Institution: University of Leicester

Unit of assessment: 7 - Earth Systems and Environmental Sciences

a. Overview

The Department of Geology has a strong commitment to research as exemplified by its level of outputs, impact, international collaboration, and research income. Innovative, curiosity-driven and multi-disciplinary research within the field of Earth Systems and Environmental Science is strongly encouraged and supported. Currently, research is organised in three groups, which act as foci for aligned research projects, and where science topics and underlying methodology are integrated. These groups are:

Palaeobiology, Palaeoenvironments & Palaeoclimates Research Group (Palaeo3): Davies, Gabbott, Harvey*, Kender*, Leng, Purnell, Siveter, Williams, Zalasiewicz and Unwin (Museum Studies)

Crustal Processes Research Group (CPRG): Barry, Branney, Holwell*, Jenkin, Parrish, Saunders, Smith*, Walker*

Geophysics, Rock Physics & Borehole Research Group (GRBRG): Davies, England, Fishwick, Lovell, Moorkamp*, Vinciguerra, Walker* (*****ECR)

b. Research strategy

Overview Our overarching strategy is to stimulate, facilitate and encourage the very highest quality research, driven by researchers' intellectual curiosity, informed by external drivers. The strategy is underpinned by 5 key goals: **(i)** to recruit and retain outstanding researchers; **(ii)** to encourage the pursuit of rigorous, well-designed research programmes through winning funding and the timely and effective reporting of outcomes in recognised peer-reviewed channels; **(iii)** to encourage researchers to take advantage of opportunities and external developments, including external funding agency strategies, RCUK priorities, and issues of concern and benefit to research users and society; **(iv)** to engage with audiences beyond academia; **(v)** to contribute to wider scientific debate and the research base, through participation and leadership in research councils, learned societies, professional bodies. All this is supported by the tools and resources, staff and infrastructure, required to maintain world-class research programmes.

Each Research Group includes early career researchers (* above), and is led by a professor (**Purnell, Saunders**, **England**). Our strategy of maintaining groups as organisational units also allows efficient and effective administration, and rapid responses to external opportunities. Groups evolve in response to external drivers, and the research interests and directions of individuals, department, college and university (e.g. broadening of the Palaeo3 group reflecting the strength of our palaeoclimate/palaeoenvironment research, new appointments and significant new RCUK funding complementing existing strength in palaeobiology. Also, the Geophysics, Rock Physics & Borehole Research Group reflects new appointments, improving integration across the group, increasing our expertise and activity, and enhancing links with BGS Rock Physics).

Comparison with previous position The 2008 panel noted that having 3 research groups was 'well-suited' to the size of the department, and our plan has been to maintain, reinvigorate and strengthen each of them. We have appointed new staff to all three (**Harvey**, **Kender** & **Leng** to Palaeo3; **Moorkamp** & **Vinciguerra** to GRBRG; **Barry**, **Holwell** & **Smith** to CPRG; **Walker** at the interface of GRBRG & CPRG). These groups ensure core research activities have critical mass to maintain strength and depth, but provide flexibility to develop new directions. The panel also commented that the NERC SEIS-UK contract and links to BGS (at that time particularly the NERC Isotopes Geoscience Laboratory) were particularly important for maintaining a high quality environment. Our strategy has been to strengthen these links, through the appointment of **Leng** to salaried professor of Isotope Geosciences (also Head of NIGL Stable Isotopes; in addition to Parrish - salaried professor, and NIGL Director), and the appointment of **Vinciguerra** (Reader at UoL; Head of Rock Physics at BGS). We continue to provide the SEIS-UK geophysical facility (see section d).

Overall our success in achieving our 2008 plans is evident from our outputs, impact, and activities. Compared to the position described in REF 2008 we have doubled the number of peer reviewed research papers, increased the number of staff returned, increased research income, increased

PhD student numbers, and invested in significant new infrastructure. We continue to publish in journals of the highest scientific impact, and we increased external recognition of our research quality (Faculty of 1000 “very good” paper, NERC Annual Report highlight (x2) and ‘top NERC achievement’, 2 x Shortlisting for Times Higher Research Project of the Year). Our research also secured significant public engagement, being featured in BAFTA winning documentary ‘Flying Monsters”, at major public engagement events (details in Impact Case studies), and attracting significant international media coverage (inc. live and recorded pieces for national TV and radio (inc. Today Programme)).

Briefly summarising our position by research group:

- ***Palaeobiology, Palaeoenvironments & Palaeoclimates Group*** (ca. 285 peer reviewed papers): All of our 2008 plans were achieved; investigations of fossils as indices of palaeo-oceanographic conditions and climate change broadened from original plans, resulting in a book and highly-cited concept-shaping papers on the Anthropocene.
- ***Crustal Processes Group*** (ca. 115 peer reviewed papers): 2008 plans were achieved, except those to develop LiDAR for tectonic analysis (ended by the departure of Cunningham). We have developed vibrant and innovative physical volcanology research (NERC and multimillion $ US funding) with a focus on the mechanisms and processes of ejecta emplacement during large explosive eruptions.
- ***Geophysics, Rock Physics and Borehole Research Group*** (ca. 80 peer reviewed papers): Plans were achieved. Our continued leading role in the Integrated Ocean Drilling Project resulted in >£3 million in research income during the REF period.

Since RAE2008 we have moved from a Faculty to a College base, encouraging and facilitating interdisciplinary science, shared resources, infrastructure, and collaboration internally and with external partners. In RAE2008 we stated our primary driver for research direction as the intellectual curiosity of academic staff members; this remains our central ethos for enabling research.

Future Strategy Our strategic vision is to maintain and develop our three research groups; to review the balance of activities to ensure quality time to undertake research; to build collaborations, especially with BGS, but also across the College and University, and with external organisations including industry. We see the development of consortia and of regional teams (exemplified by recent awards of NERC DTP to CENTA consortium, and NERC thematic catalyst grant) as increasingly important, including across Europe and worldwide.

Our strategy informs and is informed by the College of Science and Engineering (CSE) Research Strategy. Lines of communication are clear, with the Chair (**Purnell**) of the Research Strategy Committee (RSC) sitting on the Department’s weekly management committee, the CSE Research Committee, and the University Research Policy Committee. The RSC is the main focus for planning and overseeing the unit’s research, and we review our strategy annually. RSC oversees PGR student recruitment and training; manages PhD project proposal process, selection, and advertising; monitors development of new funding applications and works with investigators to maximise application quality/ensure high success rates; advises applicants, provides feedback, and shares best practice; develops study leave goals; maintains overview and reviews research base (equipment, facilities, staff and students); identifies new opportunities (to maintain and enhance infrastructure); coordinates bids for funds. Our research informs our teaching, and Mgeol research projects enable proof of concept research and projects leading to high quality publications. The University’s Research Support Office and the Enterprise and Business Development Office, both with dedicated professionals, support research, including research with commercial partners. New personnel and funding at University and College level have enhanced activity in this area since RAE2008.

Examples (far from exhaustive listing) of specific research goals beyond the REF period include:

Palaeobiology, Palaeoenvironments and Palaeoclimates

- Continue innovative studies of decay, preservation, evolution and palaeobiology, especially of exceptionally preserved Palaeozoic organisms.
- Continue to develop tooth wear and microtextural analysis of diet, studies of pterosaur palaeobiology, and integrated sedimentological and geochemical testing of hypotheses linking

environmental change and major macroecological/evolutionary transitions.
- Investigations of fossils and their isotope chemistry as indices of global environmental, climatic, and palaeo-oceanographic change, including major changes linked to melting of the polar ice caps since the last glaciation, and development of Anthropocene perspectives.

Crustal Processes Research Group
- Continue to develop models of the physical processes of large explosive volcanic eruptions and impact-related events.
- Develop methods of rock and mineral analysis, with particular emphasis on trace element analysis, and U-Th-Pb geochronology applied to temporal calibration of major geological events, processes of erosion, exhumation, tectonics, and related climate change.
- Advance the understanding of the geological processes that generate mineral deposits, and develop efficient exploration targeting, including models of volatile element and sulphur transfer from mantle to crust in magmatic and hydrothermal systems.

Geophysics, Rock physics and Borehole Research Group
- Apply our core expertise in seismic, electromagnetic and potential field methods to develop integrated studies of continental crust and lithospheric mantle, focusing on processes driving surface elevation change, fluid circulation, subduction processes, and resource exploration.
- Develop new research directions in experimental rock physics to investigate the properties of geological materials and better understand processes, including microseismic and electrical resistivity imaging of rock deformation.
- Continue to develop innovative approaches, combining sedimentology and petrophysics, for studying conventional and unconventional hydrocarbon resources.

Aspects of our future plans link across groups: continued leading roles in IODP and ICDP, for example, will feed into both GRB and Palaeo3; rock physics and other aspects of our geophysical research link into projects within CPRG, such as integrating petrophysical and seismological analysis with field and petrological investigation to study igneous sill emplacement.

c. People:

Staffing strategy and staff development Our staffing strategy aims to maximise delivery of our research priorities without compromising our ability to deliver research-led teaching. We support and develop research groups by appointing the best people and providing a research culture and environment that allows researchers to flourish, develop their careers, and progress, with success awarded appropriately. We carefully balance the need to innovate and evolve against maintenance of core strengths and critical mass. This maximises our ability to attract staff of the highest calibre and ensures high retention rates of highly motivated researchers, allowing us both to develop the skills of staff recruited as ECR *and* attract senior academics from outside. All staff are consulted on staffing strategy. During the REF period five academic staff retired or moved (Aldridge, Cunningham, Hill, Jeffrey, Petterson). We successfully replaced each of these, but strategically decided against a simple like-for-like replacement, and consequently increased the number of staff engaged in excellent research producing high quality outputs, while boosting the vigour of all three research groups. New appointments to Palaeo3 group (**Harvey**, **Kender**, both ECR; **Leng**, Professor) further enhance our strengths in exceptional preservation, arthropod palaeobiology, and isotopes and palaeoclimates. The GRBRG group benefits from **Moorkamp** (ECR) with expertise in joint inversion further developing our numerical geoscience base, and **Vinciguerra** (Reader) whose interests are at the interface of petrophysics, rock mechanics, seismotectonics and volcano seismology. We made three appointments to the CPR group (**Holwell**, **Smith**, **Walker**; all ECR). **Smith** and **Holwell** reinforce our expertise in metaliferous deposits; both align strongly with industry and NERC's strategic minerals programme (Security of Supply of Mineral Resources). **Walker**'s research focuses on the dynamics, mechanics, kinematics and geometry of fault zones and links strongly to Vinciguerra. **Barry** (NERC Research Fellow) is developing our numerical/geochemistry research in collaboration with mathematicians at Leicester.

All our researchers benefit from Staff Development activities, key to the University's strategy for delivering research excellence and supporting staff. Procedures for identifying personal, professional and career development needs include Annual Appraisal, and for newly appointed staff a formal mentoring and probation scheme. Mentors are senior staff (typically professors) with

an established track record in research but whose expertise lies outside the mentee's research group (members of which also provide informal mentoring); mentoring also provides an effective means of exposing junior staff to best practice in research, grant writing and publication. Annual Appraisal, conducted by senior staff (with head of department maintaining a unit-wide overview) considers individuals' research activities and plans in the context of their wider commitments, a strategy to ensure that a balance is maintained and that no staff (ECR in particular) are loaded with teaching and administrative duties to the detriment of research time. In addition we have a cross-college mentoring scheme for academic staff career development, involving a more senior academic in another department. The University supports an Academic Study Leave system, with staff eligible for one semester of study leave every seventh semester. This system has been successfully deployed since 2008, enhancing outputs and allowing staff (e.g. Gabbott, Davies) to develop collaborations and major successful NERC grant applications during periods of leave.

Statistics since 2008 indicate our staff development strategy is successful, with 4 successful promotions to personal chair (**Davies**, **England**, **Purnell**, **Williams; Purnell** and **Williams** previously promoted to Reader), and 5 promotions to Senior Lecturer (**Branney**, **Fishwick**, **Gabbott**, **Jenkin**, **Zalasiewicz**).

Research is indirectly supported by Teaching Fellows who contribute by reducing teaching demands on researchers. Research assistant numbers have increased, with 19 employed since 2008. As with all staff, the professional and career development and training needs of research assistants are identified through appraisal and a structured probation scheme and mentoring, in accord with the Concordat to Support the Career Development of Researchers. Research assistants are represented on the Research Committee. Evidence of our success in this area is that since 2008 several research assistants have received merit awards, and 5 have successfully moved on to fellowships, research positions and permanent positions in academia and industry.

International staff appointments and visitors confirm that we operate at an international level. Advertised positions attract strong applicants including many non-UK academics, with **Moorkamp** and **Vinciguerra** appointed from overseas. Of three academic staff who moved on from Leicester since 2008, two moved to positions outside the UK. Visiting scholars who have taken extended research visits with us include Coe, Hughes, Rogers - USA.; Hou, Jiang, Lü, Zhang - China; Ozdemir-Atakul - Turkey; Keays - Australia; Storey - Denmark; Heincke - Germany; Maupin - Norway. All three research groups have received visitors.

Support of equalities and diversity is integral, and our Equal Opportunities Officer supports the Head of Department in ensuring all activities take due regard to equalities legislation and encourage best practice. The University has embraced Athena SWAN, and the department will shortly apply for recognition in improving gender equality; our staff participate in equalities committees at higher levels. Progress in this area since 2008 is evident from our staff profile: in 2008 there were no female senior researchers in the department; at present there are 2 professors and a senior lecturer.

ii. Research students

Research students are a vital and fundamental part of our vibrant research community. The University Graduate School is at the heart of this community and oversees implementation of regulations and procedures, and provides advice and guidance to staff and students.

The primary driver of recruitment is student quality. Selection of students is based on a robust process, comparable to appointment of staff, which takes place within the department. This involves shortlisting of all applicants to all projects followed by interview and ranking. Only highest ranked students are selected. Overall this results in an even distribution across research groups. Since 2008 we have expanded the number of PhD students, averaging 36.5 registered FTEs for each year of REF. 31% are international (China, Mexico, Iraq, France, Germany, Belgium, Pakistan, Papua New Guinea, Angola and Nigeria) reflecting our international reputation and reach. Many international PhDs return to academic positions (National Centre of Excellence in Geology, Peshawar; University of Balochistan); others embark on careers in the UK (e.g. Natural History Museum; Robertson Research) and Europe (Panterra Geoconsultants). Our PhD projects range across the discipline, and reflect extensive collaborations with BGS and strong links with industry (BG Group, Weatherford, RPS, ExxonMobil, Scotgold Resources Ltd, Caledonia Mining Corporation, and the USGS). Within the University, cross-disciplinary projects involve Archaeology

and Ancient History (**Williams**), Mathematics (**Barry**, **Lovell**), and Biological Sciences (**Purnell**).

Our procedures for support of postgraduate research students are closely integrated with Department, College and University strategy and policy, designed to provide each individual with the best and most appropriate opportunities for research, study, progression and career development. Each student is allocated a research-active Supervisor Team comprising a main supervisor and at least one supporting supervisor. Each student establishes a personal training plan in discussion with their supervisors, and this builds to a portfolio of research-subject-specific and transferable skills; training is undertaken as an active learning process, structured and supported to encourage students to reflect on their learning performance and achievement, and plan personal educational and career development. The student maintains a training record and its evaluation is an important part of the probation review.

The central Academic Practice Unit provides generic and specific discipline based help, support, and training, especially in terms of career development. A dedicated Postgraduate Tutor in Geology also supports career development and provides pastoral support. In addition, the Head of Department meets frequently with the postgraduate community to discuss concerns and ideas. Postgraduate representatives inform departmental research strategy and representatives participate in the Research Committee, Student-Staff Committee, and the Department Staff Meeting. Postgraduates attend department research seminar and lecture series (Mondays and Thursdays) and organise Friday research talks.

Formal monitoring follows University regulations and departmental procedures and involves regular reporting, meetings and presentations, and a Probation Review Panel (PRP) with at least two members of academic staff who are not project supervisors. Probation and progress reviews involve a 3-month meeting to ensure that clear aims and objectives have been established, that a research programme has been devised, and that the student has started research and understands the project. This provides a formal opportunity to raise queries, and a written report of this meeting is agreed. At the end of Year 1 a formal written report and viva assess research progress, and examines research skills and training (based on the training plan and training record). The PRP recommends to the Graduate School whether the student progresses to the second year. In Year 2 students give a research presentation in the department followed by questions and feedback as part of our departmental postgraduate talks competition. At the end of the year the PRP writes a formal report on progress. In Year 3 the student makes a further presentation (often at an external research meeting). The thesis is examined by viva examination normally involving one external and one internal examiner; supervisors do not attend the examination.

The quality of research training and supervision is shown by success in University, national and international competitions and conferences, and by career destinations. For example, winners of the annual CSE PhD prize (x4); Petroleum Geoscience Collaboration Conference; BGS BUFI (2012); SPWLA Symposium (2013), AngloAmerican Mapping prize (2008), Mann Redmayne Medal 2013, Palaeontological Association poster Prize (x2), and the Edward Forbes prize of the Palaeontographical Soc.

The Geology led Leicester's development of a bid for a NERC DTP, with Birmingham and other partners in the Central ENgland Training Alliance. Our culture and processes for training and support for research students fed into this successful bid. The award of a DTP will further enhance the range of amount of training and career development that our research students receive.

d. Income, infrastructure and facilities

Our research income for 2008-2013 averages over £2M/year compared with an average during RAE2008 of £1.3M/year. Over 83% of REF income is won competitively from RCUK (inc. Royal Society), of which 12% is NERC national facilities grants; on average 12% is from industrial funding, with up to 5% of funding p.a. from Europe. Our plans include significant bids for RCUK and industrial funding, with increased activity in respect of European funding. We also have plans to develop larger collaborative consortium grants involving environmental scientists across the University and external partners, including industry, building on recent network development associated with the NERC DTP bid. These plans encompass core research activities and new directions: a major consortium bid involving industry and academia (including non-geoscientists) to NERC's sustainable supply of strategic minerals call (currently in NERC funded catalyst phase;

Jenkin, **Holwell**, **Smith**); interdisciplinary work at the interface of rock physics, seismics, and igneous/structural geology (**England**, **Vinciguerra**, **Walker**); development of new concepts of comparative and analytical taphonomy and bias in the fossil record, applied to major Palaeozoic Lagerstätten, with overseas collaborators (**Gabbott**, **Harvey**, **Purnell**, **Williams**, **Zalasiewicz**).

The Department has more than 750 square metres of dedicated research space, accommodating laboratories, instruments and interpretation facilities. During REF we have invested in research infrastructure through major investment in laboratory refurbishment and state-of-the-art equipment. Our University-funded laboratory refurbishments have been extensive and include: an ICP-MS machine room with new LA-ICP-MS instrument; a wet chemistry laboratory; a preparation laboratory for palaeobiology and palaeoenvironment studies; a specialist laboratory for experimental taphonomy, and a mineral separation/picking room; refurbishment of a dedicated research space with specialist computing facilities for SEIS UK/IODP; and a new thin section laboratory with new automated sectioning and polishing equipment. Investment in these facilities totals £458,500.

Our equipment base has been augmented through new purchases and replacements. New equipment since 2008 includes: LA-ICP-MS (funded from University Research Equipment and Infrastructure Fund (REIF, £380k), X-ray diffraction system with high-T and cryogenic chamber (REIF, £220k), Nikon Metrology XT H 225 X-Ray MicroCT system (with engineering - SRIF; £223k); new LLC 'LEMI' magnetotelluric instruments (REIF, £55k), replacement JEOL Superprobe (REIF, £107k; plus £30k from BGS). Our new dedicated taphonomy lab is equipped with multiple incubators, holding tanks, time lapse photography systems, and tumbling barrels (NERC). We also operate one of only 2 surface metrology systems dedicated to analysis of palaeobiological materials in the UK (NERC, £80k). Pre-REF period equipment includes a SEM with EDX, CL and accessories; digital microphotographic/macrophotographic facilities; XRF; EMPA, ICP-OES, fluid inclusion stage, LECO carbon/sulphur analyser, and supporting sample preparation laboratories. All have specialist department-based technical support, and we are currently reviewing technical provision to ensure sustainability for the future. The University is a member of the M5 group, which is developing the tools for effective equipment sharing, and exploring the possibility of joint procurement and maintenance, which will enhance future access to large scale equipment.

In addition to custom laboratories for (micro)palaeontological and geochemical preparation and processing, including isotope preparation laboratories, we have a comprehensive network of IT support, and access to additional facilities across campus. Researchers from Geology make use of the University's Advanced Microscopy Centre, with TEM, Field Emission SEM, UHV-STM and Scanning Probe Microscopy. In addition the Department runs its own servers for research data storage and archive with dedicated research computing staff. A £32M University investment in library facilities supports comprehensive access to 17,000 on-line journals. The library employs expert Information Librarians, with a specified librarian supporting our Unit of Assessment.

The RAE2008 panel commented that our links with BGS/NIGL and SIES-UK help to maintain the quality of our research environment, and this has been enhanced since 2008. Formal involvement in the NERC Isotope Geosciences Laboratory (NIGL) at Keyworth has been strengthened with the appointment of **Leng** (Leng and Parrish (NIGL Director) both UoL salaried professors), facilitating extensive collaborative isotope research with staff and research students: we have a strong record of joint research projects using cutting-edge isotope equipment. Facility-in-kind contributions through NIGL in this RAE period total more than £502k. Total in-kind contributions for Research Council facility use amount to more than £1m. The appointment of **Vinciguerra** (UoL Reader, and Head of Rock Physics BGS) is part of our strategy to maintain and develop links, and further enhances access to BGS equipment and infrastructure. We continue to provide the seismic equipment node of the NERC Geophysical Equipment Facility (SEIS-UK), derived from a department-led JIF initiative, providing field equipment, computers and software for experiments involving onshore recording of earthquakes and controlled seismic sources. SEIS-UK personnel provide expertise and training. Our participation in the Integrated Ocean Drilling Program provides additional research capability with industry petrophysics software and a wide range of Geotek petrophysical core scanning capabilities. Our staff have spent 1095 days offshore on IODP expeditions, with 215 days supported by ESSAC/NERC.

Consultancy and provision of professional services take place in all research groups. Examples include advice and analysis provided to Lonmin, informed by experience gained through work on NERC CASE project with Scotgold, increasing efficiency of exploration programmes for precious metal and associated elements (inc. e-tech element tellurium), of benefit to the local and national economy (**Jenkin**). Similar work on gold mineralisation in Ethiopia has the potential to develop a mineral resource that could significantly boost the local economy. Work with Orosur Mining on a gold deposit in Chile has directly fed into the company's exploration strategy for the region (**Holwell**). **Lovell** and **Davies** have provided consultancy in developing and delivering CPD courses for the oil and gas industry, building on their research and experience. This has involved leading courses for multi- and single-clients, developing and leading field-based and class-based courses in conventional and unconventional petrophysics including shale gas; courses delivered to >600 people from >30 international companies. Additional details of work with research users are listed in section e below.

e. Collaboration and contribution to the discipline or research base

Staff in all three research groups collaborate widely and contribute to the research base across the discipline, both nationally and internationally, through research collaborations, involvement in professional societies — including leadership roles — and in setting the subject agenda at conferences and debates.

Research collaborations involve more than 70 universities and research organizations worldwide; specific highlights include: world leading innovations in methods in geochronology (with UCL, Lancaster, Bristol, Oxford, MIT, Stony Brook; **Parrish);** strong IODP involvement through European Petrophysics Consortium (with Montpellier, RWTH Aachen, and Lamont Doherty Earth Observatory; **Davies, Lovell**); Co-PI in the $multimillion HOTSPOT deep drill programme, Idaho (ICDP and US Department of Energy funded; **Branney**); Co-PI in ICDP SCOPSCO project (Lake Ohrid drilling), with numerous international partners (**Leng**); studies of Chengjiang exceptionally preserved biota with Yunnan Key Laboratory for Palaeobiology, (**Gabbott**, **Purnell**, **Siveter**, **Williams**); seismological investigations with Geological Survey of Norway, Universities of Aarhus, Oslo, Uppsala, Copenhagen, and Bergen (**England**); lead investigator on age and extent of the Siberian Traps and impact on end-Permian ecosystems (MIT, Novosibirsk (Russia), SUERC, and Roskilde (Denmark)) (**Saunders**); investigation of the significance of the Anthropocene concept, (ANU, Mainz, Milan) (**Williams**, **Zalasiewicz**). Staff hold positions of visiting professor at: Nottingham; Yunnan, PRC; Nagoya, Japan; Wroclaw; and Research Associate at Dublin Institute of Advanced Studies; BGS; Royal Ontario Museum.

Interdisciplinary collaborations outside of geoscience include: **Williams** (with Archaeologists at Leicester and Reading University; Geographers at Birmingham) using microfossil content of Iron Age, Classical and Medieval constructions, pottery and artefacts as a new tool for provenance; **Purnell** on surface metrology and microtextural analysis to characterise tooth wear and diet, with metrology specialists (Huddersfield), bat biologists (Bristol) cetacean biologists (Copenhagen, Uppsala, SeaWorld, Winnipeg), fish biologists (Montreal, Leiden, and Bern), and anthropologists (Arkansas); **Jenkin** with mutation researchers (Leicester), ecotoxicologists (Nottingham Trent), medical geologists and environmental geochemists (BGS) on ecotoxicological effects and human health risks of arsenic in contaminated soils; **Purnell** and **Gabbott** (with Leicester Biological Sciences and Chemistry) on decay and preservation of non-biomineralized fossils. We have an emerging Geomathematics research group with the Mathematics Department funded by BGS and Weatherford, developed from joint PhD studentships (**Lovell** and **Barry**)
Collaborations with research users have informed activities and strategy through projects sponsored by SINDRI (Faroese hydrocarbon exploration licensees) leading to development of passive seismic methods for better imaging of sub-basalt sequences and new models of regional geological evolution/North Atlantic opening (**England**, **Walker, Moorkamp**). Work with Aramco led **Williams** and **Zalasiewicz** [text removed for publication]. Work with ExxonMobil, BG-group, and Cuadrilla (**Davies**, **Lovell**) has led to a number of projects on shale gas, linking sedimentary facies to organic content, hydrocarbon potential and maturity, and investigating petrophysical models for gas in place. Work with RPS and BGS on shallow subsurface studies for offshore windfarm (Dogger Bank) is driving new research interactions, combining petrophysics with 3-D sub-surface modelling (**Davies, England, Lovell)**.

Exemplars of leadership: Staff contribute to leadership through national and international involvement in professional bodies and learned societies, Research Councils, and advisory boards. Selected examples include: Chair, IODP Scientific Measurements Panel; Chair, President, Society of Petrophysicists and Well Log Analysts (SPWLA) Foundation (**Lovell**). Chair of NERC facilities committee (**Parrish**). UK convenor International Continental Scientific Drilling Programme (**Leng**). Director, European Petrophysics Consortium (**Davies).** Director, SEIS-UK, Ex-Officio member NERC Geophysical Equipment Steering Committee (**England**). Chair, Anthropocene Working Group, International Commission on Stratigraphy; Chair of Geol. Soc. of London Stratigraphy Commission (**Zalasiewicz**). Chair, Volcanic and Magmatic Studies Group GSL and Mineralogical Soc. (**Saunders**). Chair and Secretary, Mineral Deposits Studies Group (**Jenkin**). Co-chair, NERC grants moderating panel (**Purnell**). Membership of NERC Peer Review College (**Branney**, **Davies**, **England**, **Purnell**, **Williams**), NERC Scientific Advisory Panel – IODP, Member of EPSRC Grand Challenge Expert Panel and NERC oil and gas catalyst panel (**Lovell**). Geol. Soc. of London Stratigraphy Commission (**Barry**) and Science Committee (**Jenkin**). ESF Peer Review Panel, European Plate Observing System UK steering committee (**England**). **Jenkin** provided input to House of Commons Science & Technology Inquiry into Strategic Metals. Roy. Soc. Newton International Research Fellowships Panel (**Purnell, Siveter**). Volcanic Margins Research Consortium science committee, Tectonic Studies Group secretary (**Walker)**. Vice-President, Palaeontographical Soc. (**Williams).** Micropalaeontological Soc. Secretary **(Kender).**

Members of the department have been active in the organization, convening and chairing of many conferences. Organiser roles include the International Palaeontological Congress, London (**Purnell**), Geol. Soc. London Fermor meeting (**Jenkin**), MDSG Annual Meeting (**Jenkin, Holwell, Smith**), TSG Annual Meeting (**Walker**), Micropalaeontological Soc. Annual Meeting (**Kender**), scientific committee of International Conodont Symposium, Argentina (**Purnell**). Sessions convened at European Geosciences Union, American Geophysical Union (**England**, **Walker**, **Williams**, **Zalasiewicz**), International Palaeontological Congress (**Gabbott**, **Purnell**, **Williams**), Goldschmidt (**Parrish**), the Mineralogical Soc. Annual Meeting (**Jenkin**), International Conodont Symposium, Calgary, and British Science Festival (**Purnell**), Volcanic and Magmatic Studies Group of the Geol. Soc. London Field trip (**Branney**)

Invited keynotes and lectures at international conferences are too numerous to list. Highlights include: GSA Penrose conference; VMSG AGM 2013; IAVCEI General Assembly, Reykjavik; HOTSPOT ICDP/DOE Meeting (**Branney**); AGU Fall meeting (**Parrish**, **Zalasiewicz**); Goldschmidt Seminar, Norwegian Geological Survey (**Fishwick**). SPWLA Perth Unconventional hydrocarbons, EAEG Unconventional hydrocarbons (**Lovell**). International Conodont Symposium, Calgary (**Purnell**); Geol. Soc. of America Annual Meeting (**Harvey, Parrish**, **Purnell** x2, **Siveter**). European Geosciences Union (**Saunders** x2, **Zalasiewicz**). International symposium on Ostracoda; Darwin Festival, Shrewsbury (**Siveter**). Geol. Soc. of London Shell lecture series (**Siveter**, **Zalasiewicz)**. Berlin Haus der Kulturen der Welt (**Zalasiewicz**). Staff have also given invited research seminars at many universities and research institutes. Editorial activities, include: *Journal of the Geol. Soc. London* (**England**,). Geol. Soc. Special Publication – *Ore Deposits in an Evolving Earth* (**Jenkin**). *Geochemistry, Geophysics, Geosystems*, *Silicon, Quaternary Science Reviews* (**Leng**). *Petroleum Geoscience* and *Phil. Trans. Roy. Soc. A* (**Lovell**). *Journal of Geophysical Research - Solid Earth* (**Moorkamp**), *Precambrian Research* (Chief Editor), *Earth and Planetary Science Letters* (**Parrish**). *Phil. Trans. Roy. Soc.* thematic volume on the Anthropocene (**Williams**, Lead Editor). *Geoscientist*, *Geological Quarterly*, *Proc. Geologists' Association* (**Zalasiewicz**).

Fellowships, awards and prizes include NERC Research Fellowship (**Barry**); Murchison Medal (Geol. Soc. London), Schlumberger Medal (Mineralogical Soc.) (**Parrish**), Volcanic and Magmatic Studies Award (**Branney**), Alan Higgins Award 2010 (Micropalaeontological Soc.) (**Kender**); SPWLA Distinguished Service Award 2008 (**Lovell**); shortlist Times Higher Research Project 2008 (**Purnell**) and 2011 (**Gabbott**, **Purnell**), SGA-Barrick Young Scientist, Wardell Armstrong Award (**Holwell**), Midland Valley Exploration structural prize, TSG Shell Prize, TSG Ramsay Medal (Geol. Soc. London) (**Walker**). **Parrish** is a Fellow of the GSA.