

SERVICES & FACILITIES ANNUAL REPORT - FY April 2014 to March 2015

SERVICE British Ocean Sediment Core Research Facility (BOSCORF)	FUNDING Block	AGREEMENT NOC SLA R8/H10/41	ESTABLISHED as S&F 1997	TERM 5 years
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TYPE OF SERVICE PROVIDED:

BOSCORF is the UK's national deep-sea core research facility and provides a unique and strategic service to the scientific community. It provides an advanced state-of-the-art non-destructive core logging and analysis capability that is unique in the UK. BOSCORF also provides specialised long-term core storage facilities, so that sediment cores collected by NERC ships, and NERC-funded researchers, can be kept under optimum conditions to ensure long-term preservation, and availability to the scientific community. BOSCORF promotes multiple usage of the core material in its care ensuring cost-effective exploitation of an important national scientific resource. It is also responsible for long-term curation of core-based data relating to its holdings and from core-based national marine programmes in compliance with NERC data management policy.

The BOSCORF facility provides a vital service to support excellence in the UK research communities' contribution to the global science effort in earth and ocean sciences because:

- Sediment cores and samples are the fundamental data source for information on seabed character and global environmental change
- Sediment cores are very expensive to collect and the cores held by BOSCORF represent an investment of many millions of pounds already spent by the UK across the NERC remit. Unless cores are stored under optimal conditions (+4°C) they rapidly degrade (dry out and fracture) within months, limiting their value for further research
- As new measurement techniques and instrumentation become available and concepts evolve, existing cores can be re-sampled and analysed further to test methods/techniques and produce new data
- BOSCORF maintains a state-of-the-art, high-quality instrumentation suite for community use for analysing cores to extract maximum high-resolution environmental information
- BOSCORF is unique in offering to the UK research community advanced core logging tools and sophisticated x-ray analytical facilities. There is no other national repository for storing deep-sea cores in the UK
- BOSCORF plays a major role in training postgraduates and post-doctoral scientists in core logging, sampling and analysis, and provides specialist training workshops and courses. It has a wide user base within the environmental sciences, which has grown in recent years to include limnologists, geographers and archaeologists

The BOSCORF core collection currently consists of 2106 sediment cores (although data is held on 2655 sample stations) representing some 7.9 km of core material in total. The BOSCORF core storage facility differs from that of BGS in providing long-term refrigerated storage for deep sea and lake cores that are available for environmental and sedimentary process records.

ANNUAL TARGETS AND PROGRESS TOWARDS THEM: 1) *To maintain a high profile and usage of the facility and ensure delivery of quality-assured data:* Demand on the facility archives and core logging instruments continues to increase, with a record number of users, Ph.D. students supported, and throughput of cores logged and sampled during the reporting period. Ninety-seven percent of users rated BOSCORF service as 'Excellent' during the reporting year. 2) *To create additional storage space to accommodate new core acquisitions:* In order to accommodate new core acquisition this year we have been forced to dispose of some non-NERC discrete samples and compromise the quality of storage by using polythene layflat tubing rather than the standard rigid d-tubes. This inferior storage allows higher density stacking but greatly increases the risk of physical damage, dehydration and contamination as well as severely impeding access and retrieval. 3) *Replacement of departing skills and succession planning:* With the retirements of the Multi-Sensor Core Logger specialist and Curator, replacement of departing skills and succession planning is critical. For the interim, the Deputy Curator has undergone specialist training in multi-sensor core logging and a Band 7 Core Laboratory Technician with an instrumentation background has been recruited.

SCORES AT LAST REVIEW (each out of 5)			Date of Last Review:	
Need 5	Uniqueness 5	Quality of Service 4.5	Quality of Science & Training 5	March 2011 Average 4.88

CAPACITY of HOST ENTITY FUNDED by S&F	Staff & Status	Next Review (March)	Contract Ends (31 March)
100%	Curator (NERC B4) 100%; Assistant Curator (NERC B5) 100%; Core Laboratory Technician (NERC B7) 100% (from 12.1.15); MSCL Specialist (NERC B5) 30% (until 12.5.14)	2016	2017

FINANCIAL DETAILS: CURRENT FY

Total Resource Allocation £k	Unit Cost £k (average over last 3 years)				Capital Expend £k	Income £k	Full Cash Cost £k
	<u>Sediment samples distributed</u>	<u>ITRAX metres logged</u>	<u>MSCL-XYZ metres logged</u>	<u>MSCL-S metres logged</u>			
302	0.073	0.406	0.282	0.316	16.62	-	370.25

FINANCIAL COMMITMENT (by year until end of current agreement) £k

2015-16	£ 302k	2016-17	£ 302k	2017-18	No alloc.	2018-19	No alloc.	2019-20	No alloc.
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STEERING COMMITTEE	Independent Members	Meetings per annum	Other S&F Overseen
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BOSCORF SC	5 (Chair: Prof. I. Hall, Univ. of Cardiff)	1-2	None
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APPLICATIONS: DISTRIBUTION OF GRADES (current FY — 2014/15)													
	10	9	8	7	6	5	4	3	2	1	0	International users	R*/Pilot
NERC Grant projects*		5	4										
Other academic		12	14	4								10	
Students				4	27							3	
Pilot													3
TOTAL		17	18	8	27							13	3

APPLICATIONS: DISTRIBUTION OF GRADES (per annum average previous 3 financial years — 2011/2012, 2012/2013 & 2013/2014)													
	10 (α5)	9	8 (α4)	7	6 (α3)	5 (α2)	4	3 (α1)	2	1 (β)	0 (reje- -ct)	International users	R*/Pilot
NERC Grant projects*		3	3										
Other Academic		5	13	3								5	
Students				3	13							1	
Pilot													1
TOTAL		8	16	6	13							6	1

PROJECTS COMPLETED (current FY – 2014/15)										
	10 (α5)	9	8 (α4)	7	6 (α3)	α2		α1	β	R*/Pilot
NERC Grant projects*	All BOSCORF sampling/logging requests made during the year were completed. Information on NERC Grant/academic project completion is not collected.									
Other Academic										
Students										
Pilot										

Project Funding Type (current FY – 2014/15) (select one category for each project)										
Grand Total	Infrastructure					PAYG				
	Supplement to NERC Grant *		PhD Student		Other	NERC Grant*	PhD Student		NERC Centre	Other
		NERC	Other	NERC			Other			
86	9		18	16		14				29

Project Funding Type (per annum average previous 3 financial years - 2011/2012, 2012/2013 & 2013/2014)										
Grand Total	Infrastructure					PAYG				
	Supplement to NERC Grant *		Student		Other	NERC Grant*	PhD Student		NERC Centre	Other
		NERC	Other	NERC			Other			
50	6		5	12		11				16

User type (current FY – 2014/15) (include each person named on application form)				
Academic	NERC Centre	NERC Fellows	PhD Students	Commercial
38	14	0	34	0
User type (per annum average previous 3 financial years - 2011/2012, 2012/2013 & 2013/2014)				
Academic	NERC Centre	NERC Fellows	PhD Students	Commercial
22	11	0	17	0

OUTPUT & PERFORMANCE MEASURES (current year)										
Publications (by science area & type) (calendar year 2014)										
SBA	ES	MS	AS	TFS	EO	Polar	Grand Total	Refereed	Non-Ref/ Conf Proc	PhD Theses
	19					8	27	19	4	4
Distribution of Projects (by science areas) (FY 2014/15)										
Grand Total	SBA		ES	MS	AS	TFS	EO	Polar		
86			81					5		

OUTPUT & PERFORMANCE MEASURES (per annum average previous 3 years)										
Publications (by science area & type) (Calendar years 2011, 2012&2013)										
SBA	ES	MS	AS	TFS	EO	Polar	Grand Total	Refereed	Non-Ref/ Conf Proc	PhD Theses
	30					11	41	21	16	4
Distribution of Projects (by science areas) (FY 2011/2012, 2012/2013 & 2013/2014)										
Grand Total	SBA		ES	MS	AS	TFS	EO	Polar		
			43			1		6		

Distribution of Projects by NERC strategic priority (current FY 2014/15)							
Grand Total	Climate System	Biodiversity	Earth System Science	Sustainable Use of Natural Resources	Natural Hazards	Environment, Pollution & Human Health	Technologies
86	32	4	4	17	25	0	4

*Either Discovery Science (Responsive Mode) or Strategic Science (Directed Programme) grants

NOTE: All metrics should be presented as whole or part of whole number NOT as a %

OVERVIEW & ACTIVITIES IN FINANCIAL YEAR (2014/15):

During the reporting period, the BOSCORF facility was well used and a total of 1301 m of core were logged (Fig. 1), an increase of 300% on the previous year. Demand continues to be high with a significant increase in users compared to previous years due to an expanded instrument portfolio (Hitachi TM-1000, GEOTEK MSCL-CIS)(Fig. 2). During FY2014-15, 23 researchers from 16 institutions/departments (including 8 from overseas) sampled BOSCORF cores taking a total of 1641 samples. In addition, 22 users from 12 institutions/departments (including 3 from overseas) used the ITRAX XRF core scanner to log 231.5 m of core. Seven users from 6 institutions/departments used the BOSCORF XYZ multi-sensor core logger (MSCL-XYZ) to log cores with a combined length of 346.6 m. A further 10 users from 5 institutions (including 1 from overseas) used the standard MSCL-S to log 286.3 m of core. In addition, 11 users from 7 institutions used the MSCL-CIS to image 436.9 m of core. During the reporting period, 13 users from 4 institutions/departments (including one from overseas) took 948 images and 207 EDX analyses using the BOSCORF Hitachi TM-1000 SEM. Staff were also consulted on core-related issues and for data requests throughout the year, and provided users with post-visit support in data visualisation and analysis. The number of Ph.D. students supported by BOSCORF continues to grow (Fig. 3). During the reporting period, BOSCORF acquired 304 new cores, totalling an extra 1498 m. A number of visitors (approximately 186 individuals) received tours of the repository during the year.

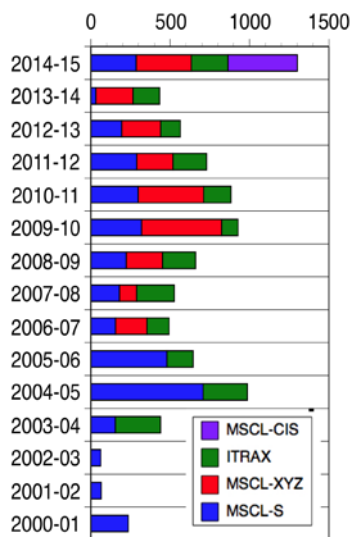


Fig. 1. Number of metres of core logged using MSCL-S, MSCL-XYZ and ITRAX core loggers from 2000-2015. The MSCL-CIS was acquired in 2013.

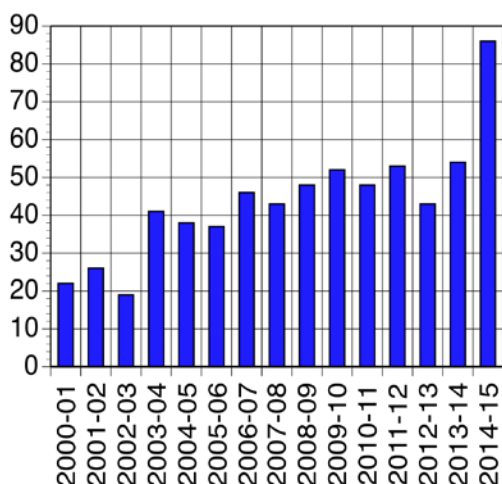


Fig. 2. Number of BOSCORF users during the period 2000-2015.

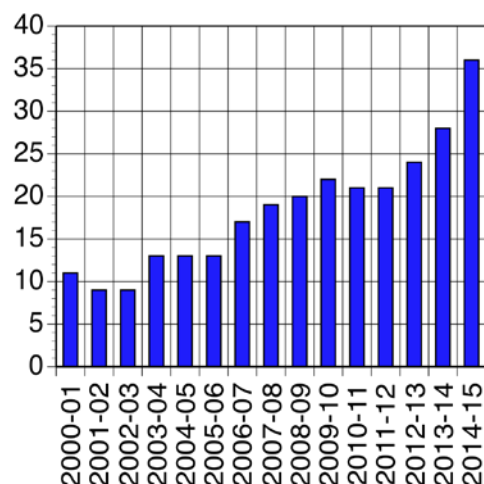


Fig. 3. Number of Ph.D. students supported by BOSCORF during the period 2000-15. In 2014-15 half the students were NERC-funded (n=18).

BOSCORF's core logging instrument portfolio has been strengthened by upgrading the Geotek MSCL-XYZ core logger electronics to state-of-the-art, resulting in greater instrument reliability and speed of analysis. Recruitment of a Core Laboratory Technician in January 2015 provides the manpower required to systematically photograph BOSCORF core holdings with the aim of posting high-quality archival images on internet databases. This will be a major task for the coming year. **The benchmark volume *Micro-XRF Studies of Sediment Cores* is now in production with Springer with publication expected in July 2015 (Fig. 4). It will contain a total of 27 papers (including 8 by BOSCORF staff) and represents a major academic contribution by the facility.** BOSCORF enhanced its training program by securing funds from the NERC Doctoral Training Scheme to hold a two-day training course on non-destructive core logging with lecturers from academia (Universities of Cambridge and Southampton) and industry (Geotek Ltd.) (Fig. 5). The training involved formal lectures, laboratory demonstrations and practical exercises. The course, aimed at Ph.D. students and early stage researchers in the environmental sciences, proved very popular and was oversubscribed.

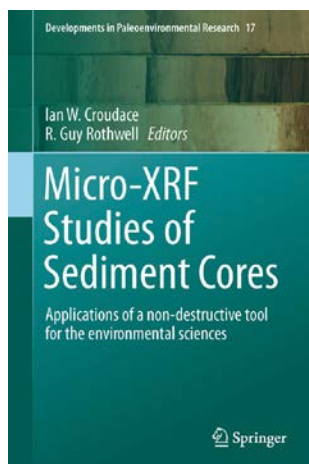


Fig. 4. Benchmark volume 'Micro-XRF Studies of Sediment Cores' to be published in July 2015, edited by IW Croudace and the BOSCORF curator.



Fig. 5. Students and lecturers from the BOSCORF advanced training course on core logging held at NOC on 24-25 March 2015.

SCIENCE HIGHLIGHTS *To focus on economic and societal impacts and benefits where possible:*

BOSCORN is key to enabling research on sediment cores from a range of environments, which are critical for UK research into past environmental change, natural hazards, sustainable use of natural resources and pollution (Fig. 6). During the year 2014, at least 27 publications (including 19 in refereed literature and at least 4 Ph.D. theses) were either wholly or partly engendered by the BOSCORN facility (listed in Annex 6). Seventy-five percent of the papers published in journals were in journals with impact factors >3 (Fig. 7). Papers published in previous years, but not reported, were also identified (see Annex 6).

Some specific highlights for 2014 are:

- Submarine landslides can be far bigger than those on land, and are an important mechanism for transporting very large volumes of sediment. Landslides that are fast enough to disintegrate can generate potentially dangerous tsunamis and produce far-travelled turbidity currents that can break strategically important cable networks. Indeed, most of the World's communications, including much of the Internet, are carried by subsea cables. BOSCORN cores have been used to map large slide-triggered turbidite frequency distributions. These data suggest that frequency of large-volume slides is unlikely to change significantly due to sealevel rise caused by global warming, contrary to some studies (Clare et al., 2014, *Geology* **42**, 263-266).
- Free gas has an important effect on seabed acoustic properties and also significantly alters sediment geotechnical character, increasing compressibility and reducing undrained shear strength. Gassy sediments are also becoming increasingly important in global studies of climate change and the methane budget. Some research suggests methane fluxes associated with marine gas seepages are greatly underestimated in the methane and carbon cycles. BOSCORN loggers have provided essential data to characterise an extensive shallow offshore gas environment on the Malin Shelf off NW Ireland with potential implications for subsea structures and slope stability (Garcia et al., 2014, *G³*, **15**, 869-885).
- Research on RAPID cores held by BOSCORN suggests regional climate variability associated with solar-induced ocean-atmosphere feedbacks could be substantial and should be considered when projecting future climate change (Moffa-Sanchez et al. 2014, *Nat. Geosci.*, **7**, 275-278)

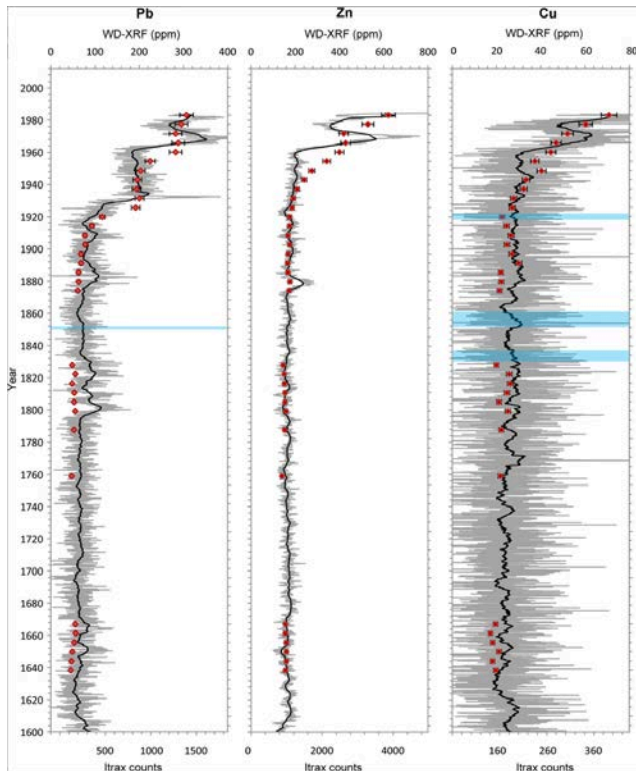


Fig. 6. A pollution record from Lake Windermere, Cumbria, recorded by the ITRAX core scanner. Note the significant increase in Pb since 1920 due to leaded gasoline. The increase in Zn and Cu since 1960 probably partly reflects flood-induced metal inwash after cessation of mining (periods of high metalliferous output shown in blue) In addition, increases in Zn can also be attributed to processed waste and human sewage inputs. The marked increase in Zn in the 1960s corresponds with an increase in direct discharge of treated sewage effluents in the catchment at this time (from Miller et al. 2014. *Environ. Sci. Technol.*, **48**, 7254–7263).

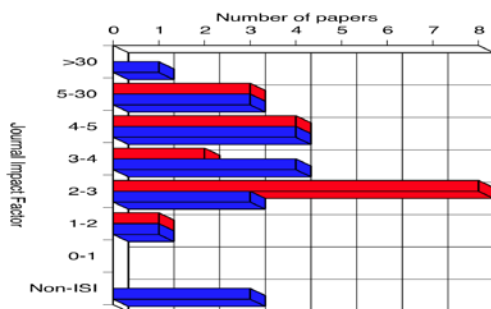


Fig. 7. Papers engendered by BOSCORN during 2014 (blue) categorised according to journal impact factor compared to papers published in 2013 (red).

FUTURE DEVELOPMENTS/STRATEGIC FORWARD LOOK - BOSCORN is already compromised in how it meets the needs of the community and is in immediate danger of breaching curatorial standards: 1) **Lack of storage space for new core acquisition continues to be critical.** Unless this can be solved in the **short term** (~6 months) then selective disposal of archive core material is inevitable. Urgent and substantial progress with the BOSCORN extension planned in 2010 is needed to avoid this outcome. 2) Additional lab space is essential. High-sensitivity instruments are deteriorating due to lack of 'clean' lab conditions and there is no space to accommodate new instrumentation should there be community need and funds available. 3) The BOSCORN budget has been flat-funded for the last 3 years. BOSCORN running costs continue to rise with inflation, placing a squeeze on recurrent expenditure that is unsustainable in the immediate future. 4) Recruitment of a dedicated facility data manager, and closer liaison with BODC, is essential to meet the terms of our curatorial policy and to address the needs of the community.