



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

Marine Coastal And Hydrocarbons Programme Programme Development Group Report

Marine Coastal & Hydrocarbons Programme

Internal Report IR/07/017

BRITISH GEOLOGICAL SURVEY

MARINE COASTAL AND HYDROCARBONS PROGRAMME

INTERNAL REPORT IR/07/017

Programme Development Group Report

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Authors: Gatliff, R W, Johnson, H and Lee, M K

PDG Members

Rosemary Johnson-Sabine (Maersk Oil Limited and BGS Board, chair of the PDG)

Prof Graham Shimmiel (Director, SAMS),

Dr Roger Scrutton (Edinburgh University and BGS Board)

Beth Greenaway (DEFRA)

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British Geological Survey offices

Keyworth, Nottingham NG12 5GG

☎ 0115-936 3241 Fax 0115-936 3488
e-mail: sales@bgs.ac.uk
www.bgs.ac.uk
Shop online at: www.geologyshop.com

Murchison House, West Mains Road, Edinburgh EH9 3LA

☎ 0131-667 1000 Fax 0131-668 2683
e-mail: scotsales@bgs.ac.uk

London Information Office at the Natural History Museum (Earth Galleries), Exhibition Road, South Kensington, London SW7 2DE

☎ 020-7589 4090 Fax 020-7584 8270
☎ 020-7942 5344/45 email: bgs london@bgs.ac.uk

Forde House, Park Five Business Centre, Harrier Way, Sowton, Exeter, Devon EX2 7HU

☎ 01392-445271 Fax 01392-445371

Geological Survey of Northern Ireland, Colby House, Stranmillis Court, Belfast BT9 5BF

☎ 028-9038 8462 Fax 028-9038 8461

Maclean Building, Crowmarsh Gifford, Wallingford, Oxfordshire OX10 8BB

☎ 01491-838800 Fax 01491-692345

Columbus House, Greenmeadow Springs, Tongwynlais, Cardiff, CF15 7NE

☎ 029-2052 1962 Fax 029-2052 1963

Parent Body

Natural Environment Research Council, Polaris House, North Star Avenue, Swindon, Wiltshire SN2 1EU

☎ 01793-411500 Fax 01793-411501
www.nerc.ac.uk

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Executive Summary

This report is the result of a more streamlined review process than previous Programme Development Groups (PDG). Nevertheless, members of the PDG were able to provide expert analysis and input covering a wide spectrum of the work of the Marine, Coastal and Hydrocarbons Programme (MCHP).

The PDG considered the Terms of Reference and determined the following:

- The PDG welcomes the close links between the commissioned and co-funded research and the core (SB funded) science programme, which is focused on the objectives outlined in the BGS 2005-10 Programme. Careful planning is required to ensure that the Programme maintains flexibility to respond to external factors, but maintains a broad focus on the underlying scientific objectives.
- The excellent links with the oil industry and DTI demonstrate a programme aligned to the needs of industry and government, and the plan to develop a new focus on the mature areas of the North Sea is welcomed. The increasing presence of new, smaller oil companies active in the UK will require different approaches to generate aligned funding. Future hydrocarbon research will require careful analysis of funding opportunities.
- The development of operations to support a new generation of detailed marine and coastal mapping and modelling based on collaboration with other research institutes, and the collection and interpretation of multibeam data is supported. This approach is directly in line with the policy to improve understanding of the marine environment in terms of ecosystems and Government policy on marine monitoring. Data already collected clearly shows the potential for new scientific discoveries and a step-change in our understanding of marine geology.
- The PDG endorses the integrated approach to the marine and coastal zone component of the programme. It is recognised that co-funded and commissioned research in the coastal area is less than in the marine and hydrocarbons areas. The number of experienced, high quality coastal geoscientists within BGS is very small and this is a factor in future development of the BGS coastal geoscience profile. Consideration should be given to establishing a distinctive, well-funded sub-programme to focus on coastal processes, particularly addressing erosion, sea level rise, and climate change to complement and strengthen the existing programme.
- There is significant progress on developing a strategy for surveying the ‘white ribbon’ and a new national sea-bed-mapping programme based on multibeam data. Closer links with other marine organisations, such as CEFAS and UKHO are being developed and the participation in joint cruises (e.g. DTI SEAs, JNCC SAC research) is welcomed. The case for an integrated approach to marine mapping is strong, but continual effort and support will be required to raise funding for a successful national mapping programme.
- The development of Lithoframe 3D modelling in the coastal and offshore areas is still immature. The PDG supports the completion of the current series of offshore regional reports as a precursor to the development of basinwide and national 3D models. BGS is in a unique position to develop such models on a national scale. Detailed models, for example, in estuaries and within the shallow section below the sea-bed should be encouraged.
- Advances in marine geology and geophysics are frequently technologically led, and it is important to maintain and develop state-of-the art equipment and capability. The marine operations capability has a world-recognised position in shallow coring and management

of major operations. The development of multibeam acquisition and interpretation skills is crucial to the programme, but there are also opportunities to develop expertise in additional geophysical techniques such as marine LIDAR, AUV technologies and improved shallow-water high-resolution seismic methods.

- Collaboration with other organisations is vital and development of data-sharing models with key organisations (such as UKHO, CEFAS and JNCC) should be further developed to maintain access to comprehensive data sources. BGS participation in PILOT initiatives (such as DEAL) and MDIP (Marine Data Information Partnership) is encouraged.
- MCHP should continue to develop links with universities, and the PDG welcomes the increasing number of joint-PhD and MSc students within a wide range of universities. Opportunities to develop closer links with universities through joint research bids to NERC and other funding bodies, and through marine pooling initiatives in Scotland are encouraged.
- MCHP has an excellent track record of international collaboration through EU projects, collaborative projects with other geological surveys, and commissioned research within the hydrocarbons sector.
- The PDG feels strongly that the SB funding for the MCHP is insufficient given the size and strategic importance of the UKCS and coastal zone. The staff have an excellent track record of attracting external funding to enhance the scientific programme but higher baseline funding is needed, particularly to cover operational survey (non-staff) costs. It is not the place of this PDG to argue for a switch of resources within BGS, however, the PDG actively encourages the Programme to seek additional funding from NERC through the FAB process, as well as from external sources. There are a multitude of players in the marine environment and BGS has a key role to play in co-ordinating activities.

Acknowledgements

BGS is most grateful to all members of the PDG and staff of the Marine Coastal and Hydrocarbons Programme for their time and invaluable contribution to the work of the PDG and preparation of this document.

1 Introduction

In 1998 the BGS Directorate and Executive Board decided that to maintain the BGS's position as the nation's foremost supplier of geoscience solutions and custodian of geoscientific information, a series of Programme-wide reviews should be initiated. This report summarises the results of a Programme Development Group (PDG) that examined the work of the Marine, Coastal and Hydrocarbons Programme (MCHP) to ensure this programme continues to address the needs of the user community, including NERC, Government, academia, business interests and the general public. Operationally, the MCHP is under the Geology & Resources Directorate (see BGS organisational chart at Appendix 1).

2 Operation of the PDG

Previous PDGs in BGS have undertaken extensive external consultation and involved a series of meetings and detailed discussions with a wide range of stakeholders. The timing of this PDG comes shortly after an extensive period of review for BGS, and a simplified timetable and approach was agreed such that the PDG would approach the task in terms of evolution rather than revolution.

A small team was put together, to represent industry, academia and government, and to cover different scientific aspects of the programme. Rosemary Johnson-Sabine (Maersk Oil UK Limited and BGS Board member) chaired the Group. Other external members were Prof Graham Shimmield (Director, SAMS), Dr Roger Scrutton (Edinburgh University and BGS Board Member,) and Beth Greenaway (DEFRA). The timetable for the PDG (below) was based round two meetings with the final report presented to the BGS Board in October 2006. Full details of contributors to the PDG and the agreed terms of reference are included in Appendix 2.

Table 2.1 Timetable

Event	Comments
First meeting, BGS Edinburgh	24 January 2005: Overview of programme (RWG); SWOT analysis; presentation on marine data issues. Agreed timetable for PDG
Preparation of report of first meeting	February 2006 Initial report prepared by RWG and HJ
Review of initial report and feedback by Board members	April 2006 Feedback received from PDG members
Second meeting, BGS Keyworth	2 May 2006 Discussion on draft report; presentations by staff from Keyworth; outline of recommendations
Presentation of recommendations to BGS Board	June 2006
Completion of final report	September 2006

3 Strategy, external drivers and objectives 2005-2010

The Marine, Coastal and Hydrocarbons Programme covers three broad overlapping areas that combine to provide an integrated programme of geological surveying-based research in the UK offshore and subsurface. The MCHP contributes to the scientific understanding of the environmental conditions, natural resources and hazards of the UKCS and the subsurface petroleum geology of the onshore and offshore sedimentary basins. Key elements of the programme cover data acquisition, interpretation and publication of the results of systematic surveys and analyses. The overall strategy is to focus research in areas of stakeholder interest and high scientific value to ensure that the programme achieves scientific goals aligned to co-funding opportunities.

Historically much of the marine and petroleum research in BGS was funded through the Department of Trade and Industry, and previously the Department of Energy. Since 1992, the amount of funding from DTI has reduced and the strategy through the 1990s and more recently has been to maintain vibrant marine and petroleum research through the NERC core funding, co-funded by aligned research consortia and commissioned research. Much of the funding has come from the hydrocarbons industry that has provided excellent support for both the marine and subsurface research programmes. The links between shallow geological mapping and the subsurface continues to be a key element of research, and is a significant driver for maintaining a combined marine and petroleum research programme.

The UK is now a net importer of hydrocarbons and production from the UKCS is likely to reduce making it imperative to encourage new exploration and development. The global dimension is also an important factor for hydrocarbon research, where security of supply is a major economic and strategic driver.

There are an increasing number of drivers for research in the marine environment, primarily driven by new EU directives and legislation (See Appendix 2). In the UK, the Government's report on *Safeguarding our Seas*, which outlines the UK's approach to Marine Stewardship, recognises the importance of integrated management, as does the EU's Integrated Coastal Zone Management (ICZM) Recommendation adopted on 30th May 2002.

As a result of the *Safeguarding our Seas* report, there are currently a number of assessments of marine information being carried out by organisations such as the Inter-Agency Commission on Marine Science and Technology (IACMST) through the Marine Data Information Partnership (MDIP) and the UK Marine Information Alliance (MIA). The recommendations include improved data harmonisation.

Generally, the UK Government response to marine management has tended to focus on oceanography and biology. Organisations such as The Hadley Centre for Climate Prediction and Research (part of the Meteorological Office) are constructing Regional Climate Models, which include likely impacts of climate change and future changes in sea level; the Marine Biological Association is managing the UK Climate Impacts Programme. In biological sciences, there are the UK Biodiversity Action Plans. While this research addresses the future needs of the marine community, there are few, if any, reports that recognise the need for systematic geological and geomorphological mapping of the sea floor, in the way that has been implemented in other countries.

The EU Habitats directive and the implementation of the Strategic Environmental Assessment Directive in 2004, have increased the awareness of the variability of sea-bed conditions and the interaction between physical, chemical and biological processes. Initial studies have also demonstrated that the quantity and quality of data is variable, depending on the presence or absence of commercial activities on or beneath the sea, or the results of a variety of localised research projects.

A recent Status Report compiled for the International Council for Exploration of the Seas (ICES) Working Group on Marine Habitat Mapping, a total of 139 mapping initiatives were identified from around the UK coastline linked to conservation management, many of which were conducted without adopting any standardised methodology (ICES WGMHM report, Sandy Hook, New Jersey, 2003). Much of this work would be better integrated and conducted within a national mapping programme, to ensure national standards and reduce costs on poorly conducted regional mapping activities.

Information gathering is considered important and the need for shared integrated expert advice and assessments of the North Sea including marine resources, environmental and socio-economic factors is recognised.

Many of the drivers for marine science have an important international dimension and our strategy will include collaboration with partners in Europe and globally to study geology, marine geohazards, marine habitats and marine resources, particularly in the context of climate change and sea level rise.

Overarching strategy for 2005-10

The 2005-2010 programme is based on building on the results of previous years work, maintaining a broad partnership with Government, industry and academia, and delivering results to enable safe, sustainable and efficient choices to be made in managing the marine and sub-surface environment and utilising its resources, in line with the drivers summarised above and in Appendix 2. Key strategic elements of the programme include:

- Undertaking a new programme of high-resolution marine surveys of the UK designated waters, based on multibeam data integrated with shallow sampling and high-resolution shallow seismic data to provide the basis for detailed shallow geological models and the underpinning geological data for the ecosystem approach to marine management. This will allow detailed strategic sea-bed mapping at a scale relevant to the modern marine users, including fishing, renewable energy, environmentalists, conservationists, aggregate extraction, pipeline and cable routes etc
- Enhance the resolution of the existing products by utilising new techniques, including the integration of data from the first returns of 3D seismic data (a procedure developed in the Western Frontiers Association)
- Developing new approaches to surveying and modelling in the coastal zone, known informally as the “white ribbon”
- Surveying and generating models of estuaries, including the Thames, Clyde and Forth
- Surveying and modelling “hard” and “soft” coasts with contrasting conditions to monitor and model causes and rates of erosion or deposition, particularly in response to changes in climate and sea-level
- Modelling Pleistocene to Recent sediments and processes using a source-to-sink approach, with a focus on climate change and glacial processes
- Developing the BGS marine geohazards expertise globally
- Developing a national approach to modelling UK sedimentary basins with an initial focus on offshore basins
- Developing a multi-disciplinary approach to aspects of petroleum geology in the UK

The UK is a leading maritime nation in Europe and our knowledge of the sea-bed and shallow subsurface has dropped from being a world leader to one where important commercial and environmental decisions are being made without the relevant strategic information. Managing our seas without a sound knowledge of the sea-bed environment and the processes that shape the

sea-bed features makes it difficult to conserve key areas, maintain biodiversity and economically develop our marine resources in an economic, efficient and sustainable way. Recent developments in marine landscape mapping, data delivery and visualisation techniques provide timely, proven technologies to develop a new generation of sea-bed morphology and geological information, which will address issues as follows:

- The lack of knowledge of the sea-bed and shallow subsurface in nearshore areas has cost and environmental implications for the increasing number and variety of coastal developments, including wind farms, wave and tidal power schemes, aggregate extraction, maintenance of navigation channels for shipping, coastal erosion, tourism and preservation of the submarine heritage. The coastal zone will become increasingly critical because of the potential impacts of climate and sea-level change
- The requirement to define Special Areas of Conservation (SACs) is based on the need to recognise and map special areas of significance. At present, defining potential SACs is based on limited information. Detailed surveys are required for each SAC, but without regional information it is impossible to know whether the proposed SACs are the best, relatively unique, or just something relatively normal. Strategic Environmental Assessments, such as those being carried out by the Department of Trade and Industry for the benefit of the oil industry also require a regional framework in which to assess their significance. New proposals to introduce Marine National parks, and requirements under the proposed Marine bill for Marine Spatial Planning, also require similar strategic information.
- The location of pipelines and submarine cables requires detailed studies to assess risk, hazard and environmental impacts. Currently these are based on individual studies along proposed routes, but these studies cannot be assessed in a regional context.
- The assessment of risk of submarine landslides and other hazards that can affect structures located on the sea floor (such as oil platforms, offshore windfarms, and cables) requires detailed bathymetric and sea-bed sediment data.
- The absence of detailed data on the sea floor makes inshore fishing and shellfish fishing (for example, scallops) a “blind” operation. Fishing in areas with unsuitable sea-bed conditions results in extra time at sea, the use of inappropriate equipment and unnecessary damage to the sea-bed environment.

Estuaries are the principal zones of sediment transfer between fluvial and marine systems and provide habitats for many organisms. They form sinks for sediment moving downstream, alongshore or landwards and for contaminants from both terrestrial and marine sources. The distribution of estuarine sediments and contaminants, coupled with an understanding of the processes that influence their distribution are important in many aspects of estuarine management. Knowledge of contaminant levels in estuaries is fundamental to the UK’s obligations under international treaties, such as OSPAR, which requires the separation of natural background and anthropogenic inputs, and to the EU Water Framework Directive.

Hydrocarbons remain one of the key elements of the UK economy and the drive to discover new reserves, enhance recovery and store both natural gas and CO₂ are key issues. Our strategy will be to work in conjunction with the industry, DTI, and other programmes in BGS to address exploration and development through:

- Developing more detailed regional models of the UK sector to help encourage new exploration, including onshore and offshore basins
- Focusing on the frontier areas to the west of the United Kingdom, where rewards are potentially huge but the understanding of basin development is less well known. Although there is no evidence yet for significant methane hydrates in UK waters, the

physical conditions for the generation of hydrates exist within the Faroe-Shetland and Rockall basins.

- Undertaking detailed geological analyses and high-resolution stratigraphy in areas of the UKCS which are now at a mature stage for hydrocarbon exploration, to respond to the increasingly attractive economics of small fields and opportunities to redevelop abandoned fields

4 Science Programme 2005-10

4.1 3D BASIN ANALYSIS AND PETROLEUM GEOLOGY

There are several relatively long-term elements to the deeper subsurface research programme. The following section summarises current and recent research programmes and deliverables and highlights how co-funding and commissioned research feeds into the core science programme. Key deliverables, and projects which are in progress or nearing completion, are described below. A full list of projects active since 2005 is given in Appendix 5.

Rockall area regional report

The Rockall regional report will be the next to be published in the series of BGS offshore reports and brings together the results of 15 years collaboration with government, industry and academia, through the co-funded Rockall Consortium project. The funding received from the consortium members has underpinned a major programme of drilling, seismic surveys and analysis that could not have been contemplated without industry support. The work has resulted in a massive leap forward in the understanding of Rockall and Hatton Basin geology, many publications, funding of PhD and MSc students and assisted research projects with various universities, including Imperial College and Cambridge University. The EU 5th framework Stratagem project (Stratigraphic Development of the Glaciated European Atlantic Margin) built on earlier EU projects such as ENAM (European North Atlantic Margin) and BGS contributions to these EU projects is a direct result of the work completed through the Rockall project.

The Rockall consortium continues to support BGS science and it is envisaged that new opportunities for research in Rockall may come from the next offshore UK hydrocarbon licensing round (likely to be announced in 2007). In recent years, BGS's position as leaders in research into the region has led to further opportunities to work with the Spanish Institute of Oceanography, the JNCC SAC survey work and the DTI Strategic Environment Assessment surveys (SEAs). It is envisaged that a Hatton regional report will be the next major project, and core programme resources are assigned to this area. In 2005 and 2006, seismic (using the *RRS Charles Darwin*) and multibeam cruises were completed, and in 2007 a major sea-bed sampling and shallow drilling campaign using the new BGS rockdrill, is planned aboard the new NERC vessel (the *RRS James Cook*) to test the geology of the numerous highs within and on the banks around the Hatton Basin. The 2001 drilling campaign has resulted in characterising the age and terranes of the basement around the Rockall Basin. One of the aims of recent geophysics cruises has been to collect data prior to making a joint-institute IODP proposal studying tectonics and ocean circulation in the NE Atlantic (M. Stoker, lead scientist).

Faroe-Shetland Basin regional report

The first edition of the Faroe-Shetland report was published in 1993. A huge amount of exploration, the development of the first oil fields west of Shetland and extensive co-funded research projects into marine geohazards (Western Frontiers Association), habitats (SEAs etc), sub-basalt imaging, and 3D modelling (Passive Margin Modelling Project) has been completed

since publication. A major new project, in conjunction with the Faroes Geological Survey, and co-funding from many UK and Faroes operators covering the entire Faroe-Shetland Basin was agreed in 2005 and the project is now in progress with completion of the text in 2007.

In parallel with this project, BGS has participated in new commissioned research in the area with projects assessing the geology and potential geohazards of possible pipeline routes, sampling of active mud diapirs in the north of the area and a new analysis of the Wyville Thomson Ridge. BGS is a partner in two SINDRI (Faroes research programme funded by exploration licensees) including a geochemistry source-migration project (led by C. Vane) and new 3D modelling (led by G Kimbell).

Southern Permian Basin Atlas

BGS is participating in a project to produce a new Petroleum Geological Atlas of the Southern Permian Basin Area. This will include a complete overview of the geological, exploration and exploitation history and is a celebration of over 150 years of petroleum exploration and the 50th anniversary of the Groningen gas field discovery. This is a joint project of the geological surveys of [Belgium](#), [Denmark](#), [Germany](#), [the Netherlands](#), [Poland](#) and [the United Kingdom](#). The aim of the Atlas, which is due to be published in 2009, is to present a comprehensive and systematic overview of the results of over 150 years of petroleum exploration and research in the Southern Permian Basin. Publication will be both in paper and digital (pdf and GIS) format. A wide range of petroleum exploration & production companies, licensing authorities, research institutes and universities support the project. BGS is participating in all chapters and is leading in several areas as well as providing the Chief Editor (Alan Stevenson) for the project. The results of commissioned research from DTI are feeding into this project. The project follows the successful launch in 2003 of the Millennium Atlas of the petroleum geology of the central and northern North Sea.

New bedrock geology maps

The geological mapping programme formed the core of the offshore programme in the 1970 to 1990 era with major funding from the DTI. The current programme of publishing maps is much curtailed and is focussed on completing the deep-water areas and revised sheets where new research allows. In recent years two 1:500,000 bedrock geology sheets of the Rockall area have been produced. The current programme includes the completion of a new sheet covering the St George's Channel, which parallels a PhD project with Birmingham University. The map is a new style, focussing on the pre-Cenozoic structure. The first bedrock geology sheet of Møre Basin area (north of 62°) is also nearing completion and is a collaborative project with the Norwegian and Faroes geological surveys. The next map to be produced will summarise the current research work on the Hatton area.

LithoFrame

Work on national and basin-scale models of UK sedimentary basins is undertaken in conjunction with the National Geoscience Programme. It is envisaged that following the completion of regional reports, the future focus of the programme will move towards basin modelling. At this time the programme is looking at capturing national datasets for key horizons and a key deliverable this year is the preparation of a series of three maps (supracrop, depth and subcrop) for the two major unconformities (Caledonian and Variscan). This follows the completion of nearly national crustal thickness and depth to Moho maps produced as part of the Passive Margin Modelling Project.

Passive Margin Modelling Project

MCHP has a lead in 3D modelling at a regional scale based primarily on the work of G. Kimbell. A major co-funded project covering the NE Atlantic margin was completed in 2002 and resulted

in a series of publications and commissions to take the work further with more detailed modelling in the Faroes, Ireland and Hatton. A recent licensing of the results of the original project has provided resources to further develop the techniques and bring the project deliverables into the latest GIS formats.

One of the drivers for this work was the requirement to image beneath the cover of Palaeogene volcanic rocks on the Atlantic Margin. MCHP has a lead in the regional distribution and facies within the volcanic sequences (D Ritchie, K Hitchen, H Johnson and R Gatliff) and the project successfully integrated potential field, deep seismic and seismic facies and stratigraphic techniques. MCHP were also able to contribute to a joint BGS-Edinburgh University sub-basalt imaging project in collaboration with the Edinburgh Anisotropy project.

Compressional Deformation on Passive Margins

One of the key scientific advances in recent years is our understanding of the complex history of post-break up deformation along the NE Atlantic margin. A series of papers are in preparation and a conference (held in autumn 2005) was convened; BGS staff are now contributing to the editing and preparation of a Geological Society Special Publication (H Johnson, D Ritchie and R Gatliff). Recent geophysics cruises have focussed on collection of new data in key areas and a new PhD student (co-supervised with Edinburgh University) began last year researching aspects of Cenozoic inversion and compression on the UK Atlantic Margin.

Geochemical and Isotopic Characterisation of Basement Terranes within the NE Atlantic Margin

MCHP is working with NIGL on a programme of dating basement samples from oil industry wells and BGS shallow boreholes. A series of papers (D Ritchie, lead MCHP author) is planned covering a range of topics resulting from this work including Caledonian granites, NE Atlantic refits, U-Pb age dating, Nd-chemistry and the definition of the Anton Dohrn Lineament. This initial paper will be on a newly discovered Caledonian alkaline granite west of the Hebrides.

Integrated analysis of an archived oil field (Hutton)

One of the new areas of research proposed for future years is to study on of the archived oil fields from the North Sea. The strategy behind this research is to bring the multi-disciplinary petroleum geology techniques and specialities distributed across BGS together to provide a new integrated study of newly available data on a previously decommissioned oil field. It is likely that this project will receive additional resources next year once the Hutton Field archive process is complete. This year some resources were provided for an initial review of the data received and collaboration with Imperial College involves joint supervision of an MSc student who is currently working on re-evaluation of Hutton Field facies architecture and reservoir zonation. His work has already demonstrated that the data are incomplete and there are opportunities to reassess the detailed reservoir model, particularly in the Ness Formation.

DTI Geological Advice contract

BGS has worked closely with DTI for many years and now has a new three-year contract to provide geological advice on exploration, development and reserves estimates as required. This relationship has underpinned much of the BGS hydrocarbon programme and is an important factor in maintaining the BGS capability. The current project leader is D. Cameron, ably supported by I. Andrews, S. Stoker and M Sankey. The necessary controls on confidential information and conflict of interest apply to this work, although there are opportunities for staff to publish work and participate in organisation of major conferences etc. Six-monthly or annual meetings between senior staff in DTI and BGS provide opportunities to develop new ideas for science and collaboration.

The project demonstrates the expertise within BGS and has resulted in several major co-funded opportunities, such as the large research consortia, contributions to the Millennium Atlas and international contracts.

International Projects

The international hydrocarbons projects have traditionally been fully funded commissions and have allowed the development of several world-leaders in different areas of geoscience. A full list of current international projects is included in Appendix 5. The geological and licensing advice contract to the Falkland Islands Government (led by P. Richards) and a series of biostratigraphical research projects in the Middle East (led by S. Molyneux and M. Stephenson) highlight the opportunities to build on the core skills developed within BGS and lead to publications and new research opportunities. BGS staff are convening international conferences on South Atlantic tectonics and biostratigraphy in the Middle East in the near future.

Forward Look and Prioritisation

Feedback from the industry and members of the PDG indicates that the current outline programme is endorsed (see Recommendation 4.2). Industry colleagues commonly comment that BGS' regional geoscience approach complements industry's focus on licensed acreage. One specific proposal from industry is the preparation of a tectonic element atlas of UKCS, which should be regarded as a priority. There is a very strong chance that this project would not only receive backing from the industry and the DTI, but that co-funding would also be forthcoming. A further incentive is to capture knowledge and expertise of some of the older staff before this is lost through retirements. In particular the PDG endorses:

- The 3D basin analysis and petroleum programme with an emphasis on completing the regional reports, followed by the generation of regional digital basin models
- The new project based on work on an archived field
- The initial proposal to develop a tectonic elements report/GIS, similar to those prepared in the Faroes, Ireland and Norway
- Continued application and transfer of skills through international projects

Major projects provisionally planned for 2006-10 include the following, although progress on some of these will be linked to successfully raising co-funding:

- Cenozoic Tectonostratigraphic Atlas of NE Atlantic
- Tectonic element atlas of UKCS
- Hatton Basin and margin regional report
- Integrated analysis of an archived oil field
- Production of first offshore-onshore regional and national Lithoframe models
- Development of Faroe-Shetland Basin IODP proposal

4.2 MARINE GEOLOGY

The marine geology programme changed dramatically at the end of the DTI-funded mapping programme in 1985. The main shelf areas were all surveyed using high-resolution seismic data and around 30,000 sea-bed samples and shallow boreholes. During the last few years major progress was made generating digital products in GIS format for the sea-bed sediments, bathymetry and bedrock geology. One of the key decisions in the early 1990s was to expand the customer base and draw in funds to map the deeper waters to the north of 62°, in the Faroe-Shetland Basin and the Rockall-Hatton area. This was successful in several significant ways:

- Access to NERC research vessels for SB cruises to support the strategic mapping programme
- Co-funding through the Rockall Consortium of oil companies to fund several key cruises including sampling, drilling and a range of geophysics
- Co-funding through the Western Frontiers Association (geohazards research in the Faroe-Shetland Basin)
- Access to EU funds to support cross-border mapping revision (e.g. with France in the Channel etc) and a range of marine geohazard projects

Although data density is not as great as in the shelf areas, the tangible results of this approach are now appearing in the form of new offshore regional reports, bedrock maps and other publications covering the deep-water areas.

The 2005-10 programme has made an excellent start, with co-funding and strategically aligned commissioned projects from the EU (MESH project), aggregate levy fund, the DTI Strategic Environment Assessments, and a new agreement with the UKHO to use their data to produce new 1:50,000 sea-bed character and bedform maps. BGS is developing excellent working relationships with a range of marine research organisations, including CEFAS, JNCC, SAMS and NOCS. We have also focused on collecting third-party multibeam data from site investigation companies, the oil industry and other research organisations. The fishing industry provides another source of sea-bed data through our participation in the OLEX system of sharing bathymetric data. Progress has also been made in developing links with other marine organisations to provide a co-ordinated approach to generate a new multibeam-based national mapping programme.

Current PhD projects with funding include projects on high-resolution climate and stratigraphy in the Quaternary of Rockall (St Andrew's), submarine landslides (Edinburgh), NW Scotland Quaternary (Glasgow), Quaternary in the central North Sea (Imperial College), and tsunami hazard from volcanoes in the Atlantic (University College London). BGS hosted the international GeoHab conference in May 2006 and co-convened an international hydrates conference with Heriot-Watt in August 2006.

Key deliverables, and major projects which are in progress or nearing completion, are described below. A full list of projects active since 2005 is given in Appendix 5.

Production of new sea-bed characterisation and bedform map series with UKHO

The strategy to develop a new series of maps at a scale of 1: 50,000 is based on utilising existing detailed multibeam and sidescan-sonar data and integrating these data with newly collected data. This year BGS and the UKHO reached an agreement to let BGS have access to UKHO data to develop a joint product. This is an excellent basis for taking the new generation of sea-bed geology interpretations forward. The initial focus has been on developing a template, style and content through working on a trial area along the East Anglian coast. The project is testing methodologies for cost-effective integration of BGS and UKHO data. The results of this project will feed into delivery of new products using UKHO, BGS and other third-party data. M. Harrison is now coordinating this key project.

Additional third-party data, including OLEX bathymetric data compiled from fishing industry data will provide additional resources for this project.

Summer Isles: development of new onshore-offshore map and publication.

In 2005/06 new multibeam data were collected in the Loch Broom/Summer Isles region of NW Scotland. These data underpin a joint project with the onshore Quaternary mapping team and the results will form part of a source-to-sink study of glacial sediments and the deglaciation history. A new map is in production as a pilot for a new series of integrated onshore-offshore maps. The

first of several papers is in press and a new PhD project has just been approved. This year the results of the project were used to develop a gravity-coring programme to groundtruth the multibeam data. This work is in joint partnership with SAMS and the University of St Andrew's and is led by M. Stoker.

This project also provided an opportunity to trial the use of GeoSwath multibeam systems and demonstrate the feasibility of using temporarily installed multibeam systems on vessels of opportunity, which in this case was the *RV Calanus*, belonging to SAMS. This approach is being pursued through collaborative ventures with other vessel owners, such as Forth Ports Limited.

This project demonstrates the value of close links between the onshore and offshore zones. Despite the project spanning the onshore-offshore transition, this is not a coastal geoscience project, but primarily a study of glacial sediments that happen to extend through the coastal zone.

Bristol Channel habitat study (funded through the Aggregate Levy)

The project (led by C. James) integrated geological and biological information gathered through geophysical and benthic surveys into a comprehensive interpretation of marine habitats. Our biological partners were staff from the National Museum of Wales (NMW). New multibeam, sidescan and reflection seismic data were combined with historical records held in the archives of the NMW and BGS. Detailed bedform, sediment and faunal distributions, habitats and biodiversity distributions were defined within the study area. These provide physical, geological and biological data as baseline criteria for the sustainable development of sea-bed resources, including fisheries, aggregates and wind farms, and inform the planning and regulatory process with regard to marine conservation, and national and EU legislation. As well as providing data and interpretations through maps, reports and publications the project aims to make its results available to a wider audience through a bilingual multimedia CD-ROM, web pages, museum exhibition, and outreach awareness sessions of its results at education institutions (universities, colleges, schools), societies and interest groups.

The project began in June 2003 and the final report has now been submitted. BGS co-funded additional seismic data and multibeam collection (in the inner Bristol Channel) in conjunction with the DTI SEAs programme. These data provide new opportunities for research prior to any decision to build a tidal barrier across the inner Bristol Channel.

English Channel Habitats study (funded through Aggregate Levy and DEFRA in conjunction with CEFAS)

This aim of the project (also led by C. James) is to provide integrated habitat maps for an extensive area within the central part of the Eastern English. The maps will be based on an interdisciplinary approach, integrating geological, geophysical and biological data and interpretations, including new surveys using multibeam and sidescan, sampling and video. The immediate driver is the discovery of substantial aggregate resources in this area and the requirement to manage the sustainable development of this resource and minimise potential impacts. The area of resource needs to be assessed within the broader context of the Eastern English Channel. The project is due for completion in 2007.

MESH (Mapping European Sea-bed Habitats)

MESH began in 2004 and is a 3-year EU co-funded looking at sea-bed habitat mapping. The BGS project manager is D. Long. The project is examining existing habitat maps in NW Europe, and the techniques and protocols used, with the aim to produce a web-accessible habitat map for the whole area by 2007. BGS is contributing to two new methodology/case studies. It will provide information on sea-bed processes in a range of environments. The continuing collaboration with The Irish Marine Institute (Galway) and DARD (Belfast) will help provide new links as well as provide data that BGS would not be able to collect itself thereby updating the offshore database. The project compliments NERC/BGS's aim of strategic survey and

environmental monitoring in the marine environment. The project will demonstrate that geology provides the baseline for ecosystems whose distribution is strongly controlled by the structure, lithology and morphology of the sea floor.

Strategic Environment Assessments

BGS has contributed to all the DTI Strategic Environment Assessments for offshore oil exploration. In several cases BGS has provided the chief scientist (e.g. Richard Holmes, Heather Stewart, David Tappin) for research cruises, and the results of the projects feed directly into the BGS core programme.

International Projects

The award of the contract to take a lead role in the science management of the European contribution to the Integrated Ocean Drilling Programme is an excellent recognition of the tremendous skills and experience generated through the marine science programme at BGS. After two successful missions (Arctic and Tahiti), BGS now has an experienced team ably led by Dan Evans and Alister Skinner. Although the marine operations team have developed excellent links across the globe through the IODP programme and other operations, the BGS marine scientific programme has remained primarily focussed on UK and NE Atlantic margin geoscience. It is hoped that BGS will be able to contribute to a more global research programme as recognition grows through projects such as IODP, although new sources of funding will have to be achieved.

The disastrous Indian Ocean tsunami generated on Boxing Day 2004 provided an opportunity for BGS to put one of the first civilians on board the naval survey vessel *HMS Scott* during a survey of the sea-bed in the area of the origin. This has led to a high profile for BGS geohazards work and several exciting research opportunities and BGS has since provided a senior scientist (David Tappin) on two further research cruises supported by the BBC and the Discovery Channel (SEATOS) and BGR (SEACAUSE) expeditions. BGS will participate in a new EU-funded project assessing tsunami hazard around the coasts of Europe.

Forward Look and Prioritisation

The PDG suggests that BGS should develop its own capability and a coordinating role with regard to the acquisition and collation of new multibeam and related sea-bed survey data and welcomed the emphasis on collecting new, legacy and third-party data. It was noted that there are many collaborative projects and aligned commissioned research, and agreed that BGS core resources should be focussed in areas where there is potential for collaboration, high stakeholder interest and exciting scientific deliverables.

One of the priority areas recognised for future work by the PDG is the completion of the regional sea-bed sediment maps in the deep-water areas to the west of Britain. These areas were never included within the DTI mapping programme and BGS is now focussing efforts on mapping in these areas through the core NERC SB funding, the Rockall Project, and participation in SEAS, JNCC and other surveys where possible.

A second key area for mapping and modelling is in the nearshore areas known as the “white ribbon”. The PDG welcomes the initiative to develop a nearshore survey programme.

In Particular, the PDG endorses:

- The plan to develop detailed (1:50,000) digital maps and models based on the integration of multibeam data with other geological and geophysical data
- That these models should provide the fundamental marine geology to underpin the ecosystem-based approach to marine management. They should aim to develop our

understanding of the Holocene and Quaternary geology and processes and include links to the offshore within a source-to-sink context

- The development of a new methodology for producing new maps and models based on SIGMA-type principles developed for digital onshore mapping. It was acknowledged that more corporate resources might need to be put into standards and systems for MCHP mapping to develop SIGMA-like capabilities
- Research into the geological interpretation of multibeam data and its integration with other geophysical data is a priority
- The strength in geohazards research is recognised and further work on geohazards within Europe and internationally is supported

Major projects provisionally planned for 2006-10 include the following, although progress on some of these will be linked to successfully raising co-funding:

- Development of sea-bed sediment maps of the Atlantic margin
- Further development of the current marine mapping programmes in the Summer Isles, Bristol Channel, Midland Valley and elsewhere if co-funding and collaborative opportunities arise
- A continuation and development of the pilot 1:50,000 map series in conjunction with UKHO
- A programme of updating the existing 1:250,000 maps in conjunction with more detailed 1:50,000 map series.

4.3 COASTAL GEOSCIENCE

Prior to 2005 the coastal geoscience activities were carried out as a separate Programme within a different Directorate. One of the arguments for combining coastal projects with the marine programme was to simplify the link between inshore and offshore geological research. Another was that much of the recent research undertaken in Keyworth related to marine resource and habitat mapping, with direct links to the marine programme rather than specifically coastal issues. This in part has reflected the availability of co-funding to support marine mapping and difficulties in attracting co-funding to support in the coastal geosciences area.

The current coastal SB research programme is included as a joint project with marine geology, led by Alan Stevenson. This was set up to provide a platform for integrating the activities across Keyworth and Edinburgh. Compared with other aspects of the MCH Programme, coastal geoscience is relatively under-resourced.

There are specific issues associated with coastal geoscience that relate to sediment movement, coastal erosion, coastal deposition, and sea-level change. Hydrodynamics, erosional process, pollution and engineering geology are all very important in modern multi-disciplinary coastal geoscience. It is an area where 4D modelling and a process-orientated approach are both very important. The main reasons for a relatively small programme in coastal geoscience are: (i) the shortage of skilled leading scientists within BGS in this area, (ii) insufficient funding was allocated when coastal geoscience was transferred to MCHP in 2004; (iii) some aspect of coastal geoscience are carried out within the Physical Hazards Programme.

This PDG restricted its activities to looking at the current coastal programme within the MCHP (but makes some recommendations regarding the broader picture later in this report in section 11).

The three main element of this work are 3D modelling of estuaries, geochemistry of estuaries, and the open coasts. This area of research differs from other parts of the MCHP programme as there is a relatively small core programme linked to a series of small commissioned research projects.

Key deliverables, and major projects which are in progress or nearing completion, are described below. A full list of projects active since 2005 is given in Appendix 5.

Estuaries Research

The emphasis in the estuaries is on 3D modelling with a view to looking at coastal vulnerability, impact of sea-level rise and geochemistry/pollution. The geochemistry research is focussed on multi-element chemical analysis incorporating elements of particular environmental concern, radionuclides and selected organic components, with a view to definition and mapping of baseline and contaminant levels for inorganic and organic components on an estuary-by-estuary basis.

There is an inherited backlog of research in the Wash and Mersey estuaries, where projects have previously been undertaken. Major research in the Humber was undertaken as part of the Land Ocean Interaction Science (LOIS) project, and although a series of papers have been published a definitive BGS report on the area was not produced. A report on the geology of the Wash will be sent to external review this year, and a Mersey geochemistry report is planned for completion in 2006/07. The direction of future work will to some extent be based on reviews of the Wash report, and success in attracting co-funding and aligned research.

There is a current focus of interest in the Thames Estuary both within BGS (the Thames Gateway project) and externally (e.g. the Environmental Agency). There is cross project collaboration with the Thames Gateway Super project, particularly for 3D modelling of the Holocene prism. This year a series of boreholes was drilled close to the coast with a view to extending the study to the submerged estuary in future years. This is one area for trial work with resistivity profiling from onshore to offshore. Analyses of the cores will focus on geochemistry, dating and characterisation of peat horizons.

Activities in the Clyde are aligned with a multi-disciplinary onshore modelling project funded by the City of Glasgow. A source-to-sink approach to the geochemistry has been developed and future work will extend the project downstream. Integration of geochemistry with multibeam and seismic data demonstrates a very thin contaminated sedimentary layer within the Clyde, reflecting the post-glacial isostatic uplift in the region.

Open Coast

During the first year of the new programme a review on techniques for mapping in the white ribbon was undertaken. This has been followed up with meetings and workshops with others interested in problems of surveying in shallow water (e.g. Southampton University, Maritime & Coastguard Agency). Comments on the technical aspects of this review are included in Section 7.

Within the open coast projects we propose to focus on key areas most at risk from coastal erosion and sea-level rise, and tie in the work to the joint BGS-UKHO mapping programme. Emphasis will be on coastal processes and change in terms of 3D/4D modelling. At present resources are limited, although a request for additional funding for 2006/08 has been submitted.

Cohesive Platforms

One area of research has been examining the role played by the erosion of cohesive platforms in coastal retreat as an extension to a DEFRA-funded CR project led by Haskoning UK. That project is considering only two sites at Sheppey in Kent and Easington, East Yorkshire. The core science project has sought to obtain data from other sites in order to look at wider implications than will be possible from the limited dataset obtained by the commissioned project. Sites at Whitstable, Harwich, Walton-on-the-Naze and Spurn have already been identified and some samples obtained. This research has been in collaboration with the University of Brighton.

ICZM (Integrated Coastal Zone Management)

ICZM and marine planning issues in general are an area high on the political agenda. BGS is in a good position following an invest-to-save project with the OS and UKHO. Follow up to this project has been limited, but in 2006/07 BGS was awarded a grant to collect LIDAR data with the NERC aeroplane along a window about 400m inland and 200m out to sea around the entire coastline of the Isle of Wight. Although the NERC system has little penetration through water, the foreshore areas will be captured in their entirety. Results are expected in 2007/08. The results will lead to characterisation of the foreshore and allow comparison with earlier fieldwork in the Isle of Wight completed as part of the original ICZM project.

Other Commissioned Projects

A full list of projects is included in Appendix 5. Two recent projects include a review of Dounreay beaches and groynes and an assessment of the Magnox Power Station sites. The project with the most scientific interest spans the marine and coastal areas and is a DTI-funded review of evidence for channel migration within sandbanks in areas with potential for offshore renewable energy installations.

Forward Look and Prioritisation

The estuaries work will continue to focus on the Clyde and Thames, although opportunities will be taken to work in the Forth as part of equipment and technique, as this area is both convenient and part of a basinwide study of the Midland Valley. It is planned to extend the Clyde work further downstream and develop the source-to-sink model into the sink areas of the Firth of Clyde. There is potential to develop this project with SAMS and SEPA. The Thames work is considered to be strategically important and it is hoped to develop this with aligned research funding from interested parties, such as the Environment Agency and Thames Port Authority.

One area for future development of the science is the comparison in sediment architecture between the two estuaries, which are at opposite ends of the tectonic spectrum within the United Kingdom, with isostatic uplift in the Clyde and subsidence in the Thames. Results should be applicable to other estuaries.

The proposed 'open coasts' projects are focussed on eastern England where coastal erosion rates are high and the risk of flooding is greatest. Several project outlines have been developed (see below) to address a series of specific scientific issues along the coast from the River Deben in Suffolk and Winterton Ness in Norfolk. The results of each of these projects will enhance our understanding of coastal processes, feed into the white ribbon project, and enhance the nearshore element of the new 1:50,000 sea-bed character and bedform maps:

(a) Slaughden, Aldeburgh, Suffolk:

The River Alde deviates sharply from a west-east orientation to flow southwards behind the sand and gravel spit of Orfordness. The spit at this point is only a few 10s of metres wide and there are concerns that a breach might occur with the result that the River Alde would flow directly into the North Sea. Erosion is occurring on both the seaward side and also on the river side of the spit. Possible consequences of a significant breach include changes in the direction of flow of the River Ore, changes to the tidal range within the estuary, with wide impacts on habitats, economic and leisure interests in the area. The potential breach site is underlain by a palaeovalley infilled by Holocene deposits, which represents a potential point of weakness as the rest of the modern estuary is geologically controlled by the London Clay and Coralline Crag formations. This proposed project would investigate the 3D geometry of the estuary and the spit to better understand the geological constraints on the estuary and the relationship to the overlying spit.

(b) Bawdsey

At Bawdsey a low cliff of London Clay is being very rapidly eroded threatening local property. In the intertidal zone a platform of London Clay is exposed. Bawdsey would provide an excellent additional site allowing comparison of several London Clay sites, which differ in morphology, lithology and exposure to wave energy.

(c) Benacre Broad

Benacre Broad is a coastal lagoon separated from the sea by a low barrier beach. Coastal saline lagoons are a priority habitat in the UK Biodiversity Action Plan and EU Habitats Directive. The beach ridge spans the gap between two rapidly eroding sections of cliffs. As the cliffs recede so the barrier migrates landwards by a process of washover, thereby reducing the area of lagoon habitat. With rising sea levels such environments are particularly vulnerable. Up until 1737 there was a small coastal haven at Benacre that became closed off at that time. The barrier and the lagoon are consequently relatively recent features. There is a great deal of interest at a national level over coastal lagoons and the potential future evolution of coastal barriers. Benacre represents a specific type of barrier system that could contribute data to the wider study of the behaviour of such systems in the UK.

It is proposed to undertake a terrestrial LIDAR survey in conjunction with beach surveys using dGPS. This will act as a baseline survey of the barrier. It is proposed that the barrier is monitored either by repeat surveys at 3 month intervals or by ad hoc surveys timed after storm events.

There are opportunities here for a more integrated approach with land-based mapping projects, where there has been recent work in this area.

(d) Scroby Sands and adjacent coast

Scroby Sands is a coast parallel sandbank lying offshore from the port of Great Yarmouth. The crest is emergent at extreme low water and the bank forms a major defence for the adjacent coastline from waves. The first operational large-scale offshore windfarm has been constructed there and consequently there is a large body of data in existence regarding sediment transport and bed mobility that has been acquired as part of the original site investigations and subsequent monitoring programmes. There are also nearby areas of sea-bed subject to bathymetric routine re-survey by MCA due to the proximity of important navigation channels in to the port of Great Yarmouth.

BGS is presently involved in a project for DTI regarding offshore renewables which will enable us to obtain much of the data associated with the windfarm. BGS has also been included in an application for funding under NERCs's FREE (Forecasting Risk For Extreme Events) programme which involves working with the University of Manchester who will be developing numerical models to assist with better understanding of the significance of wave attenuation on energy reaching the shoreline. BGS is also a project partner on Tyndall Centre project which will be addressing the impact of climate change on offshore sandbanks. Scroby Sands is likely to be the focus of this study. Some earlier BGS work on Scroby Sands was completed as part of the 1:50 000 regional mapping programme. The longer-term evolution of Scroby Sand is also of particular scientific interest, as it lies across a palaeovalley which was incised in the post-glacial period by the River Yare.

There is great national interest in the relationship between sandbank morphology and evolution and protection of the coastline. For a variety of reasons Scroby Sands stands out as potential focus for multidisciplinary work to address this issue. We already have good contacts with the main players so it seems desirable to develop our role in this area. As part of our ongoing project commitments we will be able to appraise the value of existing data. Seismic and other geophysical techniques offer a cost-effective way to develop understanding of the 3D geometry of the site but cores will certainly be required in addition. This will be an excellent pilot area for white ribbon surveys.

(e) East Anglian Nesses

Within the area defined by the UKHO project, the issue of the East Anglian nesses and their role in coastal evolution stands out as one of the major scientific challenges. The question of whether these headlands represent places where sediment is gained or lost by the coast has exercised coastal geomorphologists and sedimentologists for decades. Work was commissioned by MAFF (now DEFRA) in 1996 to improve understanding of the nesses but the findings were equivocal. Further work has been done more recently by the DEFRA-funded Southern North Sea Sediment Transport study which involved offshore survey and instrumentation off Winterton Ness. The nesses were further considered by the Futurecoast project in 2002.

It is acknowledged that the nesses represent a difficult topic and one for which BGS expertise is not entirely suited. However one aspect of ness development does appear to offer potential for a geoscience-related approach. Several of the nesses in the area have shore-attached sandbanks whose development and morphology are intimately related to the ness. It is proposed that the acquisition of survey data over these banks might yield a different approach than that traditionally used if integrated with other geological and geomorphological data on coastline controls.

5 Summary of Finances

It is envisaged that the current balance of industry co-funding, commissioned projects and SB will continue. However the commissioned research income is very variable in the marine sector. It will remain a key part of our strategy to underpin the future marine programme by working towards a new multi-agency national multibeam-based marine mapping programme.

Table 5.1 summarises the science budgets for the major projects active in 2005/06 subdivided into six broad areas (management, marine geology, coastal geology petroleum geology and basin studies, marine operations and data management).

Table 5.1 Summary of budgets 2005/06

	Staff	Other recurrent	Internal Services	Total	Comments
Management					
Management SB	260,000	30,000	1,500	291,500	Includes software licences, Landmark, conference travel etc
NERC science co-ordinators	33,000	147,000		180,000	Ocean margin LINK and IODP
Marine					
Marine SB	557,000	307,000	76,000	940,000	Includes SB towards WFA and MESH
CR projects and CR contributions to SB (co-funding)	281,000	738,000		1,011,000	Includes DTI SEAs, aggregate levy projects in East English Channel, Bristol Channel et al
Coastal					
Coastal SB	267,000	97,000	64,000	428,000	
CR projects	90,000	41,000		131,000	Includes work at Dounreay, cohesive shorelines, Spurn Head

3D geoscience and petroleum geology					
3D geoscience and petroleum geology SB	506,000	13,500	45,500	565,000	Includes Faroe- Shetlands, Rockall and S. Permian Basin
CR projects and CR contributions to SB (co-funding)	1,047,000	180,000		1,227,000	Includes DTI Geological Advice, PMMP, Falklands, Middle East
Operations					
CR projects	485,000	4,006,000		4,491,000	Includes IODP, Montserrat, Costa Rica
Data Management					
Coastal & marine GIS	41,000	1,000	3,000	45,000	MCHP funds only: main data funding from Information
Total	3,567,000	5,560,500	190,000	9,309,500	

Notes: All staff costs quoted at Full Economic Cost in GB Pounds

Table 5.1 clearly indicates that the revenue from commissioned coastal work is low compared with other areas of the programme. At present the amount of SB is also low compared with the marine area. This does not reflect the entire coastal programme in BGS, as cliff erosion studies are undertaken within the Physical Hazards Programme. Similarly studies of the Clyde and Thames estuaries are also spread across other programmes.

The science budget (SB) allocations for 2006/07 are given in Appendix 5. These show a huge reduction compared with 2005/06 because the marine programme received a number of 'one-off' additions in 2005/06 to undertake multibeam, sidescan and shallow seismic projects in the Summer Isles and Bristol Channel areas. Additional funding was also received to support the research into the geology of the Indian Ocean tsunami. The science budget estimates for 2006/07 are significantly reduced, with a slight reduction in staff time, a major reduction in OR and a 10-20% cut in internal services (final figures not yet available).

At this stage, co-funding and commissioned research for 2006/07 is considered likely to be similar to 2005/06. However, the new DTI Geological Advice contract, which was awarded in April is unlikely to be as well resourced as in previous years due to funding cuts at DTI. In addition there will not be an IODP mission this year although staff time will be spent in preparation for an extended mission to drill on the New Jersey margin in 2007.

A full list of active projects is given in Appendix 6.

6 Management and Staffing

The Programme Manager (R W Gatliff) reports to M K Lee (Director, Geology and Resources Directorate) at regular meetings when a review of project progress is reported. Regular meetings with Heads of Discipline and Programme Managers in other parts of BGS are limited to six-monthly BGS senior Staff Meetings. Other meetings are on an ad hoc basis, although there is regular contact with relevant Heads of Discipline.

Project management under the terms of ISO9001 forms the basis for successful management of the Programme. Each project is required to maintain project details on the BGS Project Management system. Large projects are required to have a project plan and regular review and planning meetings. Project Leaders meet approximately every two months, with monthly

meetings arranged alternately in Keyworth and Edinburgh. Commissioned research and co-funded projects are always undertaken in close co-operation with customers.

The Programme Manager is supported by a senior management team of scientists (Table 6.1).

Table 6.1: MCHP Senior Management Team

Gatliff, Robert	Programme Manager
Johnson, Howard	Deputy Manager, Leader of 3D Geoscience & Petroleum Geology
Stevenson, Alan	Leader of marine & coastal research
Tappin, David	Leader in Keyworth
Senior Project Leaders	
Balson, Peter	Coastal projects
Booth, Steve	Estuaries
Cameron, Don	DTI Geological Advice contract
Evans, Dan	ESO-IODP
Graham, Colin	Marine Data Manager
Harrison, Matt	Leader for 1:50,000 mapping programme delivery
Hitchen, Ken	Rockall Consortium
James, Ceri	Aggregate Levy marine geology projects
Kimbell, Geoff	Potential field geophysics
Jones, David	Estuaries geochemistry
Long, Dave	WFA, MESH
Lott, Graham	Southern Permian Basin Atlas
Molyneux, Stewart	Middle East projects
Richards, Phil	Falklands contract
Ritchie, Derek	Faroe Shetland Basin and link to Heads of Discipline
Skinner, Alister	Head of marine operations
Stephenson, Mike	Middle East projects

Around 130 staff, out of a total BGS complement of around 800, have contributed to the Programme during 2005/06 (Table 6.2). These have a wide range of specialist skills and the mix reflects the BGS matrix management structure that allows access to staff across the whole of BGS. However, Table 6.2 also highlights that the MCHP core team comprises around only 40 staff, of which 35 are classified as scientists. The small allocations of time for many others reflects excess ‘salami-slicing’ of some staff.

Table 6.2: Staff on Programme showing expertise and time allocated.

Expertise/skill	No of Days 2005/06					
	>175	100-174	40-99	11-39	1-10	Total
Management	1	0	0	0	0	1
Petroleum Geology	8	3	2	3	3	19
Marine Geology	7	2	2	0	0	11
Coastal Geology	0	5	1	2	0	8
Geophysics	1	2	3	1	5	12
Marine Ops	2	0	8	1	0	11
Biostratigraphy	0	0	2	1	2	5
Petrology/Geochem	0	0	4	1	2	7
GIS	0	1	4	0	4	9
Geologist	0	0	0	2	4	6
Support/others	5	0	3	8	23	39
Total	24	13	29	19	43	128

Notes

Petroleum Geology includes seismic interpreters, sequence stratigraphers and sedimentologists

Marine Operations staff also work on equipment/technology development

Several staff have multiple skills, but all are included only once in the table.

Table 6.3 summarises the staff distribution by grade. This highlights the skewed distribution towards senior scientists (Band 4) and the relative shortage of intermediate and junior science grades.

Table 6.3: Staff by grade

		Band 3	Band 4	Band 5	Band 6-8
Management		1	0	0	0
Petroleum Geology (Includes seismic interpretation)	>100 days	0	9	1	1
	<100 days	1	3	2	2
Marine Geology	>100 days	0	7	0	3
	<100 days	0	0	1	1
Coastal Geology	>100 days	0	1	0	3
	<100 days	0	2	0	1
Geophysics (Seismic processing & potential field)	>100 days	0	1	3	2
	<100 days	0	3	2	1
Marine Operations	>100 days	0	1	1	0
	<100 days	0	0	2	7
Biostratigraphy	>100 days	0	0	0	0
	<100 days	1	4	0	0
Petrology/Geochem	>100 days	0	0	0	0

	<100 days	0	3	1	3
GIS	>100 days	0	1	0	0
	<100 days	0	1	1	6
Geologist	>100 days	0	0	0	0
	<100 days	0	3	0	3
Support/others	>100 days	0	0	0	5
	<100 days	0	2	4	28
Total		3	41	18	66

Notes

Band 3 senior management and special merit promotion scientist

Band 4 Principal scientists

Band 5 senior scientists

Band 6-8 junior scientists

Issues related to individual areas of specialism are discussed below:

Petroleum Geologists: Within the core team of petroleum geologists and related specialisms, almost all are experienced principal geologists. This reflects the maturity of the DTI contract and long-term service. In recent years 3 new graduate/MSc staff have been taken on. These three staff are all contributing to the petroleum geology programme, but are shared with the marine geosciences projects. In February 2006, one of the senior geologists resigned. It is planned to recruit a new graduate/MSc or PhD geologist (subject to re-award of DTI Geological Advice contract).

Geophysicists: 3D potential field modelling is an area of strength for BGS. This work is lead by Geoff Kimbell with support from a new geophysicist (Gaud Pouliquen) employed in Edinburgh. However, since the end of the DTI-funded mapping programme the call on experienced geophysicists within MCHP has reduced. The operational staff have focussed on sampling and the geophysicists have reduced in numbers through natural wastage, retirement and redeployment. The Edinburgh Anisotropy Project (Geomagnetism and Seismology Programme) has become the focus of seismic research, and MCHP has focussed on providing the geological component of seismic research. The PDG notes the lack of research and development in seismic techniques and in particular the need to develop skills in new technology associated with high resolution seismic data acquisition.

Biostratigraphers: The number of biostratigraphers in BGS has reduced during the last 10-20 years, and there has been very little support from the science programme. In the hydrocarbons sector BGS has developed a speciality in high-resolution biostratigraphy in Middle East reservoirs. It is proposed to build on this expertise by initiating a research programme in the North Sea. The work programme for 2006/07, primarily based round the Middle East is strong, and there is a strong case to employ at least one new graduate to build on and transfer the skills of the established team. Permission to employ a new biostratigrapher has recently been given.

Petrologists and Geochemists: This is another area where the BGS contribution to basin analysis and petroleum geology has been limited. The high level of skill in fracture logging, diagenesis etc is based on work undertaken for the nuclear industry. These skills have been transferred to the petroleum industry, with particular success in the Middle East. It is proposed to build on this expertise by contributing to the new North Sea project on archived oil field data sets.

Marine Geologists: The core team has a similar structure to the petroleum geologists with a high percentage of principal geologists. Three geologists were recruited a few years ago in Keyworth, and two in Edinburgh to strengthen the team. One has since resigned. These staff are taking important roles in developing the programme. Another geoscientist was recruited last autumn to Keyworth and another started in Edinburgh in April, both with multibeam experience. Their skills cover some coastal issues, but most of their effort has focussed on marine geoscience.

It is proposed to strengthen the multibeam acquisition and processing skills within the programme through recruiting an hydrographer with acquisition skills (who can also support the contractual side of operations). The PDG believes that it is important that the marine scientists develop an in-depth knowledge of the technology and processing capability, and it is recognised as a priority to develop skills in operations, processing and back-scatter interpretation within the existing geoscience staff.

Coastal Geoscientists: The number of staff classed as coastal geoscientists, who are considered as core team members is very small, with one lead scientist, Peter Balson, supported by two junior scientists. Stephen Booth now provides a key role in leading the estuaries projects, and his experience in onshore mapping in SE England is an important asset to the team. Several of the marine geoscientists also have coastal expertise, although the programme has developed more towards marine geoscience. This occurred during the last few years when the Coastal Programme (based in Keyworth) moved into more marine work, reflecting opportunities provided by the aggregate levy fund. Two geochemists contribute leading roles in the coastal programme. The relative demise of the coastal programme, which covers an area of national strategic importance, is an important issue. Development of the Coastal Programme has been hindered for several reasons:

- Key staff diverted to marine geoscience
- Resignations of intermediate grade scientists
- Less experienced staff being over-stretched and allocated to onshore projects
- Absence of experienced coastal geologists in Edinburgh.

Marine Operations: The BGS marine operations team has an excellent track record as world-leaders in shallow drilling, and this has resulted in BGS being awarded a long-term contract as European Science Managers or IODP. The Head of marine operations (A. Skinner) retires soon, and options for succession/replacement are in progress. Five engineering staff covering a range of skills are now in place.

GIS and Data Management: Although data management is in a separate part of the structure, the Head of marine data management (Colin Graham) has a team of staff who support marine data management and provide GIS support. None off the data/GIS team is full time on the Programme, and the transferable skills are frequently in very high demand across BGS.

Geologists: This small group covers the onshore “field” geologists who contribute scientifically to the Programme. They include staff who work on the estuaries projects, onshore in the Falklands, and on an onshore-offshore Quaternary mapping initiative in the NW Highlands.

Other support staff: Many of the staff listed work on projects in the labs, supporting coastal operations, or provide technical support. Until recently in Edinburgh there is a full-time secretarial assistant and a core team of three staff who work primarily for MCHP. In Keyworth, the support is much more widespread with no clear support staff who have a prime role to support the Keyworth-based team.

External Staff Profile

The PDG commented on the low numbers of staff with recognisable names. Although some of the petroleum geologists have a low profile, as they work primarily on confidential work for DTI, the wide range of expertise covered by the programme means that specialists cover different fields and are known by different groups of the scientific community. The “recognition factor” is not considered a problem for the senior staff. However opportunities for the newer recruits should provide a pathway to be getting better known. All are given the opportunity to manage projects and are encouraged to develop their science skills. Their scientific development may be hindered by the diversity of science and relatively short-term projects, which hinder specialist development.

Appendix 8 lists papers published since 2002 based on work completed on MCHP projects. In addition to peer-reviewed papers there have been many presentations at conferences and MCHP staff actively convene meetings, edit special publications and conference volumes and participate in external committees (see Section 10).

Summary of staff issues recognised by the PDG:

- In light of the success of the biostratigraphy projects and world class developments in high resolution biostratigraphy in oil field modelling, a new scientist should be recruited to replace retired staff and build for the future
- The aging profile of senior petroleum geologists, and loss of an intermediate grade staff member makes it imperative to recruit at least one new petroleum geologist
- The existing junior/intermediate staff need to be encouraged to take a leading role in new projects and raise their external profile. It is particularly important that the core team of coastal geoscientists be given more time to the programme to ensure the sustainability of the core coastal skills
- A new coastal geoscientist should be appointed at Edinburgh to take opportunities arising from the devolved administration, with further review of the need to strengthen the coastal geoscience skills across BGS.
- The succession planning for Head of Marine Operations is a key issue and should be formally reviewed
- The PDG endorses the decision to develop multibeam acquisition and processing techniques through training existing staff and recruiting an experienced hydrographer/multibeam operations person to replace retired marine geophysicist

7 Technology

The PDG recognises that there is a close interplay between science and technology and in some cases technological advances can generate new scientific opportunities. The PDG therefore welcomes and supports the technological/equipment development area of the marine research programme.

MCHP has access to the full range of well-funded laboratories throughout BGS. As such there is not a clear itemised list of resources specific to MCHP. However, GIS is a widely used tool amongst all the scientific staff and underpins data storage, delivery and interpretation in many projects. Some specific items of existing and required technology are highlighted:

Landmark 2D and 3D interpretation & mapping software

Seismic interpretation is carried out using Landmark software based at both Gilmerton (DTI contract) and Murchison House. These are flexible systems but use UNIX. Although the Landmark is a standard system in the industry, along with Petrel, now used in Keyworth, they lack the flexibility of pc-based systems that allow easy use in remote-from-office locations, either in the UK or overseas. Many oil companies and universities are transferring to Kingdom Suite software, which runs stand-alone PCs or laptops. One option for consideration is the use of Citrix remotely to access Landmark systems in-house. Laptop remote access via secure VPN networking allows BGS staff to access BGS SAN and workstation systems. However Kingdom would provide a more flexible, and possibly better performance with regard to interpretation for remote, off-site display.

Potential Field 2D and 3D modelling software

BGS has developed its own 2D and 3D potential field software, which has been commercialised by Ark Geophysics. BGS now has access to the latest version of the software, which can be used with the Landmark systems.

RECALL well log analysis and display software

Several licenses were acquired as part of the National Hydrocarbons Data Archive for this software, which allows easy construction of logs and correlations. RECALL can be accessed via a web-browser interface.

Access to CDA

BGS now has access to wireline logs and reports for all released wells through the CDA Datastore. Use of data from this repository is restricted to core science projects with or without co-funding, but for all commercial research projects, access is only allowed via the customer's membership of CDA.

Multibeam Acquisition and Processing

One of the fundamental discussions in recent years has been the debate about whether to purchase a multibeam system to underpin future work or continue to hire in equipment and expertise as required. By hiring in equipment it has meant that the most modern and fit-for-purpose systems are used for specific projects. The pace of change in technology has reduced and obsolescence is no longer an immediate factor. The purchase of a full acquisition and processing capability will clearly strengthen the skills and operational capability of the MCHP and the PDG supports such a purchase. A BGS multibeam system would contribute to national and European initiatives to pool equipment and expertise and demonstrate clearly the potential for BGS to play a leading role in a national multibeam survey. The equipment should have the flexibility to be mounted on other vessels.

Small boat for nearshore waters

BGS has an old single-hulled outboard vessel. A review of this indicates that it is not suitable for modern surveys, including multibeam, shallow seismic and grab samples. It is suggested that a purpose-built towable craft be purchased to provide a flexible platform for shallow water and nearshore surveys. As part of the white ribbon project, several vessels were reviewed, and clearly demonstrated the feasibility of running a small vessel for multibeam surveys. The PDG recommends such a purchase, and acknowledge the potential for joint working with other research organisations and clear potential for underpinning a major lake and loch survey during future BGS programmes.

Marine sampling equipment, rock-drills and vibracorers

The marine operations group has an excellent track record of mounting sampling and drilling operations and through the skills and experience gained during the last 30 years, BGS was awarded the lead role in ESO (European Science Operator) for the Integrated Ocean Drilling Programme. The equipment is used to support the BGS programme and is also available for other scientific and commercial users. A full review of the equipment was not part of the remit for this PDG, but the operations and engineering group is recognised as a world leader in developing coring equipment and mounting sampling and drilling operations.

Single-channel airgun, boomer, sparker, gravity meter, magnetometer etc

BGS undertakes marine geophysics cruises in support of the core programme. It was noted that there has been little in the way of development of the marine geophysics technology within BGS for many years, and the PDG recognises the need for a period of technology catch-up and development, particularly with the move towards the nearshore, shallow water areas.

Access to UKORS research vessels and equipment

The PDG welcomes the opportunities provided by participation in cruises utilising the NERC research vessels. BGS science cruises during the last few years are summarised in Table 7.1 and highlights the planned cruise in 2007, which will utilise the new 15m rockdrill to test previously unsampled exposures of volcanic centres in the Hatton area.

Table 7.1 BGS Core science cruises using the NERC research fleet

Year	Ship	Cruise
2001	James Clark Ross	Rock-drilling and vibrocoring on the Hebrides Platform, in the Rockall Trough and on Rockall Bank
2002	Discovery	Geophysics Hatton-Rockall
2003	Discovery	Geophysics Hatton-Rockall
2005	Charles Darwin	Multibeam (Rockall) and seismic Hatton-Rockall
2006	Charles Darwin	Multibeam and seismic, Hatton and Faroes area
2007	James Cook	Rock-drilling, Hatton area

GPS positioning equipment, laser-scanning equipment

BGS has used GPS and laser scanning equipment to monitor changes in cliffs as part of a cliff stability programme within the previous Coastal Geoscience and Global Change Programme. This work now continues as part of the Physical Hazards Programme. However staff in the coastal geoscience projects (led by Peter Balson) have used the technique for repeated monitoring of beaches. If good results showing the results of storm activity and the effectiveness of terrestrial LIDAR are acquired, this technique will be developed further.

One of the technologies considered for the white ribbon is flown LIDAR. New technology has recently been developed that allows imagery of the sea-bed in shallow waters. Penetration is not good in cloudy waters (typical on the east coast of the UK), and resolution is less than ground-based systems. MCHP has been exploring options to use this technology with the UKHO in shallow waters in the SW of England. There may be potential to upgrade the technology used in the NERC plane, or future opportunities to temporarily fit a system to the NERC or the BGS plane. Resources within the core science budget OR will limit use in the immediate future.

Coda software for seismic recording, processing, mosaicing and display

This is now a standard suite for collection, storage and display of BGS seismic data and also sidescan data.

Other Packages

GoCAD, ErMapper, Earthvision, BasinMod, Promax, 3D visualisation suite, Fledermaus visualisation software, Petrel, ArcGIS.

8 Data and licensing issues

Although marine and petroleum data are managed through the Information Directorate, a presentation on data management for the marine environment was included in the review as data is a key element of the programme. One of the issues raised by the PDG was the difference between the onshore and offshore programmes. Much of the data and many products derived from onshore surveying are unique to BGS, which has undertaken the definitive onshore survey. In the offshore most of the data are collected through marine surveys and BGS is just one of several major survey organisations active in this area. To ensure that BGS can and does produce the definitive offshore national geological products, there is a need to consider a variety of data and product ‘sharing’ agreements with other marine institutions. The recent agreement with UKHO is one example and discussions are now planned with CEFAS.

This section summarises the key elements of the BGS strategy for marine and petroleum data:

- All data in the marine area is indexed and stored as hard copy or digital files in either Keyworth or Edinburgh. Through agreement with DTI, BGS has access to offshore well data for its scientific programmes
- The programme includes digitisation and databasing of hardcopy legacy data.
- The programme includes the generation of new value-added products based on geotechnical data
- MCHP staff all have access to the coastal and marine GIS, in which provides a common access to digital spatial data
- BGS supports MDIP principles of easy access to metadata and data, and BGS is moving towards accreditation as a Data Archive Centre
- The BGS data policy of licensing data and developing value-added products is applied to the offshore
- The limited market for offshore data, and complex and different attitudes to data within the marine community give rise to some issues
- BGS would be in favour of a pan-Government or multiple licence agreement to remove some of the common data licensing issues
- BGS has signed an agreement to manage the DTI SEAs data and make it available through the DEAL website as a prototype Data Archive Centre (DAC) in line with the Marine Data Information Partnership (MDIP)
- BGS has access to released wells for its science programme through agreements with DTI and CDA
- BGS has access to seismic data for its science programme through DTI, but this is sometimes a time-consuming process. The data release programme for seismic data is not

straightforward and the absence of release of spec seismic can be a problem, although there are good relations between BGS and the seismic companies for use of data

- The NHDA provides a new opportunity for the BGS science programme
- BGS should review the data licensing model in the marine area as the onshore model may not be the most suitable

9 Internal Collaboration (including marine operations and other programmes)

Traditionally the BGS marine and petroleum programmes were considered as very distinct parts of BGS; both were almost entirely funded by DTI and the hydrocarbons work was undertaken at a separate office in Edinburgh. Today there is much more integration with other programmes, although there is room for the development of more multi-disciplinary and joint projects across programme boundaries.

Geology and Resources Directorate

MCHP is part of the Geology and Resources Directorate, in partnership with the onshore survey programmes and the Minerals Programme. Recently, MCHP and Geology and Landscape Northern Britain have been working closely on Quaternary source-to-sink projects in NW Scotland. This approach is developing with more collaboration in the Montrose area and in the Midland Valley. Similar joint working is less well developed in England and Wales, although there has been close collaboration on coastal mapping programmes in East Anglia in previous years. There are now opportunities to integrate the Thames estuary work with onshore projects. The opportunities presented by multibeam landscape mapping, and in the future, LIDAR, makes future collaboration more likely. There is excellent potential to develop projects with the Geological Survey of Northern Ireland, particularly taking advantage of cross-border funding to work with the National Sea-bed Survey in Ireland.

MCHP has had limited contact with the Economic Minerals Programme. The marine mapping programme has been focussing on habitats rather than resources, and the Minerals Programme has focussed on onshore minerals. There is clear potential to collaborate in the marine aggregates area, where resource limitations have restricted MCHP activity. A second area of potential collaboration internationally may be in mineralisation associated with spreading centres. This is an area where NOC has reduced its activity in the Oceans 2025 programme.

The National Geoscience Framework Programme has been set up to deliver various scales and styles of Lithoframe maps and models. It is unfortunate that resources have focussed on developing techniques for digital capture onshore and most of the modelling is also focussed on the onshore. Only the very small scale national models are supported jointly by the NGFP. This year the production of the Caledonian and Variscan unconformity maps is a joint project between the two programmes.

Environments and Hazards Directorate

MCHP has many links with the Environments and Hazards Directorate. The Physical Hazards Programme covers the onshore part of the coastal zone and close ties are required. Although many of the coastal specialist and support staff work on projects in both programmes, the degree of integrated project working is not strong. The largest area of overlap is in the estuaries area, where the Glasgow and Thames super-projects could develop into a joint onshore-offshore 3D model.

There is potential to work with the Electric Tomography Programme on shallow profiling in the white ribbon using new resistivity modelling with profiles extending from onshore to offshore. There is some scepticism, expressed by staff working on the programme and members of the PDG as to whether this technique will be more effective than seismic techniques, but trials are planned to assess the potential of this technology.

Several projects have developed through collaboration with the Seismology and Geomagnetism Programme, where seismic monitoring and risk assessments have been part of the Western Frontiers Project. A new EU project studying the risk posed by tsunamis in Europe is about to begin, where there is collaboration between seismologists and marine geologists. The Edinburgh Anisotropy Project is now clearly the focus for seismic-related research in BGS, and a joint project on sub-basalt imaging was completed in 2003. Specialists from the EAP project contribute to the DTI Geological Advice contract working on AVO analyses.

There are natural synergies between MCHP and the Sustainable and Renewable Energy Programme, and staff work on projects based in both programmes.

Information Directorate

Hydrocarbon and marine data and marine data products form a small part of the Information Directorate in terms of resources allocated and development of digital products. There are pilot projects evaluating the potential to develop products based on geotechnical data and the capture of coastal data from aerial photographs around the Scottish coast to complete a “futurecoast” style of product. The Information Management Programme provides around £100,000 pa of resource to develop management of marine and hydrocarbon data. This project is lead by Colin Graham, who is an experienced marine geologist with wide experience of the data types and information technology. There is excellent integration of the limited Information Management Programme resources with the MCHP marine and coastal GIS, which provides access to a steadily increasing amount of MCHP data and interpretations.

With the development of new agreements with UKHO and data sharing possibilities with CEFAS and other marine organisations such as JNCC, the need for close collaboration with the Information Delivery Programme is apparent. There are opportunities here to develop a model for marine data under Government sponsored initiatives such as MDIP (Marine Data Information Partnership). A greater communication of issues around marine and hydrocarbon data is required between the MCHP and the Information Directorate, such that the BGS model for data licensing can develop in line with Government policy and new data initiatives within the marine sector.

The largest commissioned research project in the Information Directorate is the UKOOA-sponsored DEAL project. This has demonstrated to industry in the hydrocarbons sector and across other marine sectors the excellent skills and innovation within the Information. The DEAL project team and MCHP work closely together on developing new initiatives and this year DTI has funded the addition of the marine Strategic Environment Assessment data into BGS data archives with its availability highlighted through DEAL.

Geoscientific Skills and Facilities Directorate

The matrix management system within BGS requires close cooperation between HoDs with their overall staff responsibilities and the management of projects within the programmes. With the diverse nature of the MCHP, many staff from all disciplines work on MCHP programmes. R. Gatliff has presented the outline programme and strategy to a GSFD meeting to present the outlines of the programme and the medium to long-term strategy. This is important for future recruitment and development of the BGS staff profile. On day-to-day matters Derek Ritchie provides an effective and close link between programme and the GSFD.

Marine Operations

The marine operations team are based at the workshops in Loanhead and the management of the development and maintenance of the marine capability falls to Head of Operations, Ali Skinner, and Russ Evans, Head of Discipline for Geophysics and Marine Geology. Individual projects are managed through MCHP. This system generally works well for supporting MCHP science programme, however there are number of areas for further consideration:

- The resources in terms of staff support through internal services cover a very low percentage of the annual cost of running the marine operations facility.
- The success of the operations team requires external contracts to support the facility, as operational resources within the MCHP science programme are limited.
- Although the number of commissioned cruises, primarily from academia, is variable, there is potential for under-funding during lean years. The profile of BGS capability relies heavily on Ali Skinner and a review of how to develop the facility and raise its profile outside BGS in coming years is required.
- The focus of the marine operations team has been very much on coring and drilling where they are clearly world leaders. The future BGS programme will require more emphasis on multibeam, shallow seismics and coring in shallow water. There should be a development of technical capability in these areas.
- There is a growing concept of cost-effective marine pooling, particularly within the Scottish universities, and the BGS marine operations team have much to offer in this area. There are also opportunities for greater integration with the other NERC marine research teams who have combined to develop the Oceans 2025 proposals.

10 External Collaboration

MCHP aims to work closely with other parts of BGS, marine government and research organisations, such as the NERC marine research centres, DTI, DEFRA, JNCC, English Nature, Scottish Natural Heritage, Environment & Heritage Service Northern Ireland, Maritime & Coastguard Agency, UKHO, CEFAS, FRS and DARD (Agrifood and Biosciences Institute). Links with universities continues to be strengthened through joint research and an increasing number of research students. Close links with sister organisations in Europe and globally will be maintained and developed.

Members of the PDG have consulted with oil industry colleagues and had very favourable feedback on BGS petroleum geology activities/role (e.g. Faroe-Shetland Basin Project, Southern Permian Basin Atlas Project, standard nomenclature, Millennium Atlas etc). The NHDA provided a focus for developing 3D basin analysis and petroleum geology research to support the future developments in the mature areas of the UKCS, and would complement the existing focus on the frontier areas.

The contribution of petroleum geoscience to 2005-10 UK energy supplies is not adequately represented or recognised in Science Theme 6 (of the BGS 2005-10 Programme) and this aspect of MCHP is an important contribution to UK strategic science.

MCHP has extensive links with the oil industry and close links with the Faroes Geological Survey, BGR and TNO through the Southern Permian Basin Atlas Project. Links with universities in subsurface geology have not been extensive as much of the programme has been in confidence with DTI. However the Rockall consortium and associated projects has provided some excellent opportunities for work with universities, including Edinburgh (sub-basalt imaging), Imperial and Cambridge (seismic processing). A joint student with Birmingham

University has studied the St George's Channel and a new student has just started studying Neogene tectonics on the Atlantic Margin (with Edinburgh University). Staff are co-editing a Geological Society Special Publication on this topic and contribute to the Geological Society Petroleum Group, and contributed to the Millennium Atlas project and "Barbican" organising committees.

Table 10.1 summarises recent conferences and committees where MCHP staff are represented. This year P Richards has contributed to teaching at Heriot Watt (MSc) and M Stoker will teach a short course on Atlantic Margin at the Free University of Amsterdam.

Table 10.1 Conferences convened and committee representation, MCHP 2005-06, and 2006-07

Conferences	
GeoHab	A Stevenson & H Stewart
Petroleum Group of the Geological Society: Passive Margin Tectonics (2005)	H Johnson, R Gatliff, D Ritchie
Petroleum Group of the Geological Society – hydrates (2006)	D Long
Petroleum Group of the Geological Society: New insights in petroleum research (2005)	A Leslie
Petroleum Group New insights in petroleum research (2006)	H Johnson
NERC Ocean Margins Programme, Geological Society	A Leslie
5th International Workshop On Methane Hydrate Research and Development, Heriot Watt (2006)	D Long
AGU and EGU: tsunamis 2005 and 2006	D Tappin
CIMP Palaeozoic Palynology in Space and Time (workshop) 2006	M Stephenson
Committees	
Petroleum Group	H Johnson
Scottish Oil Club	R Gatliff (Hon Treasurer)
Edinburgh Geological Society editorial board	K Hitchen
Marine Group, Geological Society	A Stevenson (Secretary)
SUT policy committee	R Gatliff
SUT site investigation committee	D Long
SUT marine science committee	D Evans
NERC Ocean Margins co-ordinator	A Leslie
NERC UK IODP co-ordinator	H Stewart
EuroGeoSurveys Marine Contact Group	R Gatliff, A Stevenson (Secretary)
MDIP	C Graham, R Gatliff

Developing links and relationships in the marine sector is of crucial importance to the successful future of the marine programme. MCHP has been building and will continue to build links across the sector, and progress with the key players continues to be made. Participation in MDIP, MESH (JNCC, DARD), proposals for National Mapping projects and joint bids with CEFAS, SNH and others have improved links.

In the university sector key links have been made through joint EU-funded projects and joint PhD students. Current and recent students are with St Andrews, Edinburgh, SAMs and Imperial College. A joint bid for a NERC research grant to study the Indian Ocean tsunami has been successful with NOC, Oxford and others. Discussions are in progress with Birmingham University about a new Quaternary/Holocene project in the North Sea.

MCHP has contributed to discussions with Scottish universities on pooling of resources and applications for additional funding from the Scottish Executive. The universities have been effective in gaining new money which is only available to higher education organisations, and so far BGS has had a marginal impact on existing programmes, such as ECOSSE. There are currently moves to generate a coastal science consortium and this would provide an excellent scientific opportunity to develop the BGS coastal programme. Consideration should be given to a special application to NERC for a fully-funded 5-year senior coastal geoscientist to lead a BGS/NERC input into this new initiative.

Marine geoscience has been one of very successful collaboration with European partners, and BGS act as secretary to the Eurogeosurveys marine group. There have been several successful joint bids for EU funds, including Stratagem and several data/GIS projects. The 6th Framework was not successful for the marine geological surveys, but joint submissions have been made to the EU to improve the marine geoscience content of the 7th Framework.

Coastal issues are rather different from many of the marine issues, and this is reflected in different organisations being associated in this area. Relationships are good with those organisations that extend into the maritime environment, but work needs to be done to develop and broaden effective links with universities, the environment agencies, Crown Estates, Defra, port authorities and local authorities. The Coastal Observatory based in Southampton is an organisation where synergies should be developed. The PDG suggested that devolution is a serious issue for coastal science as the funding is more fragmented in the coastal area. The PDG:

- Endorses the initiative to bring together marine and coastal organisations to formulate an integrated national multibeam and LIDAR survey of the entire UKCS, and BGS is encouraged to be increasingly pro-active in developing proposals
- Welcomes the increasing BGS attempts to build relationships with marine organisations, universities and industry

11 Summary of recommendations

The main recommendations and observations of the PDG are summarised below. These reflects points made during the body of this report but also include some more general recommendations on wider issues. In some cases the recommendation is followed by additional observations [*in italics*].

11.1 STRATEGY

(1) The PDG welcomes the strategic approach of the MCH Programme across a broad area of research. Continued careful management of the Programme and monitoring of external business and legislative drivers is required to ensure that the programme maintains a cohesive focus.

Maintaining the balance between the strategic pursuit of objectives and retaining the flexibility to respond to changing external factors, and for prioritising work across this large, strategically important and diverse programme is a key priority. A view should be developed as to whether more overseas work would be acceptable.

11.2 SCIENCE

(2) The PDG endorses the current hydrocarbons-related elements of the programme based on developing the regional approach to the geological structure of the UK, and welcomes the initiative to develop the analysis of older archived fields.

The oil industry provides key co-funding and steerage for this part of the programme, and the PDG welcomes the support of the industry. The new project to look at the mature areas of the North Sea is welcomed; work in this area provides opportunities to develop projects with universities and industry. Close links with the Sustainable Energy Programme should be developed for this project.

(3) The proposed shift to pursue marine geology and ecosystem research more vigorously is welcome. This is a key area of research with several strategic drivers, and research in this area will underpin the geological input into the UK marine monitoring programme. MCHP's share of the SB may need to be renegotiated upwards given the scope for new work.

Once the proposed drilling campaign on the Hatton margin has been undertaken, it is suggested that operational resources should be focused on the shallow water areas. It is a timely shift, likely to yield important results and publishable research, but might not yield the major sources of commissioned research comparable with support from the oil industry. The additional SB resource should include an allocation to develop integrated workflows, protocols, data dictionaries, and standards for the capture and publication of offshore digital data/information/interpretations, similar to those already developed for onshore programmes. More business development will be required to seek additional commissioned research in the marine sector funds.

(4) The PDG endorses the integrated approach to the marine and coastal zone component of the programme as this provides the opportunity to link terrestrial and marine processes through research on the open coast, in estuaries, and through source-to-sink studies.

Few institutions have the in-house capacity to do this. Moreover, BGS has an excellent reputation for productive collaboration with other institutions. Therefore, the opportunity to link observations and processes geographically can be done in parallel with links across science disciplines. The transfer of knowledge of systems science is critical to underpinning the Government's strategy of managing the marine environment as an ecosystem. The PDG recognises deficiencies in NERC's marine strategy with respect to sustainable economy and aspects of Knowledge Transfer. The MCHP should address these issues as soon as possible in collaboration with other marine institutes.

The criteria used for selection of study sites include three important elements:

Areas of high impact (flooding, rates of erosion)

The eastern English coast is recognised as the key area and has been agreed with the UKHO as the pilot area for the new 1:50,000 sea-bed character and bedform maps. Further work will be focused in this area to address the white ribbon and 3D models.

Zones where specific scientific questions may be addressed. Examples include:

What was the rate of sea level rise at the end of the last glaciation and what was the impact on coastal areas?

How do onshore glacial features link to the offshore environment?

What are the links between bedrock geology, sea-bed sediments and ecosystems?

How have sandbars developed during the Holocene and what can be predicted during future climate/sea level change?

What are the rates of erosion of cohesive foreshores and how important is the foreshore in controlling rates of erosion and cliff retreat?

What are the controls on the distribution of contaminants and sediments in an estuarine environment?

Zones of current or likely co-funding, where there is high stakeholder interest

The current work programme is focused on areas with co-funding and stakeholder interest, such as the East English Channel, the Bristol Channel, areas studied as part of the MESH programme, the Clyde and Thames estuaries and the coast of Eastern England.

Recommendation (12) deals with the wider issue of the profile of coastal geoscience in BGS and its funding.

(5) A shift towards Lithoframe 3D and even 4D modelling wherever possible and a generally more quantitative approach to the science is to be praised.

11.3 STAFFING

(6) The PDG welcomes moves to increase the expertise and, locally, project leadership within the programme through the recruitment of several new staff to replace those who have left through resignation or are due for retirement in the coming years.

There is a need to strengthen the expertise in the operation and interpretation of multibeam technology, in coastal and marine geoscience, and petroleum geology. Consideration should be given to improving the staff hierarchy with, for example, mid-career appointments, and fast-track career paths for selected employees. Several key staff are due to retire in the next few years and careful succession planning is required.

11.4 TECHNOLOGY

(7) The PDG endorses the plans to purchase a nearshore craft fitted with a shallow water multibeam system, and supports the aim to have a state-of-the-art shallow water seismic profiling system with digital data acquisition and processing to complement sea-bed data sets.

Advances in marine geology and geophysics are frequently technology led and a capability to develop and apply new technologies should be maintained.

11.5 DATA

(8) BGS should review its data licensing policy to assess whether a different model may be more applicable in the offshore area from that which is successfully applied in the onshore.

The market in the offshore is very different from onshore, with a limited number of customers, most of which are large commercial organisations or Government Departments or agencies. Policies of data and operational sharing through marine consortia may be applicable in some areas, allowing easier collaboration with partner organisations operating in the marine environment, but maintaining the overall BGS strategy to operate within Government policy and guidelines.

11.6 COLLABORATION

(9) MCHP should continue to develop links with universities and should ensure that the present level of university collaboration is maintained, through CASE and joint studentships for example.

(10) The PDG endorses the developing collaboration with UKHO, CEFAS, JNCC and other agencies, and the application of geosciences to the environmental and ecological issues across coastal and marine science.

MCHP should play to its considerable strengths in earth science and continue to work for a national marine mapping programme based on multibeam and related techniques. Opportunities to develop proposals with the devolved administrations and European institutions should be encouraged.

11.7 GENERAL ISSUES

(11) PDG feels strongly that the SB funding for the MCHP is insufficient given the size and strategic importance of the UKCS and coastal zone. The staff have an excellent track record of attracting external funding to enhance the scientific programme but higher baseline funding is needed, particularly to cover operational survey (non-staff) costs.

It is not the place of this PDG to argue for a switch of resources within BGS when other areas could (no doubt) also make a case for being under-resourced. However, the PDG actively encourages the Programme to seek additional funding from NERC through the FAB process, as well as from external sources. There are a multitude of players in the marine environment and BGS has a key role in co-ordinating activities.

(12) Coastal Geoscience is an area of increasing importance, especially in the context of climate change. Although the integration of coastal activities with the marine programme in 2005 has had some positive benefits, the whole area of Coastal Geoscience needs to be strengthened within BGS, both in terms of funding and specialist leadership. Consideration should be given to establishing a distinctive, well-funded sub-programme within MCHP led by a high profile coastal geo-scientist.

Appendix 1: BGS organisational chart

Executive Director John Ludden			
Geology and Resources Mick Lee	Environment & Hazards Martin Culshaw		Information Ian Jackson
Economic Minerals Andrew Bloodworth	Chemical & Biological Hazards Ben Klinck		Information Delivery Richard Hughes
Geology & Landscape Northern Britain Martin Smith	Electrical Tomography Richard Ogilvy		Information Management Jerry Giles
Geology & Landscape Southern Britain Poul Strange	Groundwater Management Denis Peach		Information Products Jenny Walsby
Geological Survey of Northern Ireland Garth Earls	Physical Hazards David Bridge		Information Systems Development Bill Hatton
National Geoscience Framework Andy Howard	Seismology & Geomagnetism David Kerridge		
Marine, Coastal & Hydrocarbons Robert Gatliff	Sustainable & Renewable Energy Nick Riley		
	Sustainable Soils Barry Smith		
Geoscientific Skills & Facilities Mike Petterson			
HoD Geology John Powell	HoD Geophysics and Marine Geology Russ Evans		HoD Geochemistry Dave Harrison
HoD Information Systems Simon Rippon	HoD Support Services James Orr		Laboratory Operations Shaun Reeder
IT Infrastructure Ian Ainslie	Publications Kevin Becken	Training Mike Hawkins	NIGL Randy Parrish
Business Development & Strategy David Ovadia			
UK Business Development Malcolm Brown	International Business Development David Ovadia		Corporate Policy & Science Coordination John Rees
Administration & Operations Support Kim Grant			
Personnel Administration James Orr	Finance, Accounts & Contracts Amanda Clewes		Estates George Bowick

Appendix 2: Terms of Reference and membership

Terms of Reference

- Review the outline SB programme and the basis for current priorities in line with the results of the SMA, the proposals outlined in the 2005-10 plans and UK Marine Science Strategy'
- Review the co-funded and CR programme and its contribution to the strategic aims of the core programme
- Evaluate progress on developing a strategy for surveying the white ribbon and a new national sea-bed-mapping programme based on multibeam data, in terms of methodologies, partnerships, deliverables and customers
- Evaluate how hydrocarbons research can be developed in response to falling production from the UKCS, increased oil prices, increased decommissioning and the increasing presence of new, smaller oil companies active in the UK
- Assess options for developing Lithoframe 3D modelling in the coastal and offshore areas
- Report to the BGS Board setting out the proposed recommendations

Members of the PDG

R Johnson-Sabine (RJS, Chair, BGS Board Member, Maersk)

Prof Graham Shimmield (GS, Director, SAMS)

Dr Roger Scrutton (RS, BGS Board Member, Edinburgh University)

Dr Beth Greenaway (BG, DEFRA)

Dr M K Lee (MKL, BGS, Director, Geology and Resources)

R W Gatliff (RWG, Head, MCHP)

H Johnson (HJ, MCHP, Secretary to PDG)

Other contributors (first meeting)

C Green (Head, Information Delivery)

C Graham (Project Manager, Marine data)

A G Stevenson (Project Manager, Marine & Coastal Mapping)

Other contributors (second meeting)

D R Tappin (MCHP), marine geologist

P Balson (MCHP), coastal geologist

J Chambers (Electrical Tomography Programme)

C Vane (MCHP), geochemist

D Jones (MCHP), geochemist

J Rees (Head, BGS Corporate Policy & Science Coordination)

Appendix 3: International and government drivers in the marine and coastal environment

Law/Act/Directive/Report	Summary
1969 International Convention on Civil Liability for Oil Pollution Damage (CLC)	Provision for the assessment of liability and compensation for oil pollution damage in territorial seas and inland waters
1974 International Convention for the Safety of Life at Sea (SOLAS)	All aspects of safety at sea including updating of navigational charts, identification of hazards etc
1982 United Nations Convention on the Law of the Sea (UNCLOS)	Overarching legislation dealing with: Delineation and delimitation of maritime boundaries Sovereign rights over natural resources Protection and preservation of the marine environment Fisheries
1992 Habitats Directive: Council Directive 92/43/EEC on the Conservation of Natural Habitats of Wild Flora and Fauna	The Habitats Directive outlines the conservation measures required by each member state to list priority habitats and species, identify the areas of each habitat requiring protection Achieved through the designation of Special Areas of Conservation (SACs), and management and other development plans for these areas.
1992 United Nations Convention on Biological Diversity (CBD, Rio Convention)	Establishment of marine protected areas. The CBD addresses implementation of part of Agenda 21 (UN Division For Sustainable Development). Chapter 17 address marine and coastal environmental and sustainability issues.
1992 OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic	The Biodiversity Committee (BDC) of the OSPAR Convention has agreed on the need ‘to prepare habitat maps of the OSPAR maritime area, showing the spatial distribution and extent of habitats’ in order to meet the needs of OSPAR in the assessment and protection of marine habitats. OSPAR encourage the data collation at national level that is needed to provide international-level information

**1992 Valetta Convention:
European Convention on the
Protection of Archaeological
Heritage**

Obligation on states to “facilitate the study of archaeological discoveries by making or bringing up to date maps, surveys and inventories of archaeological sites”.

**2000 Common Fisheries
Policy: Council Regulation
(1543/2000/EC) on establishing
a Community framework for the
collection and management of
data**

Member states are obliged to “undertake scientific research at sea to evaluate the abundance and distribution of stocks .in the case of stocks where such evaluations are possible and useful”.

**2000 Water Framework
Directive: 2000/60/EC
establishing a framework for the
Community action in the field of
water policy**

Member States have to identify all the river basins lying within their national territory and assign them to individual river basin districts. Four years after the date of entry into force of this directive, Member States must complete an analysis of the characteristics of each river basin district, a review of the impact of human activity on the water, an economic analysis of water use and a register of areas requiring special protection. Nine years after the date of entry into force of the Directive, a management plan and programme of measures must be produced for each river basin district.

2001 UNESCO Convention

Provides a comprehensive framework for the protection and preservation of a broader definition of underwater cultural heritage (UCH).

**2001 Strategic Environment
Assessment (SEA) Directive:
2001/42/EC on the assessment of
the effects of certain plans and
programmes on the environment**

SEA aims to provide “a high level of protection of the environment’ and to ‘contribute to the integration of environmental considerations’ into the preparation and adoption of certain plans and programmes that are likely to have significant effects on the environment. Environmental assessment must be carried out for all plans and programmes prepared for, inter alia, fisheries, energy, industry, water management and tourism, and “which set the framework for future development consent”.

2002 The Ministerial Declaration of the Fifth International Conference on the Protection of the North Sea (Bergen March 2002)

Agreed to ‘implement an ecosystem approach by identifying and taking action on influences which are critical to the health of the North Sea ecosystem’. The Ministers also agreed to reaffirm promotion of the establishment of Marine Protected Areas and recognised the need for further development of the European Nature Information System (EUNIS) marine habitat classification system to meet the requirements for mapping and assessment of the conservation status of the marine habitats in the North Sea and wider OSPAR area.

2002 Scottish Fishermen’s Federation and the Inshore Fisheries Branch of the Scottish Executive in November 2002

There is awareness among the fishing community that the ecosystem-based approach to management is an urgent requirement. This position paper recognised that a healthy environment was a prerequisite for a healthy fishing industry.

2002 Integrated Coastal Zone Management: Council Recommendation (2002/413/EC) concerning the implementation of ICZM in Europe

Impacts on DEFRA and devolved administrations for action in coastal zone, and one of the drivers for the proposed Marine Bill. The principles of integrated coastal-zone management are set out as:

- Taking a long-term view
- A broad, holistic approach
- Adaptive management
- Working with natural processes
- Support and involvement of all relevant administrative bodies
- Use of a combination of instruments
- Participatory planning
- Reflecting local characteristics

2002 Safeguarding Our Seas

DEFRA report outlining “ecosystem approach” to maintain the health and ensure the sustainable use of UK marine waters and resources. Creation of a co-ordinated monitoring programme with open access to marine environmental data

2004 The Royal Society of Edinburgh report into the future of the Scottish Fishing Industry (March 2004)

‘Because marine ecosystems are poorly understood, we recommend the Scottish Executive and the relevant funding bodies should provide increased investment in the science required to understand marine ecosystems and to develop realistic models of the ecosystem’

‘In order to integrate fishing with wider environmental concerns, we recommend that the SE should ensure that forums (e.g. inshore management committees) established for regional fisheries management should be tasked with helping to implement environmental policy relevant to their region. This would include the establishment of marine protected areas’

‘The system of governance for Scottish fisheries needs re-appraisal and the present gulf in understanding between fishermen and scientists needs to be bridged’

2005 State of the Seas report (Charting Progress) and Seas the Opportunity

DEFRA update on Safeguarding Our Seas and Scottish Executive equivalent report

2005 UK Marine Monitoring and Assessment strategy (UKMMAS)

To prepare UK for the new EU Marine Strategy Directive. Three evidence-based groups to collate data on “clean and safe”, “healthy and biologically diverse” and “productive” seas

Appendix 4: Moderating Panel comments on the 2005-2010 Core Strategic Programme Proposals and BGS responses

The summary for the whole of the BGS core programme is included here for completeness. Comments particularly relevant to the MCHP are included in themes 1 (3D Geoscience framework of the UK onshore landmass), 2 (Geoenvironmental Information), 3 (3D characterisation of the coast, continental shelf and margins) and 6 (Sustainable and secure energy supplies and mineral resources).

OVERALL PROGRAMME	
Moderating Panel Grade: Alpha 4/5	
Moderating Panel comments	BGS Response
Throughout the eight themes the panel felt that opportunities for category 5 research drawing on the excellence of the category 1 work had been missed. Moreover, the panel encourages more — and more effective — collaboration with HEIs and other NERC Centres. The panel strongly endorses additional resources being provided by NERC to fund collaborative research ventures (as recommended by the SMA). These ventures should support the broad mission of BGS with a focus on understanding processes.	The panel's strong endorsement of the proposed Core Strategic Programme is welcomed. The SMA stated 'It is the BGS's Core Survey brief which distinguishes it from the academic and commercial sectors, and which in turn justifies its unique existence as a NERC-funded body'. The Core Strategic Programme proposals responded to this important context by focusing on Category 1 activities. Nevertheless, the provision of additional resources (as recommended by the SMA) to fund collaborative research ventures with HEIs, other research centres and the wider science community (both in the UK and internationally) will enable the BGS to capitalise fully upon research opportunities that arise from category 1 work. We see a very large proportion of our Category 5 research being done in <i>collaboration</i> with HEIs.
<i>The Panel noted that some of the common-good opportunities are lost because of current government policy driving financial benefit from information.</i>	We note this comment, but it will be appreciated that the BGS information policy is driven by and in line with current UK Government policy. Sales and licensing of data and information is a particular OST priority.
<i>There is a need to ensure greater integration (e.g. interoperability of datasets) with the activities of other NERC Centres.</i>	We agree with this comment. The proposed programme aspires to do this. Interoperability of datasets, in particular, is predicated on all NERC centres giving priority and resources to ensure the effective management of their data and information. BGS has already demonstrated interoperability of BGS and CEH data.

THEME 1: 3D GEOSCIENCE FRAMEWORK OF THE UK ONSHORE LANDMASS	
Moderating Panel Grade: Alpha 5	
Moderating Panel comments	BGS Response

<i>Excellent, cutting edge Category 1 work, highlighting DGSM and Lithoframe.</i>	We welcome the Panel's endorsement and award of α5/5/V grades.
<i>Minor concerns on spatial resolution for national-scale work.</i>	We are not sure what this means. LithoFrame will cover the same spatial resolutions as DiGMap (10k, 50k, 250k <i>etc</i>), and both Gbase and HiRes will be at best spatial resolution possible for national coverage (comparable with the best in the world).
Some concerns regarding insufficient emphasis on temporal framework.	Understanding temporal variations in an integral part of defining the geology but the primary aim of the programme is to provide the 3D lithostratigraphical, geochemical, geophysical and physical properties framework of the onshore UK. This will be used by others (internally and externally) as the definitive 3D description of the geology (for planning, resources, etc) and as a 3D framework for modelling time-dependent (4D) processes. Airborne geophysics does provide for 4D (temporal) surveying.
<i>The panel notes the need to integrate onshore and offshore data effectively (c.f. theme 3).</i>	Agreed.
<i>In Gbase, limited range of geochemical variables – organics apparently excluded, but these could be critical pollutants.</i>	G-BASE is a baseline survey of the surface environment and as such is principally concerned with inorganic elements of which a large range of nearly 50 elements are routinely determined. In urban areas where the natural baseline has been most modified by anthropogenic activity there are additional concerns about organic chemicals. There is a huge range of organic chemicals that are of concern in the environment and it is not possible for a systematic survey the size of G-BASE to routinely collect and analyse for organic contaminants, particularly in view of the costs involved in doing organic analyses. To address the problem of organic contaminants in the context of the inorganic baseline, G-BASE has been involved in co-funded projects where the co-funder has stipulated what organic determinants are done and they have also paid for the analytical costs. Work with the Glasgow City Council (GCC) is an example of this. GCC paid for the additional analysis of a subset of drainage samples from the urban environment including, polychlorinated biphenyls (PCB), total petroleum hydrocarbons (TPH) and polyaromatic hydrocarbons (PAH). In the future G-BASE will use similar co-funded arrangements to pay for the determination of organic variables. Other projects in BGS are responsible for more site-specific geochemical investigations in which organic variables will be determined.
<i>Need to explore EO opportunities more fully.</i>	We recognise the role of satellite and airborne Earth Observation techniques and intend to make use of them wherever necessary.
<i>Critical issue is whether BGS can keep pace with technological/software developments; currently has done so, and often leader, but ability to maintain depends on funding level (applies to all other themes).</i>	Agreed, this is critical. Maintenance and continued development of the necessary software is included in Theme 2 and incorporated in capital plans.
<i>Very little Category 5, some concerns over quality and lack of integration with the main programme.</i>	The programme is primarily Category 1 and includes closely interdependent R&D necessary to keep the work at the leading edge. Work under Theme 1 underpins the entire BGS programme and will be as closely integrated with other themes as possible.

THEME 2: GEOENVIRONMENTAL INFORMATION

Moderating Panel Grade: Alpha 5

Moderating Panel comments	BGS Response
<i>Category 1, very strong cutting edge programme, logical direction, very effective use of data, knowledge transfer, strong user and public focus. Compelling responses to referees comments.</i>	We are pleased to read this endorsement of our information programme.
<i>Disappointment that science and society aspects of programme are passive rather than strategic.</i>	Our planned programme does contain a considerable enhancement of our Science in Society work and we also plan to develop a major proposal leading to a step-change in the communication of geoscience knowledge during the first year of this programme. (This will be put forward for consideration under a different Funding Category - 10).
<i>Some of the common-good opportunities are lost because of current government policy driving financial benefit from information.</i>	The Panel rightly recognises that BGS's approach to information dissemination is driven by and in line with current UK Government policy.
<i>Critical issue is whether BGS can keep pace with technological/software developments; currently has done so, and often leader, but ability to maintain depends on funding level (see also theme 1).</i>	We concur with the Panel's view that our ability to maintain the leading position we have in geoscience information systems and technology is dependent on maintaining and increasing the other recurrent (O/R) funding level.

THEME 3: 3D CHARACTERISATION OF THE COAST, CONTINENTAL SHELF AND MARGINS

Moderating Panel Grade: Alpha 4 mid

Moderating Panel comments	BGS Response
<i>Strong support for the estuarine, 'white ribbon' and coastal work (mostly a5), with strong economic and common-good benefit.</i>	We welcome the Panel's endorsement.
<i>The proposal states that partnerships will be needed to deliver the theme, but the panel feels that in some areas the proposal does not demonstrate sufficient partnership input and involvement – in terms of skills, volume of work, and required integration and further programme development – with respect to both universities and other research institutions (e.g. POL, SOC, UKHO...).</i>	This area of work has a very strong track record of developing partnerships for strategic survey and research activities, as recognised by the SMA (the Rockall, WFA and Passive Margins Modelling research consortia). These have been mainly with industry (because that is where the main source of additional funding has been) but universities and other research institutions have also been actively involved (see response to individual referees' comments). We recognise that even greater collaboration is needed to achieve the ambitious objectives of the proposal, and this is very much part of the strategy.
<i>Some of margins and shelf work</i>	The volume and range of work are indeed wide but the peer

<i>ranges down to a3. Concerns included limited strategic planning of work, unclear prioritisation of a vast volume and range of work, and feasibility (is 4D achievable?).</i>	reviewers recognised the importance of this aspect of the proposal. The concerns expressed above presumably reflect some of the comments provided by individual referees. We have tried to address these in the earlier ‘Management responses to referees comments’ to which SISB is referred. It is also worth noting that much of BGS’s marine work is responsive to available ship time. An increase in O/R will facilitate a more “planned” approach.
<i>Specific concerns over insufficient link between sand/gravel and habitat mapping, and over ecosystem-based approach to work.</i>	We are unsure what is meant by this comment, other than to say that understanding the links between sea-bed geology and ecosystems is an important part of habitat protection and should be integral to those parts of the programme. BGS is striving to develop strategic knowledge of <i>both</i> the sand/gravel resource <i>and</i> the associated ecosystems.
<i>But overall theme is timely and should have high national priority, given emerging national and international policy developments.</i>	We welcome the Panel’s endorsement.

THEME 4: SUSTAINABLE WATER MANAGEMENT	
Moderating Panel Grade: Alpha 4 mid	
Moderating Panel comments	BGS Response
<i>The theme is a strong fit to national priorities, driven by environmental legislation such as the Habitats Directive and Water Framework Directive (WFD). Catchment work building on existing activities is strong. BGS groundwater survey is a national need and strength. The WFD demands extension to water quality assessment; the panel stresses the need to undertake survey work and research in partnership with the EA and water companies.</i>	We are very pleased that the Panel recognises the high relevance to national priorities, and that BGS has a strong base of catchment-based studies. We will consult and seek the collaboration and active participation of the Environment Agency (EA) and Water Companies to provide Quality Assurance and Quality Control to groundwater quality and quantity monitoring. The expansion of groundwater data in the National Water Archive will provide an appropriate service to regulators, government and industry.
<i>If BGS is to extend groundwater work to interactions with surface waters, it must improve the apparently weak (despite co-location at Wallingford) relationship with CEH. The key field of recharge is not well explored in the proposal. More broadly across the theme, BGS should seek to enhance levels of collaboration with institute and academic partners, as some parts of the proposal suggest modest understanding of activities of potential partners.</i>	Current studies include interactions with surface waters working on LOCAR with Imperial College, Reading University and CEH. This will be expanded to include work with the EA, including studies of the hyporheic zone on both Chalk and Permo-Triassic Sandstone catchments. CEH has deferred submission of its water-related funding proposal until 2005, and this presents an opportunity for agreement on closer collaboration.
<i>BGS should ensure it considers carefully the wisdom of developing hydrologic/hydraulic models to market, given established industry standards (e.g. MODFLOW) and the</i>	With regard to the development of integrated modelling techniques and object-oriented approaches, BGS is already in discussion with DHI concerning the use of the ZOOMQ 3D model as an engine in their integrated models, and is involved in the EU project Harmon-IT. BGS has launched the current ZOOM family of models, held its

<i>existing modelling system SHETRAN. The panel notes that there would be significant costs of marketing, to overcome inertia in persuading customers to switch codes for (perhaps) marginal benefit.</i>	first training course and licensed the models to several organisations. BGS is aware of the commercial and cost issues, and believes the approach will have a significant impact on environmental modelling.
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THEME 5: SUSTAINABLE SOILS MANAGEMENT	
Moderating Panel Grade: Alpha 4 mid	
Moderating Panel comments	BGS Response
<i>The case and need for the Digital Regolith Model (DRM) is strong.</i>	We welcome the panel's recognition of the importance of this new theme, and the role that increased scientific understanding and derived information resource will have in helping, with others, the country to manage soils. The coverage of the whole country is required.
<i>But the rest of the proposal is scientifically very weak and unfocused, and should not be funded in its current form.</i>	We disagree that the proposal is weak and unfocused, but have always recognised that it can/will be improved through directed collaboration with others. The proposal was aimed at providing the case for, and defining methodologies, involved in the development of a Digital Regolith Model (DRM). We propose taking a wide view of the six functions of soils as defined in the emerging European Soils Framework Directive. Soil as a growing medium is only one function. To manage soils across all the functions requires the collation of a wide range of processes and associated parameters, many influenced by the regolith. We decided to propose quantification of a wide range of parameters rather than focusing on a limited number related to only one soil function. New data and knowledge is needed to build on existing information. Novel techniques (airborne and remote sensing of moisture, clay content <i>etc</i>) under development by BGS as part of a new survey regime will be used to monitor processes and parameters in time and space. We would point out that most indicative "research" under this Theme was always intended to be conducted with HEIs. A reduction in funding will therefore effect the ability of BGS to develop such partnerships (see below).
<i>However, the UK need for the sustainable soils management base to which the proposal broadly aspires is strong, and NERC should consider helping to build this base with the appropriate partners (e.g., BGS, CEH, MLURI, Cranfield and other universities). The panel feels that BGS would have a key role to play in such a partnership, particularly given the DRM, but that capacity building within BGS would be required.</i>	There are many other researchers involved in this topic area. The DRM will be designed to interface and link into a wide variety of existing process-orientated science, both within and outwith BGS through collaboration with Universities and other Institutes. This was made clear in both the proposal and in response to the initial reviewers comments. The whole proposal is based upon the concept of developing the DRM. Funds are required to approach collaborators to both perform directed and allied research. Previous approaches have withered because funding in this topic is weak and competition strong. Funds would enable barriers to cooperation to be tackled for the good of the country. We welcome the comment that BGS should be a key player and look forward to a wide and productive collaboration.

THEME 6: SUSTAINABLE AND SECURE ENERGY SUPPLIES AND MINERAL RESOURCES

Moderating Panel Grade: Alpha 4 high

Moderating Panel comments	BGS Response
<p><i>There is too much emphasis on coal/coal-bed-methane and insufficient on environmental impacts of offshore renewables, given likely UK needs and priorities.</i></p>	<p>Whilst offshore renewables are an extremely important part of the government's strategy it is also policy to encourage clean coal technologies (coal-bed methane and underground coal gasification fall within this remit). The environmental impacts of offshore renewables were not sufficiently emphasised in the proposal. This will, however, be an important aspect of the work programme.</p>
<p><i>BGS need to provide reassurance that they are aware of risk/legal issues surrounding transport and injection of CO2 from onshore to offshore, and are cogniscent of relevant European/international activities in CO2 sequestration.</i></p>	<p>We are puzzled by these comments. BGS has been extremely active in relation to both issues and will continue to be in the new programme. These activities were recognised by the SMA but space limitations precluded repetition of this information in the proposal. We have worked closely with DTI and DEFRA on regulatory issues and presented at a stakeholder workshop with OSPAR and London Convention national delegates. This resulted in a ministerial-level motion that is now being acted upon for OSPAR to address the legality of sub-sea storage (BGS will present at the next OSPAR meeting). We have been working with the EA on advising where existing regulation may apply to CO2 storage, and what regulatory gaps exist. This work has now been taken over by the DTI (who is leading for Europe) and the (US led) Carbon Sequestration Leadership Forum with respect to developing regulation internationally. DTI is in the process of commissioning BGS to 'horizon scan' monitoring and verification technologies for CO2 storage as part of this process. DTI has led Europe in getting underground storage recognised within the forthcoming European Emissions Trading Scheme and BGS has been closely involved in advising DTI and the EC on this issue. BGS has participated in DTI missions to N. America (Nov 02) and Australia (Feb 04) to learn about CO2 capture and storage R&D and policy in those countries. BGS has been involved in writing many of the DTI publications on Carbon Capture and Storage (CCS) and also assisted in providing submissions to the Energy Minister when the Energy White Paper was being written. BGS has led Europe on CCS since the early 1990s WRT to underground CO2 storage, starting with point source/geo-storage capacity mapping and DSS (now being emulated in Australia and Canada). We have also co-ordinated the European R&D in the Weyburn CO2 EOR monitoring project and the NASCENT project (which looked at natural CO2 accumulations in Europe as analogues for long term storage). BGS was a prime mover in setting up (and now leads) the European Network of Excellence on underground CO2 storage (CO2GeoNet), which has 13 partners (2 of which are UK universities- Heriot Watt and Imperial). The aim of this €9m project is to align and strengthen national R&D programmes on storage across Europe and promote EC R&D into the international realm. This is a highly strategic role for BGS. The NoE has just signed an agreement with the Canadians and we are now negotiating with the Japanese (RITE) to have formal collaboration. BGS is in final negotiations with the EC and several other partners regarding a Concerted Action (InCACo2), which seeks to gather information on non-EU CCS research in order to advise the EC. BGS supplies the only UK researcher as an author to the IPCC report on CCS. This report will form the basis for recognising CCS in the forthcoming Kyoto Phase 2 negotiation.</p>
<p><i>The panel supports the case for a UK</i></p>	<p>The Panel correctly notes most blue skies process-oriented</p>

<p><i>Minerals Centre of Excellence, but more detail is needed of how this would be established, and how this would link in to the existing expertise at BGS. As there is a lot of relevant process-based work undertaken in universities, the BGS should explore doing the process-based work in collaboration with the academic sector.</i></p>	<p>metallogenic research is undertaken at Universities. BGS and other bodies do engage in this area but to a relatively modest degree. BGS has a particularly important role to play in a whole range of applied minerals geoscience: for example construction and industrial minerals geoscience, development of mineral information systems, minerals and planning, strategic environmental assessment, lifecycle analyses of mineral commodities and mineral statistics and information. Other key actors in UK minerals include government, industry, planners, Mineral Industries Research Organisation, NGOs, social scientists, economists and geoscience consultancies. The vision of a UK Minerals Centre of Excellence is to set up a national body that brings together representatives of the main stakeholding groups with the aim of making decisions on how Research and Development Money is spent within the UK on minerals geoscience. The body would nurture and quality assess activities in this area and switch funding as national and science/strategic drivers required. BGS could act as the key organising body pulling the Centre together. BGS has the advantage of being an organisation well versed in strategic organisation, management and planning, with interest and expertise areas that span the full range of minerals geoscience. The Centre would probably take 12-18 months to set up and develop Terms of Reference and Modus Operandi. The value and impact of the Centre will, of course, be dependent on having an appropriate level of funding through this proposal.</p>
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<p>THEME 7: PHYSICAL, CHEMICAL AND BIOLOGICAL HAZARDS IN THE GEOSPHERE AND THEIR IMPACTS</p>	
<p>Moderating Panel Grade: Alpha 4 mid</p>	
<p>Moderating Panel comments</p>	<p>BGS Response</p>
<p><i>The panel broadly supported Category 1, although the overall resources are spread too thinly. Partnership development to be encouraged.</i></p>	<p>It is agreed that this Theme covers a lot of ground. Implementation of the proposal will undoubtedly benefit from working closely with others. Some relationships are already in place and we have good contacts with most of the UK researchers in the field. However, to develop these partnerships further will require funding, as most universities are little interested in collaboration that has no money attached.</p>
<p><i>Proposal light in areas of risk analysis, generation of maps well populated with credible probability data, and modelling. The proposal also lacked mention of temporal dimensions of monitoring hazardous situations. Area of biological hazards needs strengthening, by partnership and/or capacity building.</i></p>	<p>We disagree that the physical hazards part of the proposal is light on risk analysis as it specifically includes a project to examine this. It should be remembered that Geological Surveys are competent to assess hazard, but do not have all the skills to assess risk – this is why the risk analysis project is proposed. Modelling has been carried out as part of GeoSure (not part of the proposal) and will be expanded further in the future so the reference to modelling should be viewed in this context. We would agree that more specific reference should have been made to monitoring, and it is our intention to carry out more of this work if resources allow, although we did refer to 4D modelling (which is temporal) and to examining the effects of the impacts of climate change.</p>
<p><i>BGS strengths in volcanic hazards can be used to better design the hazards aspects of the theme. The proposal had weakness in terms of understanding the processes that create the hazards. Given that there is much relevant process-based</i></p>	<p>The comment about BGS work on volcanic hazards may reflect the particular knowledge of the monitoring panel of this topic. However, it appears that the panel was less familiar with what has been done and what is being proposed with regard to a wide range of hazards, which are driven by very different processes. We disagree with the panel's view on our understanding of processes – we already understand much about the processes driving the hazards, have</p>

<i>research undertaken in universities, the BGS should develop process-based research in collaboration with the academic sector.</i>	carried out high quality research on process recently (for example on Brickearth) relevant to Category 1 funding. We do intend to increase collaboration with universities in to cover a wider range of processes, subject to funding.
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THEME 8: MONITORING TECTONIC AND WHOLE-EARTH PROCESSES	
Moderating Panel Grade: Alpha 4 mid	
Moderating Panel comments	BGS Response
<i>Geomagnetic components of proposal very strong. Seismic monitoring data not being extensively analysed, but potential for collaborative analytical work is considerable.</i>	We are pleased with the rating awarded in this proposal. Much of our effort in seismology over many years has been put into building the UK seismic network and securing the funding needed to maintain it. Emphasis has been placed on service delivery, and the broad customer base that has been established and sustained for more than 15 years is a clear demonstration of success. The academic sector has not been neglected, and many university researchers, and PhD students, have benefited from data from the UK network (e.g. the universities of Bristol, Brunel, Cambridge, Durham, Leeds and Leicester). The Seismology component is strongly co-funded, and this external contribution may not have been appropriately emphasised.
<i>Decisions on upgrades to broadband of seismic sensors (which ones to upgrade, and when) should therefore be undertaken in discussion with stakeholders. The BGS should consider broadening the range of activities/methods to monitor the UK by geophysical methods e.g. INSAR, GPS network; there is a NERC facility (BIGF) which archives UK GPS data.</i>	We are surprised at the remarks on our plans to upgrade to broadband instrumentation. The need to upgrade to produce the quality of data required to advance the stated research objectives is clear, and our plans are consistent with the approach taken by other scientifically developed countries. The upgrade plans were discussed with stakeholders at the annual meeting held in May 2004, and supported by them. We have assisted the universities of Leeds and Bristol in a short-term deployment of broadband instruments.
<i>Lack of any significant demonstration of research activity (with regard to seismics), despite clear potential for such and recognised expertise within the organisation.</i>	In the areas of seismic hazard and historical seismology BGS has, over many years, maintained what we believe to be a creditable rate of publications in peer-reviewed journals, together with production of many major Commissioned Research reports. However, we acknowledge that the number of scientific publications by BGS staff, based on UK data, has been modest, although the scientific quality of the many Commissioned Research reports produced should not be overlooked. We aim to increase the research component in seismology in the new programme. This is not from a standing start; in the last few years the complement of young seismologists in BGS has grown, and this is beginning to pay dividends.

Appendix 5: Outline Programme 2006/07

Two-page summaries of all BGS programmes are submitted to the BGS Board at the start of each year. The MCH Programme Overview for FY 2006/07 is as follows.

Science budget

Several cruises were undertaken in 2005/06 and the results of these cruises will be written up in papers and developed into new map products. Work will continue to integrate Keyworth and Edinburgh methodologies. Following the white ribbon methodology study plans will be implemented to test procedures in the coastal zone in key areas of open coast and estuaries. In 2006 data will be collected on the Hatton Margin and adjacent areas. Cost-effective coastal and marine surveying in conjunction with the DTI SEAs programme, JNCC and with the Marine Institute is planned. Proposals to purchase a shallow water multibeam system and upgrade or replace the existing coastal boat will be submitted to allow for cost-effective nearshore mapping. Results will feed into the new sea-bed character, bedform and Quaternary maps and models. Estuaries work will focus on further work in the Thames and Clyde (geochemical mapping & modelling). Research into the Indian Ocean tsunami, in conjunction with National Oceanographic Centre Southampton and BGR will continue. A continuing theme will be to develop an integrated national mapping programme with other marine organisations. Much of the hydrocarbons and deep geology programme is co-funded (see below), and further research will focus on understanding the timing, styles and mechanisms of post-break-up compressional deformation on the Atlantic Margin. A new study to evaluate data from archived fields in the North Sea will begin. Work will continue on basement terrane to the west of Britain work with NIGL.

Co-funded enhancements (including NERC Thematic and EU research projects)

BGS will continue as designated leader of the ECORD European Science Operator, with EU funding channelled through NERC, IMI and ECORD. Co-funding contributions also significantly enhance the rest of the SB allocation. The Rockall Consortium (14 years) continues and will support the completion of the Rockall regional report. The co-funded projects to produce a new regional report for the Faroe-Shetland Basin (in conjunction with the Faroes Geological Survey) and an atlas of the Southern Permian Basin (in conjunction with TNO, BGR, GEUS, GSB and the Polish Geological Institute) will continue. In addition to industry co-funding, the MCHP will be supported through the MESH Interreg project that includes BGS participation in a geohabitats project in the Hebrides and Irish seas. MCHP also provides the science coordinator for the NERC Ocean Margins LINK project and the NERC-funded UK IODP co-ordinator.

Fully-funded commissions (UK and world-wide)

Commissioned research (CR) is undertaken on behalf of UK central government, overseas governments and the international aid agencies as well as individual commercial companies. CR and co-funded income represents over 50% of the total offshore budget. In 2006/07, the MCHP has a range of major commercial projects including the DTI Geological Advice project, Falkland Island Government oil exploration and EEZ assessment, and 3D potential field modelling in the Faroes area (SINDRI). Additional work includes the DTI SEAs projects and a range of research in coastal settings (sediment transport, erosion etc) and petroleum geology and environmental work for the oil industry (Middle East, North Sea and Atlantic Margin).

Summary of deliverables (SB and co-funded projects)

Project Code & Title	Deliverables
SB. E2024S73 MCHP Science Management Project	Ensuring programme delivery Promoting and representing BGS Developing science programme Developing MCHP web profile Landmark software/hardware maintenance/ installation
SB. E2028S73 Margins 3D Geoscience Project	Submit paper & edit compressional deformation volume Development of regional 3D potential field modelling Undertake and analyse results from Charles Darwin cruise Complete UK Variscan and Caledonian unconformity maps Initiate study on NHDA data from the Hutton Field Finalise results of basement terranes study Continue supervision of PhD student (passive margin tectonics)
SB. E2027S73 Marine & Coastal Mapping	Completion of sea-bed classification Produce first maps in sea-bed & bedform series with UKHO Assess OLEX data as source of sea-bed geological information Run GeoHab conference in Edinburgh Summer Isles: new onshore-offshore map and publication Complete Mersey estuary legacy report Extend Thames and Clyde estuary modelling studies Trial surveys “white ribbon” open coast on eastern England Coastal & marine GIS will be linked to the GDI Continue supervision of PhD students
Tsunami Hazards (E2201S73)	Prepare publications from results of 2005/06 expeditions
Co-funded P9179 ECORD ERANET	Support Integrated Ocean Drilling Programme Continue outreach and publicity campaign for ECORD
Co-funded. E2026S73 Rockall	Rockall Basin Offshore Regional Report at publication stage
Co-funded. E2163F73 Southern Permian Basin Atlas	Continue chapter writing for new atlas Continue population of project GIS
Co-funded E1784F73 Faroe-Shetland Basin report	Completion of chapter writing Completion of project GIS
Co-funded E1698F73 MESH (habitat mapping)	Integrating BGS seismic with multibeam - Irish & UK waters Creation of sediment maps based on EUNIS classifications Create a trans-border deep water habitat map in Rockall area Contribution to Northern Ireland marine habitat mapping study

Appendix 6: Summary of projects active since April 2005

Client (or funding source)	Project code	Title - description	Project Leader	Approximate total contract value	Project start date	Project end date
NERC	E1013N73	Ocean Margins Link Project coordinator	Alick Leslie	£200,000	01-Apr-00	31-Dec-06
EU	E1022F73	OMARC - Ocean Margin Deep Water Research Consortium	Dan Evans	£201,000	01-Feb-03	31-Jan-06
EU	E1063R73	PROMESS – scientific drilling in the Mediterranean	Ali Skinner	£100,000	01-Jul-02	31-Mar-06
CEFAS	E1125R85	Sea-bed Mapping Techniques	C James	£20,000	25-Sep-01	30-Jun-05
Univ East Anglia	E1127R85	Integrated Coastal Simulator	S Pearson	£165,000	01-Aug-02	31-May-05
DTI	E1149R73	Petroleum Geology Geological Advice	Don Cameron	£1,760,000	01-Apr-03	31-Mar-06
Falkland Island Gov	E1152R73	Petroleum Geology Advice and management	Phil Richards	£675,000	01-Apr-03	31-Mar-06
Rockall Consortium	E1154R73	Rockall area geoscience research	Ken Hitchen	£6,600,000	01-Jan-92	31-Dec-07
Saudi Aramco	E1370R76	Petrology and biostratigraphy	G Lott	£140,000	01-Apr-03	31-May-05
WFA Consortium	E1527R73	Western Frontiers Association – geohazards on the Atlantic Margin	Dave Long	£60,000	01-Apr-05	01-Mar-06
Defence Science & Tech Lab	E1539R85	Corrosion of depleted Uranium	A Milodowski	£90,000	01-Oct-03	30-Apr-05
MIRO	E1541R85	Bristol Channel Habitat Study	Ceri James	£530,000	01-Jul-03	31-Mar-06
Faroe Petroleum	E1602R73/ E2319R73	Analyses of blocks prior to licensing for hydrocarbon exploration	D Ritchie/H Johnson	£300,000	01-Feb-04	31-Mar-07
ECORD	E1674R73	Arctic Drilling	D Evans	£6,625,000	01-Jan-04	31-Mar-06
GEUS	E1677R73	Rock drilling offshore Faroes	D Smith	£110,000	01-May-04	31-Mar-06
Reslab-PDO	E1684R76	Palynology	Mike Stephenson	£140,000	03-Apr-04	31-Mar-06
Dept of Environ Food & Rural Affairs	E1690R85	Intertidal Characterisation	M Harrison	£40,000	01-May-04	31-Aug-05
MBA	E1694R85	Estrogens in estuarine sediments	C Vane	£45,000	01-Jun-04	31-Mar-07
EU Interreg	E1698F73	MESH- marine habitat study	Dave Long	£70,000	01-Apr-04	31-Mar-07
Irish Shelf petroleum	E1701R73	Regional 3D potential field modelling	Geoff Kimbell	£80,000	01-Jun-04	31-Aug-05
Geotek-DTI	E1702R73	SEA 6 marine environment study	Tappin/Holmes	£55,000	01-May-04	01-Jun-05
NERC	E1713N36	UK IODP – UK co-ordinator	Heather Stewart	£670,000	01-Oct-03	30-Sep-08
IODP- Management Int (IMI)	E1744R73	ECORD ESO Tahiti Science Operating Costs	Dan Evans	£890,000	01-Oct-04	31-Mar-06
CNRS-INSU	E1745R73	ECORD ESO Tahiti Platform Operating Costs	Dan Evans	£3,910,000	01-Oct-04	30-Sep-05
EMU Limited	E1747R85	Marine Biodiversity &	C James	£30,000	01-Jul-04	30-Jun-05

		Aggregates study				
CEFAS	E1758R85	East English Channel Habitats study	Ceri James	£1,050,000	01-Sep-04	31-Mar-07
ExxonMobil	E1765R76	Palynology training	J Riding	£10,000	10-Oct-04	31-Mar-06
UKAEA	E1772R85	Dounreay sea-bed sediment movement	D Long	£75,000	01-Oct-04	31-Jul-05
Consortium	E1784F73	Faroe-Shetland Basin regional report	D Ritchie	£100,000	01-Jan-05	31-Mar-07
CROWN ESTATE	E1803R85	Marine Aggregate Prospecting	C James	£17,000	01-Jan-05	30-Jul-05
Univ of Southampton	E1810R73	Hatton-Rockall Basin study for Law of the Sea	K Hitchen	£10,000	01-Apr-04	31-Mar-07
Saudi Aramco	E1811R76	Petrology and biostratigraphy	G Lott	£70,000	01-Feb-05	31-May-05
Univ of Wales	E1821R85	Shell Chemistry in the North Sea	S Chenery	£20,000	01-Feb-05	31-May-05
Seacore	E1833R73	Antarctic drilling operation	A Skinner	£40,000	01-Apr-05	01-Dec-06
Museum of London	E2139R73	Severn Estuary review of information	G Jenkins	£5,000	01-Apr-05	30-Sep-05
JKX	E2157R73	Biostratigraphy	S Molyneux	£5,000	11-Apr-05	30-Jun-05
NERC	E2160N73	Montserrat vibracoring	A Skinner	£80,000	01-Apr-05	31-Mar-06
UKAEA	E2161R73	Dunnet Bay Beach Assessment	S Pearson	£16,000	01-Apr-05	31-Mar-06
TNO	E2163F73	Southern Permian Basin Atlas	G Lott	£110,000	01-Apr-05	31-Dec-09
Standley Dr RC	E2174R73	potential field study-hydrocarbon exploration	P Williamson	£11,000	09-May-05	30-Jun-05
Haskoning UK Ltd	E2180R73	Cohesive Shore Platforms erosion	P Balson	£30,000	09-Jun-05	30-Apr-07
SINDRI-GEUS	E2188R73	Faroes Geochemistry: hydrocarbon analyses	C Vane	£30,000	01-May-05	31-Mar-06
SINDRI-GEUS	E2197R73	Faroes potential field modelling	G Kimbell	£90,000	01-Apr-05	17-Apr-06
IFM-GEOMAR	E2200R73	Costa Rica drilling	A Skinner	£100,000	01-Jul-05	31-Mar-06
UKAEA	E2205R73	Dounreay Beach Trials of equipment	D Jones	£30,000	01-Aug-05	31-Mar-06
JNCC	E2207R73	Simplified Sea-bed Sediments map of UKCS	D Long	£7,000	01-Aug-05	31-Mar-06
EXXON	E2220R73	Qatar ExxonMobil Palynology	D Stevenson	£12,000	01-Aug-05	31-Mar-06
Connaught Energy Ltd	E2229R73	Geological study – hydrocarbon exploration	D Evans	£7,700	01-Aug-05	31-Mar-06
IMI	E2235R73	New Jersey science operating costs 06	D Evans	£1,700,000	01-Oct-05	30-Sep-06
Chevron Texaco	E2237R73	Environmental Data GIS in Faroe-Shetland Basin	D Long	£120,000	01-Aug-05	31-Mar-07
TOTAL E & P UK PLC	E2259R73	Pipeline route study	D Long	£20,000	01-Nov-05	31-Mar-06
GUCPO	E2270R73	Palynology Training	J Riding	£4,000	01-Dec-05	31-Mar-06
EVANS DR CDR	E2278R73	Sand Banks & River Channels study	C James	£9,000	01-Dec-05	31-Mar-07
EU (via NERC)	P9179	ECORD ERANET – IODP support	A Kingdon/ C Cotterill	£250,000	01-Dec-03	01-Dec-07
DTI	E2310R73	Channel migration in wind power sites	P Balson	£40,000	01-Mar-06	31-Dec-06
HSE	E2307R73	3D for site investigation	J Bulat	£10,000	01-Feb-06	01-May-06
GeoTek-DTI	E2292R73	SEA 7 environmental geology	R Holmes	£30,000	1-Oct-06	30-Sep-06
IMI	E2366R73	Science operating costs, New Jersey 07	D Evans	£1,500,000	1-Oct-06	30-Sep-06

CNRS-INSU	E2367R73	Platform Operating Costs, New Jersey 07	D Evans	£4,500,000	1-Oct-06	30-Sep-06
Occidental	E2328R73	Palynology Oman	D M Stephenson	£100,000	1-Apr-06	31-Dec-06
GeoTek-DTI	E2326R73	SEA 8 environmental geology	C James/ R Holmes	£15,000	20-Jan-06	30-Mar-06
ABPMer	E2364R73	Coastal study of power station sites	P Balson	£10,000	01-Jun-06	31-Jul-06
	E2406R73	Pipeline study in Irish Sea	D Long	£9,000	01-Aug-06	01-Oct-06
Shell	E2387R73	Potential field Modelling	G Kimbell	£38000	1-Sep-06	30-Sep-07
Indago	E2393R73	Well site palaeontology	S Molyneux	£30,000	31-Oct-06	30-Apr-07
JNCC	E2394R73	Cruise planning	D Long	£30,000	0-Aug-06	31-Oct-06
UKAEA	E2381R73	Study of groynes and trenches	S Pearson	£3,000	01-Jun-06	31-Jul-06
Neftex	E2395R73	Stratigraphic consultancy	M Stephenson	£14,000	01-Aug-06	30-Dec-07

Appendix 7: Results of SWOT analysis

A SWOT analysis was carried out at the second meeting of the PDG. A summary of the key points is given below. Duplicate comments have been merged and the results have been grouped together under staff, science and operational, business and data issues. Typically many of the threats are also opportunities and many of the strengths have a resulting impact on weaknesses.

STRENGTHS

Staff: Experienced staff with a wide range of scientific and management skills and interests, giving a flexible work force. Within BGS there is large pool of additional skills to call on for specialist and interdisciplinary studies. Good networking and awareness with excellent representation on marine and petroleum geological committees. Overall there is a team of dedicated staff with exceptional expertise covering global, regional and local studies.

Science and Operational issues: There is a large breadth of activity offshore supported by well-founded facilities and technology. There are experienced scientists in various aspects of petroleum geoscience, marine geology, and coastal geoscience, with a focus on marine resources, marine geohazards and geology of marine habitats. BGS is recognised as a leader in regional aspects of the geology of the UKCS. The operations capability is reflected in the award of the ESO contract.

Business Issues: The MCHP epitomises the combined funding model that provides good value for money for NERC and the stakeholder community. There is strong SB/CR leverage, within a long-term strategy with short-term flexibility. The Programme is based on a sound financial position with a good track record in external funding. This model ensures that the core science programme is relevant to users with excellent synergy between core and commissioned research. Key strengths of the programme are the overall neutrality, impartiality and continuity, with a strong brand and a good track record. BGS is seen as geoscience leaders and often a catalyst for action and understanding. The MCHP is market focused, with good industry linkage, many customers, and experienced at working with other organisations.

Data Issues: BGS has a large and unique set of data holdings (although aging data sets), which are, maintained for the long term, with well-organised data management procedures. There is expertise in 3D, GIS, web, data management. BGS is working towards DAC (Data Archive Centre) status.

WEAKNESSES

Staff: Key expertise is often retained by just one person making succession planning difficult, with human resource spread too thinly – e.g. no top class coastal geoscientist in Edinburgh. There is a significant gap between the older very experienced staff and the newer recruits who have yet to establish their research standing through publications. The scientific staff need to ensure that they are learning and developing from the wealth of international published research.

Science and Operational issues: (i) Although there is now only one programme within BGS with a marine operational role, the OR budget is insufficient to cover the high-cost of marine surveys, and there is therefore limited use of the operational capability. The lack of modern technology (e.g. multibeam) and the lack of investment in modern high-resolution shallow-water seismic equipment is a hindrance in mounting cost-effective operations. (ii) In recent years there has been a focus on the geology of marine habitats and geohazards at the expense of other aspects of marine geology, such as aggregates, renewable energy developments and research into gas hydrates.

Business Issues: MCHP is a small part of a mainly land-based operation and BGS is not always seen as a national/ international marine science organisation. The marine and coastal programme has to work closely with other marine organisations and develop closer relations with key players, including governments, universities and other parts of NERC. Care must be taken to balance science drivers with UK policy needs, and there is a need for greater policy contribution. There is a risk of potential objectives not being met through undertaking too much with limited science budget resources, taking on too many small commitments and the need to balance commercial priorities versus science. Close links need to be developed between BGS and the national and devolved administrations

Data Issues: Much of the regional survey data is aging and gaining access to modern data from other organisations is not straightforward with complex relationships between organisations operating in the marine environment. There are complex licensing issues for BGS data

OPPORTUNITIES

Staff: MCHP should continue to develop links with universities through increasing use of UCAC.

Business Issues: BGS should continue to take the lead on an integrated national sea-bed programme, where geological information provides the overall framework, particularly for marine spatial planning. Greater university collaboration, for example, in the coastal area is important. There are opportunities to work closely with marine science issues, such as UKMMS, marine spatial planning and public/commercial agendas with UK and devolved administrations. The 7th Framework is a key opportunity, where BGS is well-placed to take a lead in European marine geological research.

Data issues: BGS has unique collection of data (geological) for the UKCS. This can be built on as a significant asset, as long as licensing issues are resolved. There are opportunities to extend the user community for marine science and data and increase the range of data and information products, particularly by integrating products with policy.

Science and operational issues: BGS has a niche position in UKCS geology with excellent opportunities to develop offshore-onshore links (e.g. climate change, source to sink) and 3D/4D geoscience applications and models. The increasing range of marine activities, including conservation, exploitation of resources and marine renewables presents new scientific opportunities, with multi-disciplinary overlap with the research requirements of other sectors. The availability of NERC ship-time should be considered on a global basis. There are new opportunities in the mature areas of the North Sea as decline in production grows and emphasis falls on redevelopment, satellite and small prospects. New technologies, including survey, processing and visualisation techniques provide additional opportunities.

THREATS

Staff: Loss of key staff through retirement (demographics).

Business issues: The MCHP is relatively highly-g geared with commissioned research, and further reduction in SB funding, possibly associated with a NERC move away from strategic science towards blue skies research, is a threat to the viability of the programme. Better co-ordination amongst the UK marine science community and strategic developments, particularly in universities in Scotland, means that more links with universities and other marine organisations are required to reduce competitive threats to funding/excellence.

Data issues: Marine and petroleum data are expensive to collect and for much data, BGS is not the sole collector and there is a need to work closely with other organisations, such as government departments, research centres and agencies, universities and industry. Innovative approaches to IPR, data licensing, data sharing and joint products will be required to develop the best geological products. There are threats from other marine organisations expanding to develop

geological expertise. Information is needed by government in real time (or for timely decisions), and as BGS, a research based institution, is one step back from the decision making process, BGS data may not be used and may become not relevant. A strong programme of effectively managing old data is required to avoid future data distribution and archiving problems.

Science and Operational issues: Some of the MCHP key research is underpinned by external funding, and care must be taken to continually ensure that projects, such as the Rockall Consortium remain focussed, relevant and continue to produce good science. With a large programme and many projects, there is potential for overstretch and non-delivery. There is also potential for a loss of position at the leading edge of marine science if resources are cut. Expertise is a niche market, and although BGS is well known in some areas, some key agencies are not aware of the level of “marine” skills, especially in the coastal, habitats and real time areas. This is particularly important now, as Government is required to take an ecosystem approach.

Appendix 8: Marine, Coastal & Hydrocarbons

Note: Some confidential reports are not included in this list

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