocarbon dates show us that there may have been some more recent collapses post 21 ka adding to the investigation of tsunami hazard and likelihood of one occurring in the near future.

The analysis of the rock samples and the documenting of the ROV videos has already furthered our understanding of the scars and in conjunction with the analysis performed at the National Oceanography Centre in Southampton, partners of SORBEH, will generate another publication for a peer-reviewed international journal. As a result there will be two papers stemming from this grant.

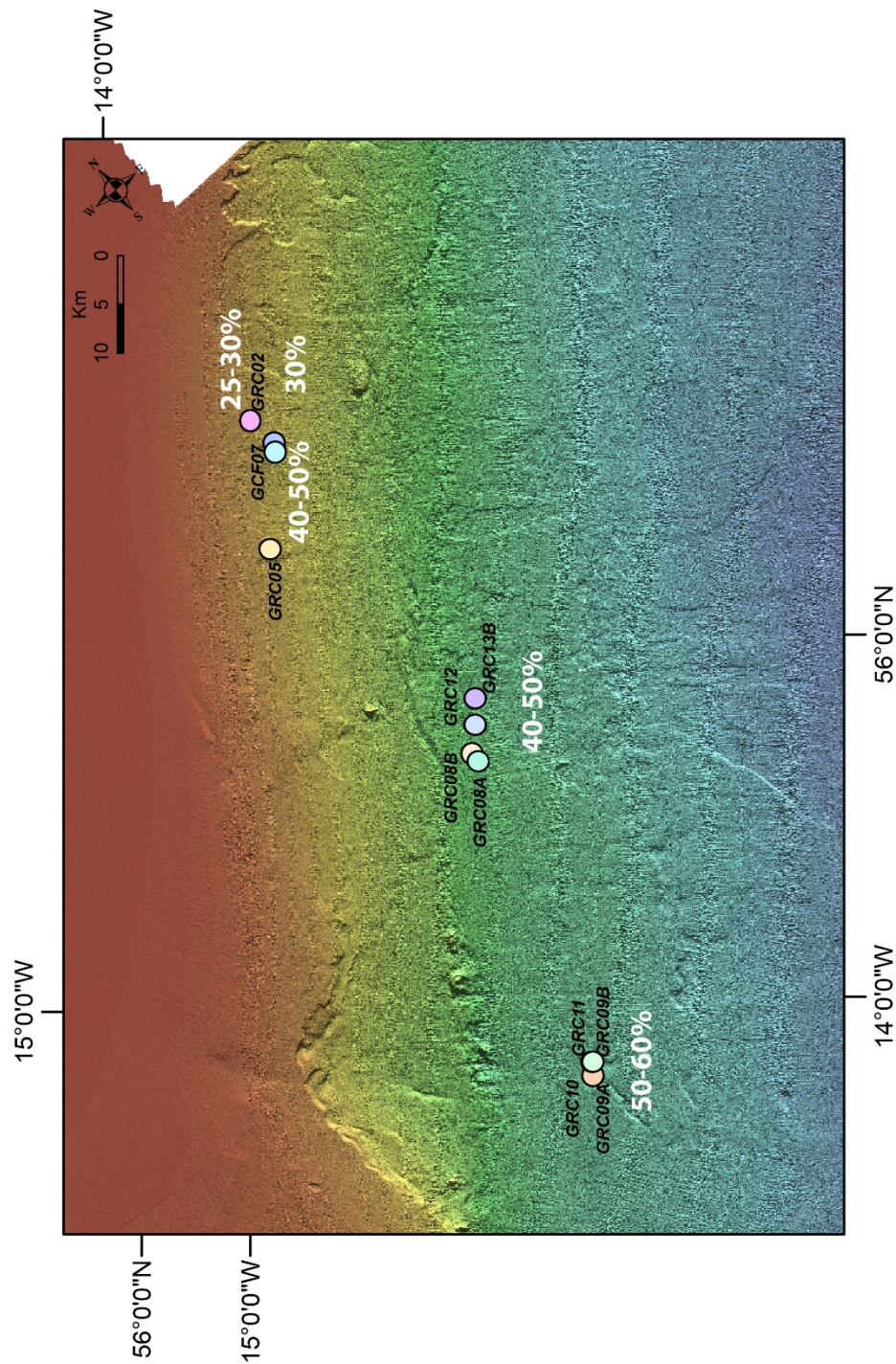
Appendix 1 – Publications & Presentations:

Georgiopoulou, A.; Reale, C.; Wynn, R.B.; Huvenne, V.E.I.; Gavin, K.; Lo Iacono, C. (2016)
Preconditioning factors for the unstable eastern Rockall Bank slope, NE Atlantic 35th
International Geological Congress, Cape Town, South Africa, 27-AUG – 4-SEPT -2016

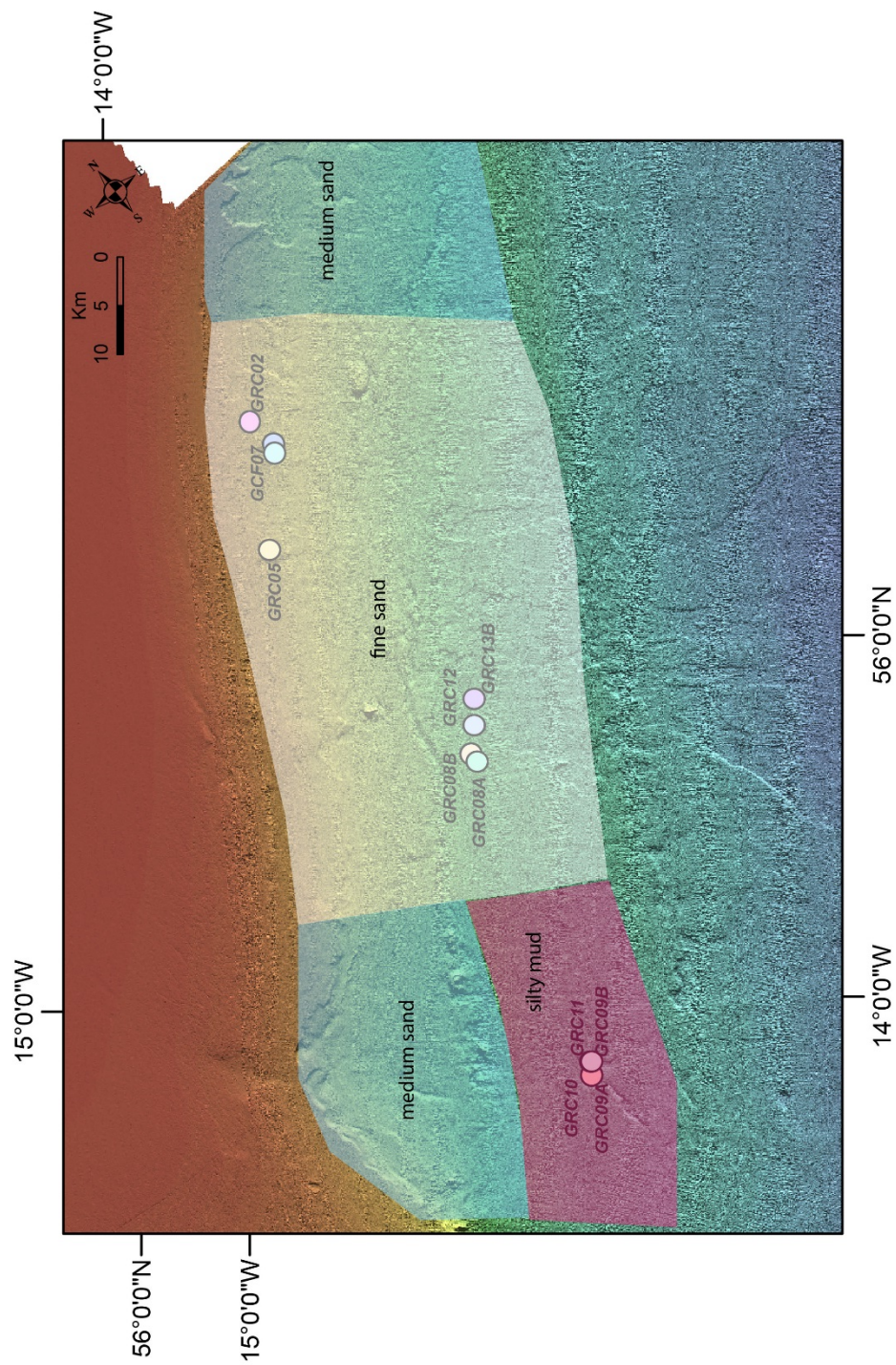
Georgiopoulou, A.; Krastel, S.; Zehn, K.; Shannon, P.; Haughton, P.; McCarron S. (2016).
Differentiating individual slide events in a slide complex: Rockall Bank Slide Complex 35th
International Geological Congress, Cape Town, South Africa, 27-AUG – 4-SEPT -2016

Georgiopoulou, A.; Finch, N.; Robert, K.; Huvenne, V.A.I. (2016) Frequency of slope collapses
on Rockall Bank and mechanical characterisation of the sediments INFOMAR Seminar 2016,
Oranmore, Co Galway, 19-OCT-2016

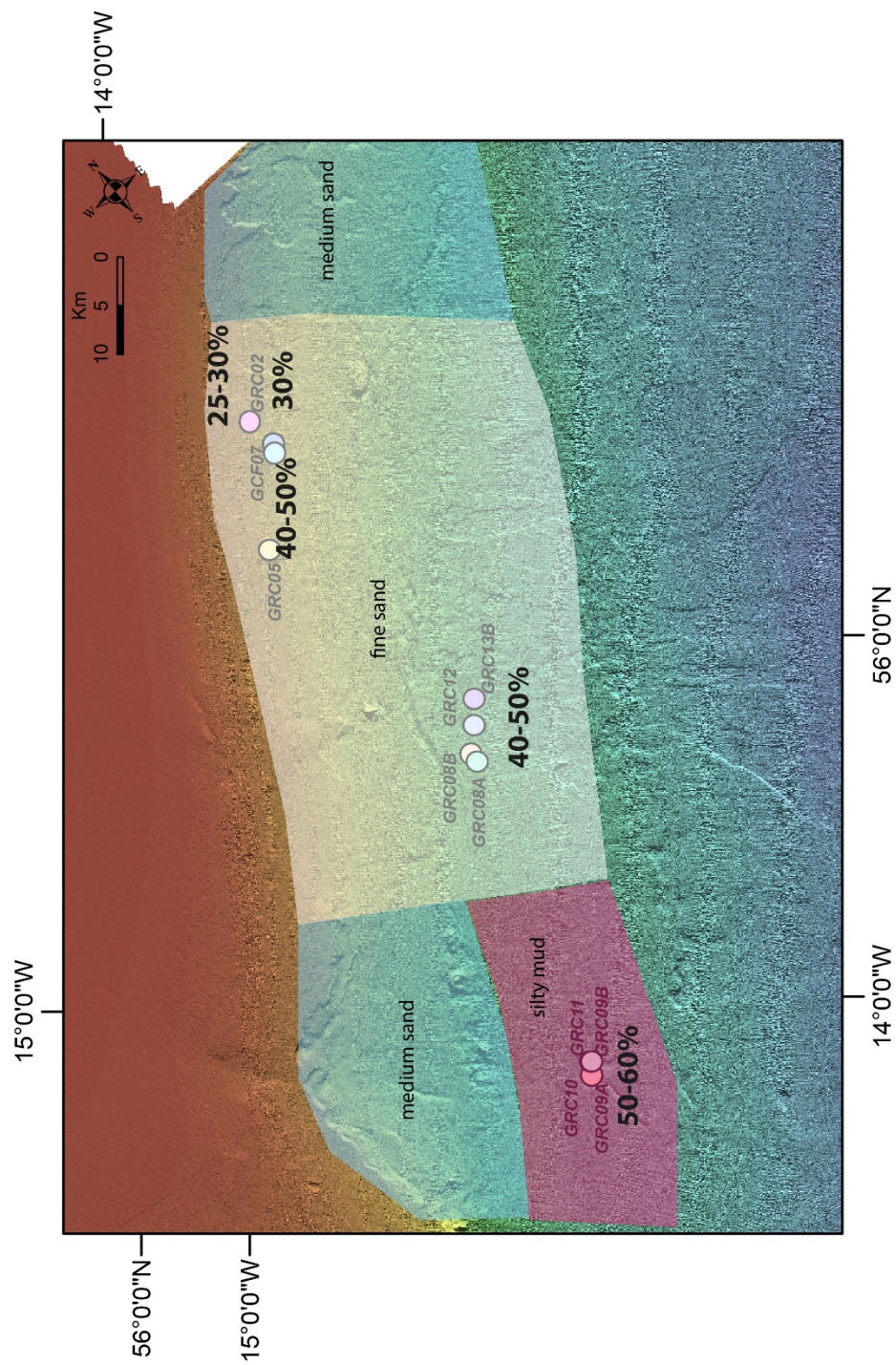
Appendix 2 – Any additional information not included above:



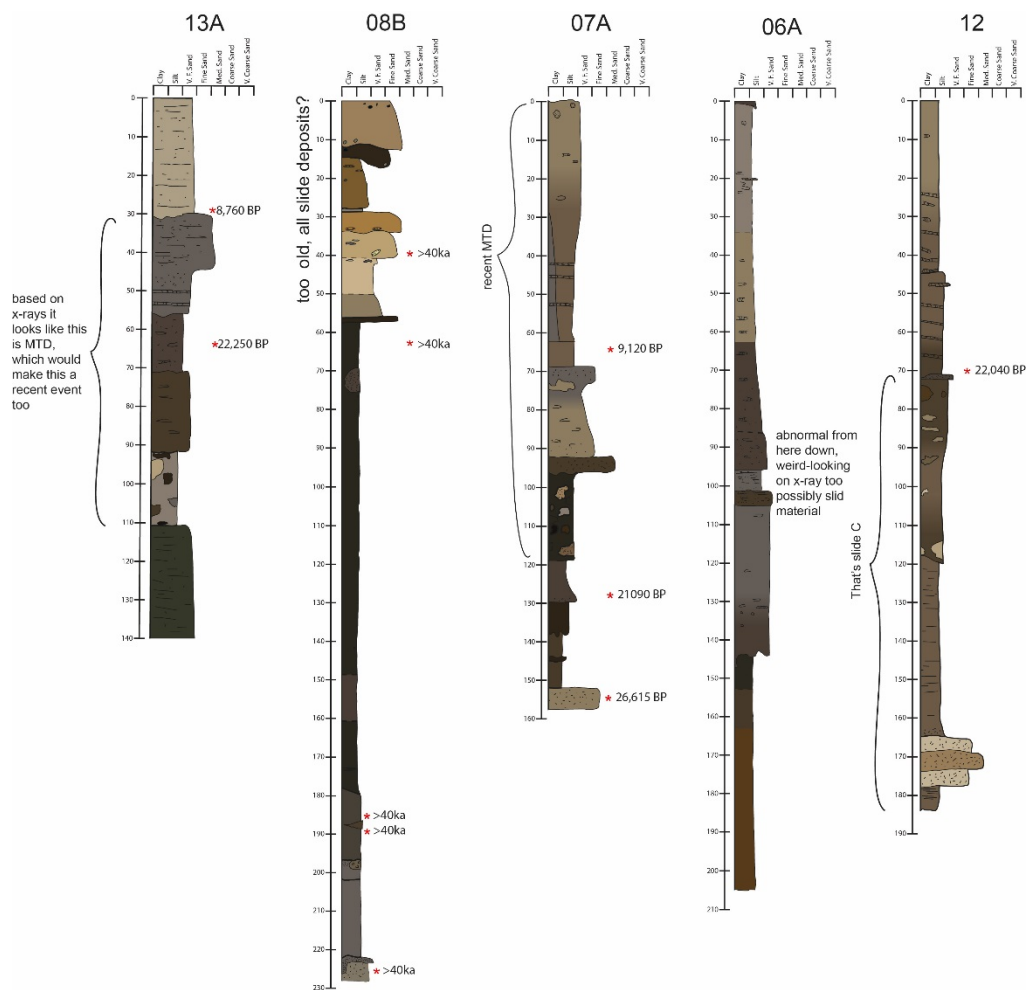
Map 1: Map of pore water distribution in top one meter of sediment expressed in % by weight. All measurements in excel files are available to the GSI upon request.



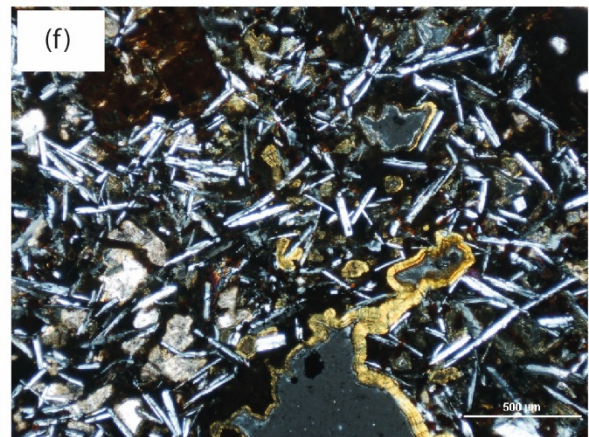
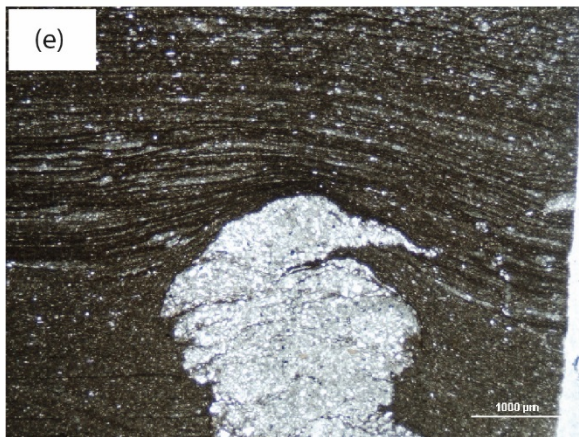
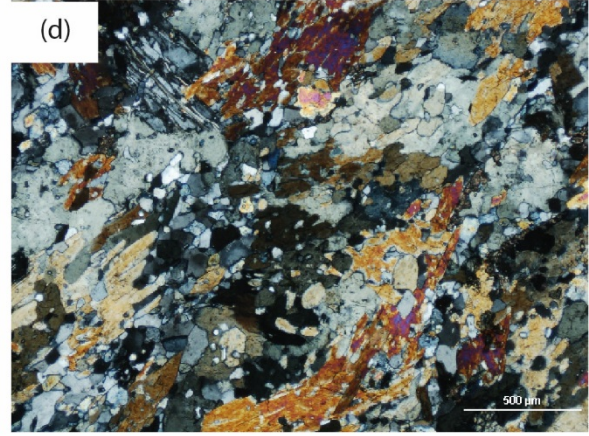
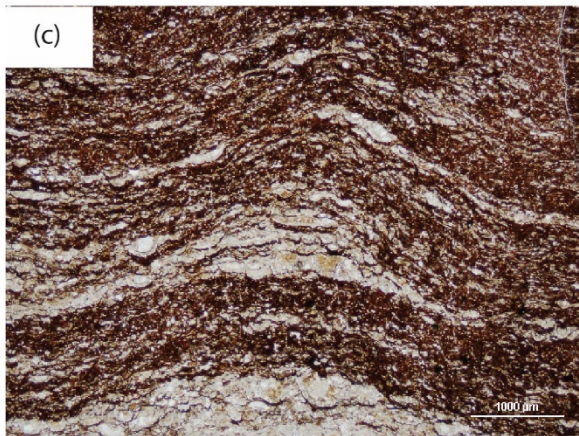
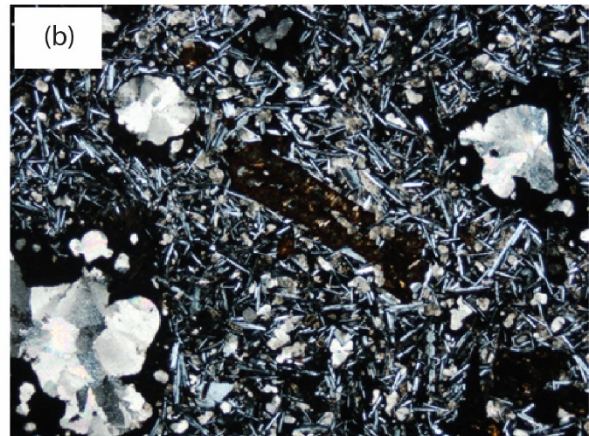
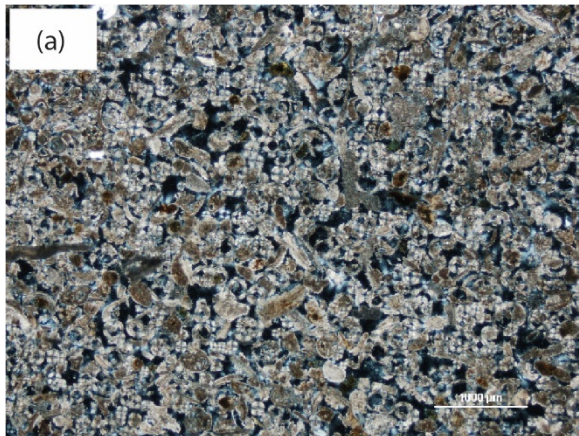
Map 2: Distribution of grain sizes. Note that the boundaries between the areas are expected to be diffuse and gradational. All measurements in excel files are available to the GSI upon request.



Map 3: The two previous maps combined showing that the most water-saturated sediments tend to be the finer grained ones.



Core panel: Ages of sediments acquired with radiocarbon dating. All radiocarbon data have been marine reservoir corrected and are available to the GSI upon request.



Thin sections: Examples of thin sections of rock samples collected during SORBEH. (a) Biogenic, lightly compacted solidified sediment from Dive 2; (b) Igneous rock extruded at the seafloor from Dive 7; (c) Foliated metamorphic rock from Dive 10; (d) Igneous rock transported as ice rafted debris from Dive 7; (e) Mud laminations with sand intrusion from Dive 7. All the rocks have been thin sectioned and are available to the GSI upon request.