SERVICES & FACILITIES ANNUAL REPORT - FY April 2010 to March 2011

SERVICE	FUNDING	AGREEMENT	ESTABLISHED as S&F	TERM
NERC Radiocarbon Facility (NRCF)	Block	EK: R8/H10/52 Ox: R8/H10/53	EK: 1975 Ox: 1991	

TYPE OF SERVICE PROVIDED:

Radiocarbon dating is the most versatile technique for archaeologists, palaeoclimatologists, palaeoenvironmentalists and earth scientists seeking to precisely date the timing of events and rates of processes in the history of humans and earth systems over the last 50,000 years. Radiocarbon is additionally useful for quantifying carbon dynamics in the natural environment. Radiocarbon support to the UK's user community (including universities, NERC Centres and Surveys - BGS, CEH, BAS) is via two nodes of the strategic facility **NRCF**: **NRCF-Archaeology (NRCF-A)**, within the Oxford Radiocarbon Accelerator Unit (ORAU), University of Oxford and **NRCF-Environment (NRCF-E)**, hosted by the Scottish Universities Environmental Research Centre (SUERC), East Kilbride. The single two-node facility was established in 2007 following review by SRG-2006 which recognised that the proposed single facility would simplify access to NERC-supported radiocarbon analyses, increase flexibility in operation and enhance the opportunities for collaboration, with the aim of providing a stronger overall facility to the benefit of the user community. The remits of the nodes are determined both by science area and technique. NRCF-E deals with the majority of the environmental science; NRCF-A deals with Science Based Archaeology. Collaborative approved projects, using the expertise of both nodes are also encouraged. Radiocarbon support by NRCF staff is provided at all stages of projects, including advice on applications, optimising sample preparation methods, collaborative involvement (including publication), adding scientific value to projects approved by the Steering Committee or NERC grant supported projects, and training of students and visiting researchers. Training offered includes practical experience in the lab, a 2-day radiocarbon course from 2009 and alternate years thereafter, and the unique opportunity to experience the diverse yet recent technologies of the three accelerator mass spectrometers used for radiocarbon analysis by NRCF. NRCF-Environment expertise covers diverse Environmental science, including: climate change; carbon dynamics and the impact of land-use and climate change on different carbon components; marine and freshwater systems (including Antarctic marine and freshwater sediments). NRCF-Archaeology expertise is focused on Science-based archaeology (including human evolution, dispersals and paleao-anthropology), but also provides an important contribution to Earth Science (past climates, evolution of life) and Terrestrial science (human management and response to the environment, climate change) and unique expertise in the calibration and statistical modelling of radiocarbon dates and other chronological information. This expertise base allows NRCF to adapt to the evolving needs of UK Quaternary and Environmental Scientists and Archaeologists and emerging NERC strategic priorities. Science supported by NRCF spans all of NERC's Science Areas and Strategic Priorities.

ANNUAL TARGETS AND PROGRESS TOWARDS THEM

Approved projects are allocated analyses on a per sample basis, but facility capacity is calculated in terms of analytical units, taking into account resources required to process samples and quality control standards. **NRCF-E:** Annual capacity = 1300 analytical units. Actual processing = 1548 analytical units; Average turnaround time = 3.9 months; range 0.8 – 7.5 months, excluding projects requiring significant development; User survey: 21 of 42 users receiving analytical support 2010-11 responded and were generally very satisfied with the facility. **NRCF-A:** Funded capacity = 500 AMS analytical units; Actual processing = 799 analytical units (incl. standards and fails). Average turnaround time was <6 months and dropping; High user satisfaction, 96.9% would be highly or very likely to recommend ORAU to others, 77% are extremely satisfied with the reliability of their results.

SCORES AT LAST REVIEW (each out of 5)		Date of Last Review:		January 2007
Need EK:5.0 Ox:5.0	Uniqueness EK:4.5 Ox:4.5	Quality of Service EK:5.0 Ox:4.5	Quality of Science & Training EK:5.0 Ox:5.0	Average EK:4.87 Ox:4.75

CAPACITY of HOST ENTITY FUNDED by S&F	Staff & Status	Next Review (March)	Contract Ends (31 March)
EK: 100% Ox: ~30%	**EK: Scientific:** Head NERC Band 5s (0.6 FTE); Glasgow University-Deputy Head Grade 8 (1 FTE), Grade 7 (2.5 FTE); **Technical:** Grade 6 (3FTE+1FTE from Jan 2011); **Administrative:** Grade 6 (1FTE); **Ox**: **Scientific:** Head Grade 10 (0.45FTE); Deputy Head Gd 8 (0.6); 3 PDRAs Gd7 (0.3,0.4,0.45); **Technical** (4) Gds 4 and 5 (0.3). **Administrative**: Gd 5 (0.4).	2012	2013

FINANCIAL DETAILS: CURRENT FY

Total Resource Allocation £k	Unit Cost £k (analytical unit)			Capital Expend £k	Income to S&F £k	Full Cash Cost £k
	full cash cost /units analysed	Resource allocation /units analysed	Unit 3			
EK: 762.84	0.58	0.49		0	82.75	897.94
Ox: 349.05	0.71	0.44		0	n/a	566.59

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

2010-11	2011-12	2012-13	2013-2014	2014-2015
EK: 804.64 Ox: 293.12	820.73 304.85	837.15 316.75		

STEERING COMMITTEE	Independent Members	Meetings per annum	Other S&F Overseen
NRCF-SC	Joint Chair+Ox:8 EK:8	2	

APPLICATIONS: DISTRIBUTION OF GRADES (current FY — 2010/11)								
	α5	α4	α3	α2	α1	β	R*/Pilot	Reject
NERC Grant projects*	0	15	1	0	0	0	1	1
Other academic	2	27	2	2	2	0	14	2
Students	0	16	6	1	1	0	10	1
Pilot								
TOTAL	2	58	9	3	3	0	25	4
APPLICATIONS: DISTRIBUTION OF GRADES (per annum average previous 3 financial years —2007/2008, 2008/2009 & 2009/2010)								
	α5	α4	α3	α2	α1	β	R*/Pilot	Reject
NERC Grant projects*	0.67	13.00	0.00	0.33	0.67	0.00	2.00	0.00
Other Academic	1.33	24.33	3.67	1.33	1.67	0.67	17.67	3.33
Students	0.00	19.33	4.67	1.33	1.33	0.00	17.00	4.00
Pilot								
TOTAL	2.00	56.67	10.33	3.00	3.67	0.67	36.67	7.33

PROJECTS COMPLETED (current FY – 2010/11)							
	α5	α4	α3	α2	α1	β	R*/Pilot
NERC Grant projects*	1	8	0	0	0	0	2
Other Academic	1	34	1	0	0	0	5
Students	0	24	4	0	0	0	5
Pilot							

Project Funding Type (current FY – 2010/11) (select one category for each project)										
Grand Total	Infrastructure					PAYG				
	Supplement to NERC Grant *	PhD Students		NERC C/S	Other	NERC Grant*	PhD Students		NERC C/S	Other
		NERC	Other				NERC	Other		
109	37	12	26	1	13	11	2	0	3	4
Project Funding Type (per annum average previous 3 financial years - 2007/2008, 2008/2009 & 2009/2010)										
Grand Total	Infrastructure					PAYG				
	Supplement to NERC Grant *	PhD Students		NERC C/S	Other	NERC Grant*	PhD Student		NERC C/S	Other
		NERC	Other				NERC	Other		
111	41.33	10.33	25.67	3.67	11.33	12.67	2.33		5.67	

User type (current FY – 2010/11) (include each person named on application form)				
Academic	NERC Centre/Survey	NERC Fellows	PhD Students	Commercial
53	4	0	39	4
User type (per annum average previous 3 financial years - 2007/2008, 2008/2009 & 2009/2010)				
Academic	NERC Centre/Survey	NERC Fellows	PhD Students	Commercial
60.33	7.33	0	36.33	0.67

OUTPUT & PERFORMANCE MEASURES (current year)										
Publications (by science area & type) (calendar year 2010)										
SBA	ES	MS	AS	TFS	EO	Polar	Grand Total	Refereed	Non-Ref/ Conf Proc	PhD Theses
33	18.2	11.4	1.0	33.8	0.7	3.9	102	86	3	13

Distribution of Projects (by science areas) (FY 2010/11)							
Grand Total	SBA	ES	MS	AS	TFS	EO	Polar
109	42.5	24.75	18.75	0.75	21.25	0	1

OUTPUT & PERFORMANCE MEASURES (per annum average previous 3 years)										
Publications (by science area & type) (Calendar years 2007, 2008 &2009)										
SBA	ES	MS	AS	TFS	EO	Polar	Grand Total	Refereed	Non-Ref/ Conf Proc	PhD Theses
32.0	11.7	10.1	0.2	28.7		2.4	85.4	71.7	5.6	10.4

Distribution of Projects (by science areas) (FY 2007/2008, 2008/2009 & 2009/2010)							
Grand Total	SBA	ES	MS	AS	TFS	EO	Polar
111	47	13.61	17.11	0.42	23.36	1	8.5

Distribution of Projects by NERC strategic priority (current FY 2010/11)							
Grand Total	Climate System	Biodiversity	Earth System Science	Sustainable Use of Natural Resources	Natural Hazards	Environment, Pollution & Human Health	Technologies
109	27.5	8.0	2.5	17.5	3.5	49.0	1.0

**Combined Responsive Mode and Directed Programme grants*

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

OVERVIEW & ACTIVITIES IN FINANCIAL YEAR (2010/11):

NRCF-Environment East Kilbride:

Analytical programme/turnaround and delivery:

Analytical support provided was higher than capacity in terms of analytical units. NRCF-E produced results for: 798 samples approved via NRCF-SC and collaborative/commissioned work, 75 for in-house work and 186 for method development, mostly for approved projects. NRCF-SC approved projects, collaborative/commissioned work, in-house work (5% of facility capacity this year) and associated standards totalled 1325 analytical units, with development work a further 209 units. 21 samples were transferred from NRCF-A due to over capacity at NRCF-A. 49 projects (708 analyses requested) were reviewed by the Steering Committee reviewed and 33 (506 analyses) were approved. Analytical support for commissioned/repayment projects (collaborative with facility staff) included 62 analyses for NERC grants, 7 for BAS, 4 for BGS and 16 for National Oceanography Centre and 4 for Scottish Association for Marine Science. Turnaround times were slightly better than last year, likely due to a lower workload and the appointment of Dr Josanne Newton to a technical support post, January 2011.

Student training: There were 10 student visits to the lab, of which 5 involved hands-on training specific to the student projects.

Staffing: Dr J.A. Newton was appointed in January 2011 to a technical support post to which she brings, in particular, experience of carbon isotope sample preparation and dual inlet mass spectrometry.

Public outreach: Participated in Royal Society 350th anniversary summer science exhibition on the exhibit of the long-lived bivalve *Arctica.islandica* as an archive of marine climate change and a model for ageing research. 300 ^{14}C analyses had been provided for this NERC grant funded project (PIs J Scourse & C Richardson, Bangor University) ; NERC Planet Earth article (Garnett, 2010).

Scientific and methodological developments:

Development work has focused mainly on improving efficiencies and backgrounds in the lab, with significant progress:

Molecular sieve development: Modification of the methods and vacuum rig used for discharging CO_2 from molecular sieve cartridges has resulted in a three-fold improvement in the efficiency sample throughput. The ^{14}C background has also been significantly reduced and the sample size required is now less than half what it was previously. The passive and direct field sampling of CO_2 using molecular sieves (Garnett & Hartley, 2010; Billett & Garnett, 2010) are being used for various SC approved projects.

Development of standards for dissolved organic carbon sample preparation: Dissolved organic carbon standards are being developed with the aim of establishing a comparable matrix to typical samples received by the lab. IAEA-funded visiting research fellow Dr Sironic, Institute Ruder Boskovic, Zagreb, Croatia contributed to this during a month visit to the lab.

Methane analytical methods: Improved techniques for methane and CO_2 separation have resulted in much lower sample concentrations required and more efficient sample processing, widening the applications for which methane analysis can be provided.

Organic sample combustion developments: Improvements were made to the bomb combustion vacuum rig (used for large, inhomogenous samples and preparation of bulk standard gases) which is now more efficient, safer to operate and with a lower background. A new vacuum rig was built for improved, more efficient gas handling on the elemental analyser and improvements to the background have been made. The elemental analyser is now used routinely for sample combustion.

Thermo Fisher Delta V plus dual inlet mass spectrometer: After passing acceptance tests in Dec 2010, significant operational problems in running routine samples on the mass spec have been identified by facility staff and acknowledged by Thermo Fisher. SUERC dual inlet mass specs have been used for δ^{13}C analysis and this will continue while the problems are addressed.

Graphitising: Modifications to the graphitising procedure for routine and small samples (<500μgC) are being developed with the aim of improving efficiency of preparing and pelletising graphites, backgrounds and, for small samples, improvements in the duration of the graphite in the AMS.

NRCF-Archaeology Oxford:

Analytical programme/turnaround and delivery

ORAU has produced 430 AMS determinations for NRCF-A funded projects in this FY. This is equivalent to 799 analytical units (a value that includes a proportion of standards run within the unit), when our funded allocation is 500 analytical units. The turnaround time overall has decreased from equivalent times last year to 5.7 months on average. The demand for the NRCF-A service continues to be high. The numbers being funded and analysed need to be monitored to ensure that the service operates within capacity.

Scientific and methodological developments

Compound specific dating

A great deal of work has been undertaken over the last 3 years on compound specific dating of bone proteins and this continues with a successful grant from NERC (Hedges, Higham, McCullagh). The method involves the separation of amino acids using HPLC and the AMS dating of single or grouped amino acids. A PDRA has started on the project and been in post since May 2010. There have been several methodological breakthroughs in the last few months, including the ability to use water as the reagent for running the amino acids through the HPLC rather than acids.

Pre-treatment methodology

Several major programmes continue. First, work is continuing on further developing HPLC methods for separating amino acids for dating, as previously mentioned. Second, we are working on methods to allow the dating of tooth enamel carbon, with the aim of developing a formal research grant based on preliminary data. Third, we are investigating the use of hydrogen-pyrolysis, plasma oxidation and ABOx-SC to radiocarbon date charcoal more effectively. This is collaborative work with staff at SUERC and the University of Nottingham.

Radiocarbon calibration

Calibration of the radiocarbon timescale from 26—55 ka BP is being worked on with two research grants from NERC. The Lake Suigetsu calibration programme is almost completed and several publications are out or in preparation. A new project concerned with tree-ring dating of New Zealand kauri wood (Ramsey) has started. The southern hemisphere wood, dating to between 25 and 50+ ka BP is a key resource for the ongoing calibration effort, and ORAU is fortunate to be at the forefront of this work.

OxCal software development

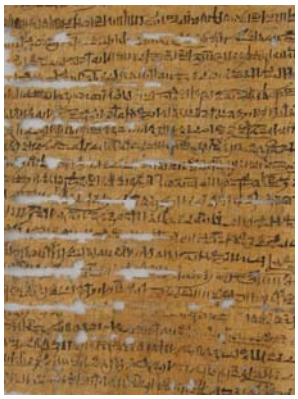
OxCal software continues to be widely utilised. In 2010 a specific taught course on Bayesian methods in radiocarbon calibration was offered for the first time. The places on the course were booked rapidly, and the course was oversubscribed. In March 2011 staff from ORAU and NERC-RCL collaborated to present a short course on radiocarbon dating to a similarly oversubscribed course in Oxford.

Research funding

Major research grants continue at the ORAU. The RESET (NERC Consortium Grant) programme is into its fourth year of five. This is a programme of research into a variety of topics linked with the overall theme of rapid climate change and its effects on humans in the past. The Lake Suigetsu (NERC standard grant) project is nearing completion with Dr T. Nakagawa and NRCF-E. Two major research projects (the NERC-funded Middle to Upper Palaeolithic transition project and the Leverhulme Trust-funded Chronology of Ancient Egypt project) reached the end of their funding cycle in 2010. The Egyptian work was published in *Science* (see science highlights). The Palaeolithic work culminates in a conference in April 2011 and subsequent papers will be submitted to top journals. A PNAS paper from the grant was published at the end of 2010 (see science highlights). Two new NERC research grants based in Oxford (the amino acid dating grant and the Southern Hemisphere kauri grant) are ongoing in the Unit.

SCIENCE HIGHLIGHTS: ARCHAEOLOGY-OXFORD

THE CHRONOLOGY OF ANCIENT EGYPT



Papyri with references to Kings and dated events such as this were dated in the project.

Research by staff at the ORAU has mapped out an accurate chronology of the kings of ancient Egypt using radiocarbon analysis of short-lived plant remains from the region. The paper was published in *Science*. The research sheds light on one of the most important periods of Egyptian history documenting the various rulers of Egypt's Old, Middle and New Kingdoms. Despite Egypt's historical significance, in the past the dating of events has been a contentious undertaking with Egyptologists relying on various different chronologies. The radiocarbon dating provides some resolution on the dates and nails down a chronology that is broadly in line with previous estimates. However, the new dating evidence does rule out some chronologies that have been put forward – particularly in the Old Kingdom, which is shown to be older than some scholars thought. For example, in the Old Kingdom, Djoser, one of the best known pharaohs of the Third Dynasty of Egypt, is thought to have commissioned the first of the pyramids, was found to have ruled from between 2691 and 2625 BCE, about 50-100 years earlier than some experts thought. The study also suggests that the start of the New Kingdom might be pushed back slightly to between 1570 and 1544 BC. The research has implications for the whole region because the Egyptian chronology anchors the timing of historical events in neighbouring areas tied to the reign of particular Egyptian kings. The results will allow for more historical comparisons to be made in countries like Libya and Sudan, which have conducted radiocarbon dating techniques on places of archaeological interest in the past. The team radiocarbon dated more than 200 samples including plants from museum collections from all over the world and used OxCal in the analysis of archaeological and environmental chronological data. The team also undertook research on environmental samples from the Oxford University Herbaria and found minor differences in radiocarbon levels in the region – important information for future dating studies.

REFERENCE: *Ramsey, C.R., Dee, M.W., Rowland, J.M., Higham, T.F.G., Harris, S.A., Brock, F., Quiles, A., Wild, E.M., Marcus, E.S & Shortland, A.J. 2010. Radiocarbon-Based Chronology for Dynastic Egypt. Science 328 (5985), 1554.*

NEANDERTHAL COMPLEXITY AND BEHAVIOUR

A new radiocarbon dating study, led by ORAU, has found that an archaeological site that uniquely links Neanderthal remains to sophisticated tools and jewellery (right) may be mixed. The study, published in October 2010 in *PNAS*, suggested that the position of key finds in the archaeological layers of the Grotte du Renne at Arcy-sur-Cure in France may not be trustworthy. A large series of new ultrafiltered bone radiocarbon dates were obtained from a range of cutmarked bones and artefacts from several layers through the site. The Bayesian analysis of the results suggested that around 1/3 of the results were statistical outliers, raising questions over the association of the Neanderthal human remains and the personal ornaments (some pictured above) found in the same archaeological layers. This research was funded by a NERC grant in 2006.

REFERENCE: *Higham, T.F.G., Jacobi, R.M., Julien, M., David, F., Basell, L., Wood, R., Davies, S.W.G. and Bronk Ramsey, C. 2010. The chronology of the Grotte du Renne (France) and implications for the association of ornaments and human remains within the Châtelperronian. Proceedings of the National Academy of Sciences of the United States of America 107(47): 20234-20239.*

EARLIEST SHOES IN THE WORLD DATED AT ORAU

An archaeological site in Armenia, which preserves archaeological remains dating back to the Chalcolithic period in unprecedented quality, has provided the earliest evidence for formal shoes ever discovered. The ORAU has worked on the dating of what was thought to be material from the last 700-800 years, but proved to be as early as 3500 BC. The remains of a leather shoe, with laces, was discovered by archaeologists at the Armenian site of Areni Cave, and dated at the ORAU. The shoe is several centuries earlier than those worn by Otzi, the famous Ice-man of the Italian-Austrian alps. Excavations are ongoing.

REFERENCE: *Pinhasi, R., Gasparian, B., Areshian, G., Zardaryan, D., Smith, A., Bar-Oz, G., Higham., T., 2010, First Direct Evidence of Chalcolithic Footwear from the Near Eastern Highlands, PLoS One, 5 (6), 1-5*

SCIENCE HIGHLIGHTS NRCF-Environment East Kilbride:
Facility staff co-authors are underlined.

CARBON ISOTOPE EVIDENCE FROM CAVE GUANO DEPOSITS FOR VEGETATION CHANGE IN SE ASIA

Cave-dwelling bats and birds feed within a limited area of their caves and feed on insects supported by local vegetation. The different photosynthetic pathways of lowland tropical grasses and their insect hosts result in substantially different $\delta^{13}C$ values from those of trees and associated feeding insects, so variations in $\delta^{13}C$ values of insect cuticles found in bat and bird droppings (guano) accumulated in caves reflect changes in the relative abundance of these types of plants in the region of the cave. Radiocarbon analysis of insect cuticles, charcoal and solvent-extracted bulk guano from cave guano deposits in Borneo and the Phillipines provided a timescale for interpreting stable carbon isotope ($\delta^{13}C$) records from insect cuticles and n-alkanes, used to infer local vegetation changes during the Last Glacial Period (LGP). With few palaeoclimatic records published, vegetation distribution during the Last Glacial Maximum in equatorial south east Asia is not well understood, so this work is a significant step forward, with evidence for substantial forest contraction during the LGP on both peninsular Malaysia and Palawan, while rainforest was maintained in northern Borneo. The results also imply that environmental barriers reduced genetic mixing between Borneo and Sumatra flora and fauna.

Guano producing, cave dwelling bats

REFERENCE: *Wurster, C.M., Bird, M.I., Bull, I.D., Creed, F., Bryant, C., Dungait, J.A.D., and Paz, V. (2010) Forest contraction in north equatorial Southeast Asia during the Last Glacial Period. Proceedings of the National Academy of Sciences, v. 107, p. 15508-15511.*

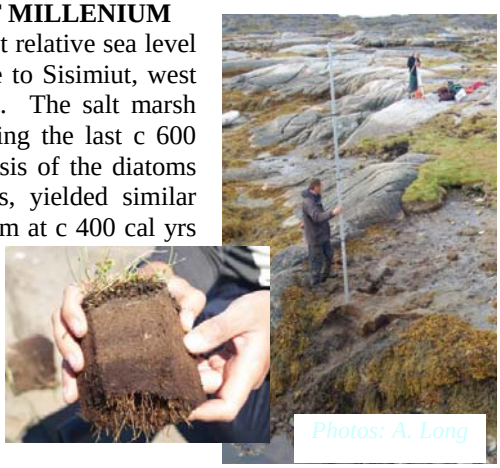
RADIOCARBON MODELLING OF DEEP SOUTHERN OCEAN VENTILATION & DEGLACIAL CO_2 RISE

The offset between radiocarbon data from planktonic and benthic calcareous foraminifera selected from the same depths within a sediment core from the Atlantic sector of the Southern Ocean was used to estimate deep-sea ventilation. The data support the hypothesis that past glacial-interglacial increases in atmospheric CO_2 concentration are due to rapid release of deep ocean CO_2, primarily via the Southern Ocean. The importance of the Southern Ocean in past CO2 variability is implied because this is the region of the global ocean where most deep water makes initial contact with the sea surface (upwelling) and consequently where CO2 that has accumulated in the deep sea can be released to the atmosphere. Previous marine radiocarbon reconstructions have not indicated a relatively aged and widely exported deep-water mass before c17.9k yr BP when atmospheric CO_2 concentrations began to rise and atmospheric ^{14}C began to drop sharply. The results from this study cover this period and demonstrate that during the last glaciation a poorly ventilated carbon pool deep in the Atlantic sector of the Southern Ocean dissipated in two pulses across the deglaciation.

REFERENCE: *Skinner, L.C., Fallon, S., Waelbroeck, C., Michel, M., and Barker, S. (2010) Ventilation of the Deep Southern Ocean and Deglacial CO_2 Rise: Science, v. 328, p. 1147-1151.*

WEST GREENLAND RELATIVE SEA LEVEL CHANGE DURING THE LAST MILLENIUM

A combination of litho-, bio- and chronostratigraphic methods were used to reconstruct relative sea level (RSL) change in the last millennium using salt marsh sediments at a field site closte to Sisimiut, west Greenland. Radiocarbon data were used to establish a time frame for the changes. The salt marsh deposits record an upwards transition from freshwater to salt marsh conditions during the last c 600 years. Different methods used to calculate RSL, by visual assessment and by analysis of the diatoms within the deposits and quantitative comparison with modern diatom assemblages, yielded similar results. The mean tide level rose from 0.6-0.2m at c. 600 cal yrs BP to reach 0.1-0.2m at c 400 cal yrs BP and then remained close to present levels at 0.2m until today. This new record demonstrates that existing models of RSL change that invoke meter scale oscillations in RSL since AD1600 are not valid in this sector of west Greenland. Although RSL did rise during the final centuries of the Norse period, after c. AD 1600, RSL had been close to present day levels.



Field work on salt marsh deposits overlying freshwater peat that rest on bedrock & an example of a sediment block cut from each sample station and analysed for diatom content

REFERENCE: *Long, A.J., Woodroffe, S.A., Milne, G.A., Bryant, C.L., and Wake, L.M. (2010) Relative sea level change in west Greenland during the last millennium. Quaternary Science Reviews, v. 29, p. 367-383.*

RELEASE OF OLD CARBON FROM ORGANIC SOILS

Organic soils contain vast amounts of carbon, cycled at a range of different rates and via many processes. The stability of these carbon stores in the face of climate change could have important implications for future warming. The effect of warming on organic soils was investigated in a soil incubation experiment, with particular attention being paid to the role of soil fauna. Results confirmed the temperature dependence of CO_2 emissions from these soils, and also the greater reproductivity of enchytraeid worms (the dominant mesofauna in these soils). A strong link was observed between the ^{14}C age of carbon assimilated by enchytraeid worms and that released through mineralisation, resulting in the release of more 'old' carbon from the deeper soil layer when enchytraeids were present and the soil was warmed. The study highlights the importance of soil biology in the response of the carbon cycle to climate change, and the insights that ^{14}C analysis can provide into the processes responsible for carbon cycling in organic soils.

REFERENCE: *Briones, M.J.I., Garnett, M.H., and Ineson, P. (2010) Soil biology and warming play a key role in the release of 'old C' from organic soils. Soil Biology & Biochemistry, v. 42, p. 960-967.*

FUTURE DEVELOPMENTS/STRATEGIC FORWARD LOOK

NRCF: Focus will continue on streamlining the two-node facility and on increased collaboration and research across both facilities. This approach is exemplified by the on-going collaboration on the α5 graded NERC grant funded Lake Suigetsu varved sediment project: terrestrial radiocarbon calibration model and inter-regional comparison of climate changes (PI T. Nakagawa, University of Newcastle), now nearing completion, but with a consortium grant application in preparation for further research on Lake Suigetsu, the successful introduction of joint panel meetings and shared peer review of selected applications. The short course on radiocarbon dating, taught by staff from both nodes has been run successfully for the second time in March 2011. Future opportunities for collaborative work will be sought. Both nodes remain responsive to community demand and needs and development strategies as well as to changes in NERC's strategic priorities.

NRCF-Environment East Kilbride:
1: Ongoing developments to lab procedures to improve operational and cost efficiencies.
2: Continuing development of methane analysis to widen the applications in which this technique is used..
3: Work with Thermo-Fisher to establish workable operation of dual inlet mass spectrometer.
4: Improve ^{14}C background for organic component of fine grained sediments with low carbon contents.
5: Application of equipment for compound group/specific compound separation to contribute to NRCF-E's collaborative research programmes.
6: Continue to work closely with SUERC AMS Facility staff, particularly in the areas of small sample and high precision analysis.
7: Working with NRCF-A towards common goals, such as new developments and research proposals, to the benefit of the user community.

NRCF-Archaeology Oxford:
1: Single amino acids/compound specific dating:
Our successful NERC grant application on the single amino acid dating of archaeological bone is progressing well. A PDRA started work on the method from June last year. Single amino acid dating would be a significant development for UK science because it would eliminate at a stroke the contaminants that have plagued the dating of old bone samples from the Palaeolithic. In addition, it is hoped that it would also overcome the problems of dating human bone affected by the freshwater or perhaps marine reservoir effects. The ability to date single non-essential or essential aminos, or groups of aminos, is a particularly attractive ability and we are hopeful that the method can be semi-routine in a few years time. Initial results on the direct dating of Palaeolithic skeletal material, formerly affected by contaminants that were impossible to remove, are hugely encouraging and the laboratory backgrounds for the single amino acids separated on our two HPLCs are very low indeed, which augurs well.
2: Further development of novel sample types:
Research into the radiocarbon dating of tooth enamel is ongoing. We are testing various chemical and physical approaches to allowing the dating of this material, which has hitherto proven rather difficult. The preliminary work will be used to seed a formal research grant. Dating enamel could be especially useful where bone proteins do not survive well (such as in tropical or arid locations). Funding from the Fell Fund of the University of Oxford has been used to investigate a new method of dating pollen grains. Again, it is hoped that this will allow for future development of this into a wider research project.
3: Dual Node facility:
As illustrated by the Lake Suigetsu calibration programme, the successful introduction of joint panel meetings and shared peer review of selected applications, and the joint taught courses we have implemented, the Dual Node facility is working well. We hope that further joint work and research proposals can be developed and will work towards this.

Non-Mandatory Facility-specific OPMs: utilisation, allocation of capacity etc

APPROVED ANALYSES: DISTRIBUTION OF GRADE (FY 2010-11)									
	α5		**α4**	**α3**	**α2**	**α1**	**β**	**Rangefinder**	**Pilot**	**Check date**
NRCF-A	0		376	10	0	0	0	0	0	0
NRCF-E	88		357	48	0	0	0	13	0	0

α3 projects are for studentship projects only