

CURRICULUM VITAE

Professor Paul L Younger FEng DL

C.Eng., C.Sci., C.Geol., FGS, FICChemE, FICE
DHC (Arequipa), DHC (Oviedo)

Director of the Newcastle Institute for
Research on Sustainability

Newcastle University, UK



SYNOPSIS

- Leading the development of the Newcastle Institute for Research on Sustainability, to coordinate activity on one of Newcastle University's three institutional priority 'societal challenge themes'. The Institute has particular expertise in the contribution of engineering in urban, rural and marine environments, and in the energy sector.
- A distinguished Hydrogeologist and Environmental Engineer, with more than 250 publications in the open literature, reflecting broad experience in the science and engineering of sustainable systems in the water, regeneration, construction, mining and energy sectors,
- Renowned for his pioneering research and outreach programme of community-based, ecologically-integrated remediation techniques for water pollution from abandoned mines; this won Newcastle University the Queen's Anniversary Prize for Higher Education in 2005 as well as a £100K prize in the first EPSRC Knowledge Transfer Challenge in 2006.
- Strategic leadership experience as:
 - Founder and leader for 15 years of the award-winning Hydrogeochemical Engineering Research & Outreach (HERO) group, and founder-Director of the Swan Institute
 - Leader of the North East bid to host the hub of the Energy Technologies Institute
 - Director of four spin-out companies
 - PVC for Engagement, developing the University's first-ever Engagement Strategy
- Noted for developing novel, substantial and sustained engagement initiatives:
 - Regionally in North East England with community groups, local government, the Regional Development Agency (One NorthEast) and Government Office North East.
 - Globally with major corporations (e.g. HSBC), sustainable development organisations (e.g. WWF, CAFOD), and with the European Union drafting a mine waste management Directive.
- Extensive experience of living and working in different countries, including 2 years in the USA as a Harkness Fellow, a year working on community water supply development with indigenous communities in the Bolivian Altiplano, and five years as manager of a major capacity-building programme in the West Bank and Gaza Strip.
- Very well networked in Spain and Latin America, taking advantage of fluency in Spanish.
- A highly gifted communicator, Paul has served as Public Orator for the University. He has a knack for conveying complex scientific concepts to lay audiences, and a strong track record of successful engagement with national and regional broadcast media and newspapers.

PERSONAL DATA

NATIONALITY: British
DATE OF BIRTH: 1st November 1962
CIVIL STATUS: Married (6th August 1988); three sons
LANGUAGES: English (Mother Tongue), Spanish (Highly fluent),
Scottish Gaelic (intermediate fluency).

EDUCATION & QUALIFICATIONS

- (1) 1981 - 1984: University of Newcastle Upon Tyne,
Department of Geology
Degree: **B.Sc. WITH FIRST CLASS HONOURS
IN GEOLOGY**
- (2) 1984 - 1986: Harkness Fellow of the Commonwealth Fund of New York:
Oklahoma State University, Stillwater,
Oklahoma, USA, Department of Geology.
Degree: **MASTER OF SCIENCE IN GEOLOGY
(HYDROGEOLOGY)**
- (3) 1986 - 1990: University of Newcastle Upon Tyne,
Department of Civil Engineering.
Degree: **DOCTOR OF PHILOSOPHY**
(Numerical Modelling of Water Resource Systems)

CAREER HISTORY

A: Principal Employment:

- (1) Harkness Fellow (Commonwealth Fund of New York), 1984 - 1986.
- (2) Hydrogeologist, National Rivers Authority, 1989 - 1991.
- (3) Groundwater Engineer, United Nations Association, La Paz, Bolivia, 1991-92.
- (4) Lecturer, Dept of Civil Engineering, University of Newcastle, Oct 1992 – July 1999
- (5) Reader, Dept of Civil Engineering, University of Newcastle, Aug 1999 – July 2001
- (6) Professor of Hydrogeochemical Engineering, School of Civil Engineering and Geosciences, University of Newcastle, Aug 2001 - Oct 2004
- (7) HSBC Professor of Energy and Environment, Newcastle University, Nov 2004 – Dec 2007
- (8) Director, Sir Joseph Swan Institute for Energy Research, Newcastle University, August 2007 – April 2008
- (9) Pro-Vice-Chancellor (Engagement), Newcastle University, May 2008 – May 2010.
- (10) Director, Newcastle Institute for Research on Sustainability, June 2010 – present.

B: Part-time Positions:

- (1) Chair, Sustainable Development North East England (SustaiNE), June 2010 – present
- (2) Member of the Societal Issues Panel, Engineering and Physical Sciences Research Council, March 2009 - present
- (3) Public Orator, Newcastle University, August 2007 – July 2010.
- (4) Public Orator-designate, University of Newcastle, Dec 2004 – July 2007

- (5) Coordinator, Energy Research North East England (ERNEE), Sept 2007 – April 2008
- (6) Energy & Environment Science Theme Leader, Newcastle Science City, June 2006 – April 2008
- (7) Member of Technology & Research Group, CL:AIRE (Contaminated Land Applications in Real Environments (www.claire.co.uk)): (2006 – 2008)
- (8) Royal Academy of Engineering Industrial Secondee, Northumbrian Water Ltd, April - September 1997

PROFESSIONAL AFFILIATIONS

Chartered Engineer (**C.Eng.**)

Chartered Geologist (**C.Geol.**)

Chartered Scientist (**C.Sci.**)

Fellow of:

- Royal Academy of Engineering (2007 -) (**FR**Eng)
- Geological Society (**FGS**) (1989 -) (Council Member 2003 – 2005; Editorial Board Member 2002 – 2008)
- Institution of Chemical Engineers (**FIChemE**) (2004 -)
- Institution of Civil Engineers (**FICE**) (2010 -)
- Institution of Mining and Metallurgy (**FIMMM**) (2001-2007)
- Chartered Institution of Water and Environmental Management (**FCIWEM**) (1995-2007)
- North of England Institution of Mining and Mechanical Engineers (**FIME**) (2000 -) (President 2003-2004)

Member of:

- International Mine Water Association (Executive Council Member, 2003 to present; Editorial Board Member 2001 – present)
- International Association of Hydrogeologists (1996-2007)
- British Hydrological Society (former Honorary Secretary at national level);
- NERC Freshwater Sciences Peer Review Committee, 2001-2003
- EPSRC Peer Review College 2003 – present
- Boards of Directors of:
 - o Project Dewatering Ltd
 - o NuWater Ltd
 - o GeothermalPlus Ltd
 - o Cluff Geothermal Ltd
 - o Five-Quarter Energy Ltd

MAJOR HONOURS

Appointed Deputy Lieutenant (**DL**) for the County of Tyne and Wear, October 2009

Elected a Fellow of the Royal Academy of Engineering (**FR**Eng), July 2007

Doctor *Honoris Causa*, Universidad de Oviedo, Spain, May 2010

Doctor *Honoris Causa*, Universidad Nacional de San Agustín, Peru, January 2010

Elected a Fellow of the Institution of Civil Engineers by Presidential Invitation, August 2010

Leader of Team which won the Queen's Anniversary Prize for Higher Education for Newcastle University in 2005

OTHER HONOURS

- Member of British Experts Delegation to Hungary, 4th – 6th November 2010, at request of the UK Prime Minister, Rt. Hon. David Cameron MP, and the Government Chief Scientist, Sir John Beddington.
- Appointed Member of the Societal Issues Panel of the Engineering and Physical Sciences Research Council (2009 -)
- Appointed to the Board of *Live Theatre*, Newcastle upon Tyne. (2009 -)
- Appointed Member of the Water Panel of the *Instituto Madrileño de Estudios Avanzados* (2009 -)
- International Orator for the Testimonial Ceremony at the Escuela de Minas, Madrid, for the Award to Prof Rafael Fernández Rubio of the *Premio Rey Jaime I del Medio Ambiente* (the Spanish-speaking world's principal prize for environmental protection, with prize money equal to that of Nobel Prizes). (Oration delivered in Spanish).
- Invited to be the UK representative on the European Expert Panel on Geothermal Energy of the European Federation of Geologists
- Runner-up, Times Higher Education Awards 2005 in category 'Outstanding Contribution to the Local Community' for the Eastgate Geothermal Energy project, Co Durham, UK
- Runner-up, Utility Industry Achievement Awards 2005, for the first-ever wetland treatment co-treating sewage and mine water, Lamesley, Tyne and Wear.
- Elected Public Orator-designate of the University of Newcastle, Dec 2004
- President of the oldest professional association of mining engineers in the world – the North of England Inst. of Mining and Mechanical Engineers, Oct 2003 – Sept 2004
- Elected Member of national Council, Geological Society (London), May 2002
- Winner of the Geological Society "William Smith Fund" 2001, for 'excellence in the practical application of geology'
- Isambard Kingdom Brunel Lecturer for the Year 2000, British Association for the Advancement of Science and Technology
- Subject of BBC Radio 4's "Changing Places" programme, September 2000
- *Gast-Dozent* (i.e. Visiting Professor) Universität Tübingen, Germany, April 2000
- Invited author, *Boletín Geológico y Minero*, Spain, 1999
- UK Conservation Award 1998: Leader of team which won overall, and which also won the "Conservation Engineering" category
- Royal Academy of Engineering Industrial Secondment, 1997
- Publication Award, Chartered Institution of Water and Env. Management, 1994
- Young Author of the Year Award, 1994, Quarterly Journal of Engineering Geology
- Harkness Fellow of the Commonwealth Fund of New York, 1984 - 1986
- Winner of the Lebour Prize in Field Geology and the Pemberton Prize (best student in the Schools of Geology, Geography and Mathematics), Univ. of Newcastle July 1984

FUNDING RECORD: RESEARCH AND RELATED ACTIVITIES

UK Research Councils:

Co-investigator: iKNOW: a Beacon for public engagement. Research Councils UK / HEFCE, 2008 – 2011. £1.97M.

Co-investigator: Generic unifying concepts for wastewater treatment design – II. EPSRC Platform Grant, 2008 – 2011. £1M.

- Principal investigator:* Environmental engineers of tomorrow: collaborating for success through people. EPSRC, 2007-2009. £140K
- Co-investigator:* Biogeochemical & microbial analyses of deep saline hotwater aquifer in the Weardale granite. NERC, 2006-2007. £51,259.
- Co-investigator:* Chemical, Biochemical & Physical Constraints during Mine Water Treatment using Vertical Flow Accretion Systems. GR/S66978/01. EPSRC, 2005 – 2008. (Joint with Cardiff University; £258K).
- Joint Principal Investigator:* Generic Unifying Concepts for Wastewater Treatment Design - I. EPSRC Platform Grant, 2004 – 2007. £440K.
- Principal Investigator:* Bioremediation of acidic mine waters by sulphate reduction in novel, compost-based, field-scale bioreactors (ASURE). UK Govt Dept of Trade and Industry LINK grant / EPSRC / BBSRC / Rio Tinto / Scottish Coal / IMC Ltd. 1-9-2002 - 31-5-2006. (Joint with University of Wales, Bangor - total value: £920,000).
- Principal Investigator:* Novel use of ochre from mine water treatment plants to reduce point and diffuse phosphorus pollution. EPSRC, 1-3-2002 - 28-2-2005. £168,358. (Joint with Edinburgh University - total value: £332,939).
- Principal Investigator:* Hydrogeology of flooded, abandoned mine workings - an integrated hydraulic / hydrogeochemical analysis. NERC, 2000 - 2001. £33,742.
- Principal Investigator:* Optimisation of Ochre Accretion at Source. Engineering and Physical Sciences Research Council, 1997 - 2000. £189K (of which £65K is committed to collaborators at University of Sheffield).
- Principal Investigator:* Controlling river pollution by metalliferous runoff from abandoned Pb-Zn mines and smelter sites, Nent Valley, Cumbria. Engineering and Physical Sciences Research Council / Environment Agency ear-marked Industrial CASE PhD Studentship (Ms C A Nuttall), 1997 - 2000. EPSRC studentship plus £15K from Environment Agency.
- Principal Investigator:* Limestone Extraction and Water Resources: A technical basis for sustainable development. DTi LINK - NERC / Mineral Industry Research Organisation. £250K. 1999 – 2001.
- Principal Investigator:* Assessing the time-scales for mine water remediation. NERC Environmental Diagnostics Programme. £32K. 1999 – 2001. (Collaborative with University of Sheffield).

Grants from other sources:

- Principal Investigator:* Expediting use of the UK's most recently-proven geothermal resource (Eastgate, Co Durham). Deep Geothermal Challenge Fund, Department of Energy and Climate Change. Jan – March 2010. £461K.
- Principal Investigator:* GEOTRAINET: Geo-Education for a sustainable geothermal heating and cooling market. EU FP7, Intelligent Energy-Europe (IEE). Sept 2008 to Feb 2011. Total value of project €952,004. Newcastle element: €64,448.
- Principal Investigator:* Feasibility study for large-scale development of Underground Coal Gasification with Carbon Capture and Storage in North East England. One NorthEast, 2008 - 2009. £105K.
- Principal Investigator:* Geothermal mapping: terrain classification for application of open-loop ground-source heat pump systems in eastern County Durham and adjoining areas. County Durham Economic Partnership / One North East, March 2008 - Sept 2009. £156K.
- Co- Investigator:* Rates and management implications of corrosion of austenitic steel structures in dewatered and ventilated underground storage facilities in granite. Nuclear Decommissioning Authority, 2008 – 2011. £138K.
- Co-Investigator and Technical Coordinator:* Catchment Management in Mining-Impacted Arid Areas of the *Cono Sur* (South America) (CAMINAR). European Commission FP6 INCO-DEV project, Peru, Bolivia and Chile. 2006 – 2009. £1.2M.

- Co-investigator:* Evaluation and prioritisation for remediation of polluted discharge from non-coal mines in England and Wales. DEFRA, 2007-2010. £200K.
- Co-investigator:* Environmental Regulation of Mine Waters in South America (ERMISA). European Commission FP6 INCO-DEV project, Peru. 2006. £67K.
- Principal Investigator:* Eastgate Geothermal Exploration Borehole: Exploring a new concept for geothermal resource exploitation in the North Pennines. Wear Valley Task Force / One North East. £500K. 2004 – 2006.
- Principal Investigator and Chair:* HSBC Chair in Environmental Technologies and Geothermal Energy. HSBC Bank, Jan 2005 – Dec 2007. £500K.
- Principal Investigator:* Simulating Radionuclide Transport from the Geosphere to the Biosphere - Phase IV. Nirex, 2001 – 2004. £150K.
- Principal Investigator:* Hydrogeochemistry of seepage entering deep tunnels in crystalline rock. Nirex, 2001 – 2004. £60K.
- Principal Investigator:* Environment Agency National R&D Fellowship in Mine Wastes and Mine Water Remediation. March 2004 – Feb 2007. £300K.
- Principal Investigator:* CoSTaR: an international research access infrastructure for mine site remediation research. European Commission 6th Framework Programme, 1-5-04 - 30-09-08. €470K.
- Principal Investigator:* Urban river basins: environmental management. European Commission 6th Framework Programme 2003-2005. €160K.
- Principal Investigator:* Modelling the creation of wetlands in pristine floodplain environments by sand and gravel winning. Sherburn Stone Co Ltd. £15K. 2004.
- Principal Investigator:* Effects of Sand and Gravel Extraction on the Enclosing Aquifers. Mineral Industry Research Organisation / Department of Trade and Industry MIST Programme. 2003 – 2004. £75K.
- Principal Investigator:* IMAGE-TRAIN (Accompanying Measure Programme on Groundwater Pollution). European Commission Fifth Framework, Oct 2001 – Sept 2004. €100K.
- Principal Investigator:* The long-term hydrogeochemical impact of man-made underground voids on the enclosing rock mass. United Kingdom Nirex Ltd, Oct 2001 – Sept 2004. £60K.
- Principal Investigator:* RAPS technology for aluminium removal from acidic mine drainage - equipment grant. BOC Foundation/ CL:AIRE, Oct 2001 – Sept 2004. £17.2K.
- Principal Investigator:* Developing a predictive understanding of hydrological and hydrochemical changes in abandoned coalfields. Coal Authority and Environment Agency, April 2001 – June 2004. £95K.
- Principal Investigator and Technical Coordinator:* ERMITE Environmental Regulation of Mine waters in the EU. European Commission Fifth Framework Programme, Feb 2001 – Jan 2004. €1M (€250K for Newcastle work).
- Principal Investigator and International Coordinator:* PIRAMID Passive In-situ Remediation of Acidic Mine / Industrial Drainage. European Commission Fifth Framework Programme, Jan 2000 – Dec 2002. €1.5M (€350K for Newcastle work).
- Joint Principal Investigator:* Impacts of River Abstractions on River Flows – II. Environment Agency National R&D Contract £70K. 1999-2000. (other PI – G Parkin).
- Principal Investigator and International Coordinator:* Risk of Subsidence due to Evaporite Solution (ROSES). European Commission Fourth Framework Programme, 2/1/1998 - 31/12/2001. €440K (~€200K for Newcastle work).
- Principal Investigator:* Improved Methods of Modelling Abandoned Coalfields. Environment Agency and Northumbrian Water Ltd. £96K. 1996-1998.
- Principal Investigator and International Coordinator:* Groundwater Resources and Climate Change Effects (GRACE). European Commission, Third Framework Programme. €392K. 1994-1996.
- Principal Investigator:* Quaking Houses Minewater Treatment Wetland: Environmental Engineering Aspects. Northumbrian Water Kick-Start Fund, 1996-1997. £54K.

Principal Investigator: Hydrogeology of the Greenhow Mining Area, North Yorkshire. Yorkshire Water Services Ltd. 1995-1997. £16K.

Principal Investigator: Hydrogeology and Geochemistry of Modern Arctic Aquifer Systems, Spitsbergen, Svalbard. Nuffield Foundation. 1993-1995. £3K.

Project Manager and Investigator: Water Resources Management: West Bank and Gaza Strip. HM Government, Department for International Development, 1993-1998. £660K. (PI: Prof P E O’Connell).

Co-Investigator: Simulating Radionuclide Transport from the Geosphere to the Biosphere - Phase II: Integrated Field and Modelling Studies. NIREX Ltd, 1995-1997. £250K. (PI: Dr J Ewen).

Co-investigator: Hardham Groundwater Scheme Modelling Project. Southern Water Services Ltd, 1997-1999. £90K. (PI: Dr G Parkin).

EDITORIAL BOARD MEMBERSHIPS

- *Quarterly Journal of Engineering Geology and Hydrogeology* (Geological Society, London) (2002 – 2008)
- *Mine Water and the Environment* (Springer) (2001 - present)

INVITED KEYNOTE LECTURES

- 7th October 2010. British Science Association Annual Lecture 2010, Newcastle University. “Coal: it’s not all black”.
- 18th October 2010: Pen & Palette Club, Newcastle upon Tyne. “The Gaelic Roots of the Golden Age of Northumbria”.
- 19th June 2010: Annual Convocation Lecture, Newcastle University. “Enough, for all, forever: Newcastle University and the Pursuit of Sustainability”.
- March 18th 2010: Science Festival Lecture, Snibston Discovery Museum (East Midlands): “The Return of Old King Coal”.
- January 5th 2010: *Conferencia Magistral* on the human dimension of natural resources management, Universidad Nacional de San Agustín, Peru
- September 23rd 2009: Parliamentary Outreach / North East Improvement and Efficiency Partnership Autumn 2009 Conference on Community Engagement and Empowerment². “From engagement to empowerment: universities and participatory social accompaniment”.
- August 25th 2009: CASE Europe Conference, Liverpool, UK. “Corporate Social Responsibility: Engaging Communities or just PR?”
- July 25th 2009: International Congress on Environmental Law, hosted by LIDEMA, La Paz, Bolivia. “*El impacto ambiental de la minería*”.(delivered in Spanish).
- Feb 13th 2008: Strathclyde University, David Livingstone Memorial Annual Lecture on Sustainability: “Coal: the key to a sustainable future?”
- Jan 31st 2008 - Aberdeen Geological Society: “Geothermal energy in the UK: pipe-dream or realistic prospect?”
- Nov 20th 2007 - Shell London Lecture Series: “Water: really precious?”
- Nov 14th 2007: Keynote – Mine Water Remediation – Brazilian Groundwater Association, Belo Horizonte
- Oct 12th 2007: Inaugural Thomas Hepburn Memorial Annual Lecture, Gateshead Metropolitan Borough Council: “Coal in a Changing Climate: Can it be the Key to a Sustainable Future?”
- Sept 16th 2007: Geological Society of London Bicentennial Conference : “Mine water: friend or foe?”

- April 2007: Keynote Address - United States Environmental Protection Agency, Abandoned Mined Lands Colloquium, Couer d'Alene, Idaho, 2 - 5 April. Lecture title - "Bioremediation of acidic mine drainage using sulphate reducing bacteria".
- Jan 31st 2007: Invited Lecture, Edinburgh Geological Society: "New uses for ancient hydrothermal structures: a renaissance for geothermal energy in the UK?"
- Jan 4th 2007: Keynote Lecture - Mineral Deposits Studies Group, UK, 3-5 Jan 2007. Lecture title: "Accessory Mineral - Accessory to Crime?".
- Nov 2006: Australasian Institution of Mining and Metallurgy. Keynote Lecture - "The Water Footprint of Mining Operations in Space and Time: A New Paradigm for Sustainability Assessments?". Conference on "Water in the Mining Industry", Brisbane, Australia, 16th November 2006.
- October 2006: "Orphaned and abandoned mines: in pursuit of best practice". Canadian National Orphaned and Abandoned Mines Initiative (NOAMI), Winnipeg, Canada, 26th October 2006.
- October 2006: "Mine water management in arid South America: from research to policy". International Council on Mining and Metals (ICMM), Environmental Stewardship Task Force, London, 11th October 2006.
- September 2006: *Ponencia Clave: "Retos en la Gestión del agua en minería". 1er Foro Latino-Americano sobre 'Agua, Cuenca y Minería: Manejo para un Desarrollo Sostenible'. Lima, Perú, Setiembre 2006.* (delivered in Spanish)
- June 2006: "Geothermal drilling: deep / shallow / meaningful?": GeoDrilling International, Castle Donnington (UK) .
- April 2006: Seminar: "Wetland treatment at extremes of pH" Stanford Univ California.
- March 2006: Invited Plenary Lecture: 7th ICARD (International Conference on Acid Rock Drainage), St Louis (MO).
- Feb 2006: "A renaissance for geothermal energy in Britain?". Geothermal Association of Ireland / International Association of Hydrogeologists (Irish Chapter), Dublin.
- Jan 2006 : "Traitement des eaux de mine" – Societé de l'Industrie Minière, Paris.
- Dec 2005: English Partnerships / CL:AIRE National Training Day on Contaminated Land Remediation Technologies, London.
- Nov 2005: CL:AIRE Workshop: Tackling contaminated land in Wales.
- June 2005: UNESCO IHP VI: Workshop on groundwater - surface water interactions and nutrient behaviour in river corridors.
- April 2005: International Association of Hydrogeologists, Irish Chapter Annual Meeting, Tullamore.
- Dec 2004: 10th Annual British Columbia Minewaste Leachates / Acid Rock Drainage Workshop, Vancouver, British Columbia.
- April 2004: CL:AIRE Annual Project Conference, University College London.
- June 2003: "Land reclamation - extending the boundaries". CL:AIRE / BLRA.
- May 2003: European Commission, Mine Waste Colloquium, Lago d'Orta, Italy.
- March 2003: CL:AIRE Annual Project Conference, University College, London.
- Sept 2002: International Conference Uranium Mining and Hydrogeology III and the International Mine Water Association Symposium, Freiberg, Germany, 15 - 21 September 2002
- Aug 2002: Earth Alert 2 Conference, Geologists' Association, Scarborough, UK, 24 - 26 August 2002
- April 11th 2002: CL:AIRE Annual Project Conference, Imperial College, London
- Jan 2002: Scott Simpson Lecture 2002, Ussher Society, St Austell.

- Dec 2001: Seminar on proposed EU directive on mining waste, Burlington House, London, 12th December 2001.
- Sept 2001: International Association of Hydrogeologists, Munich, 1st Sept 2001.
- April 2001: International Mine Water Association Symposium, April 24th - 28th 2001, Belo Horizonte, Brasil
- Feb 2001: Las Caras del Agua Subterránea. (Congreso en memoria de Germán Alfonso Galarza López). Instituto Geológico y Minero de España / Universitat Politècnica de Catalunya. (delivered in Spanish).
- Aug 2000: Isambard Kingdom Brunel Lecturer for the Year 2000, British Association for the Advancement of Science and Technology
- May 2000: Conference on “The Legacy of Mineral Extraction”, organised by the Institution of Mining and Metallurgy and the North of England Institute of Mining and Mechanical Engineers, Newcastle Upon Tyne 18th – 19th May 2000
- Jan 2000: BIOY2K Conference, (Water Institute of South Africa Conference on “The Biotechnology of Acid Mine Drainage Wastewater Treatment”), Grahamstown, South Africa, January 23 – 28th 2000.
- June 1999 : ‘Seminario Internacional Sobre Corredores Ecológicos y Restauración de Ríos y Riberas – Aplicación a la Cuenca del Río Guadiamar’. (Programas y Resúmenes de Ponencias). 9 – 12th June 1999, Seville. Consejería de Medio Ambiente, Junta de Andalucía (delivered in Spanish)
- April 1999 : El Agua en el Cierre de Minas. Universidad de Oviedo, Asturias, España. (delivered in Spanish)
- April 1998: Environment Agency National Minewaters Conference 1998 (20th – 21st April), held at the University of Sheffield, UK.

PhD Theses Supervised as Principal Supervisor

- Stunell, J.M., 1996, Hydrology and Hydrochemistry of an Upland Peat Catchment, Canker Cleugh, Redesdale, Northumberland. PhD Thesis, Department of Civil Engineering, University of Newcastle. 265pp.
- Al-Otaibi, M., 1997, Artificial groundwater recharge in Kuwait: Planning and Management PhD Thesis, Department of Civil Engineering, University of Newcastle. 369pp.
- Hadi, K.M.B., 1997, The impact of groundwater exploitation methods on the hydrogeochemistry of carbonate and clastic aquifers, Kuwait. PhD Thesis, Department of Civil Engineering, University of Newcastle. 426pp.
- Sherwood, J.M., 1997, Modelling Minewater Flow and Quality Changes after Coalfield Closure. PhD Thesis, Department of Civil Engineering, University of Newcastle. 241pp.
- Suratman, S., 1997, Groundwater protection in north Kelantan, Malaysia.: An integrated mapping approach using modelling and GIS. PhD Thesis, Department of Civil Engineering, University of Newcastle. 357pp.
- Nuttall, C.A., 1999, Aquatic zinc pollution from abandoned mines: Assessment and remediation in the Nent Valley, Cumbria, UK. PhD Thesis, Department of Civil Engineering, University of Newcastle. 266pp.
- Jarvis, A.P., 2000, Design, construction and performance of passive systems for the treatment of mine and spoil heap drainage. PhD Thesis, Department of Civil Engineering, University of Newcastle. 231pp.
- Adams, R., 2000, Simulation of groundwater rebound in abandoned coalfields: development, testing and application of a generic model. PhD Thesis, Department of Civil Engineering, University of Newcastle. 211pp.

- Kuma, J.S., 2002, Environmental Hydrogeology of the Tarkwa Gold Mining District, Ghana. PhD Thesis, Department of Civil Engineering, University of Newcastle. 296pp.
- Johnson, K.L., 2002, Manganese in mine water and its removal by passive treatment. PhD Thesis, Department of Civil Engineering, University of Newcastle. 260pp.
- Karami, Gholam Hossein, 2002, Assessment of heterogeneity and flow systems in karstic aquifers using pumping test data. PhD Thesis, School of Civil Engineering and Geosciences, University of Newcastle upon Tyne. 180 pp.
- Gandy, Catherine J., 2003, Modelling pyrite oxidation and pollutant transport in mine wastes using an object-oriented particle tracking code. PhD Thesis, School of Civil Engineering and Geosciences, University of Newcastle upon Tyne. 242pp plus appendices.
- Al-Dubaikhi, Barrak Ali, 2005, The optimal design of water well-fields for supply and dewatering purposes: an object-oriented C++ Programming Approach. School of Civil Engineering and Geosciences, University of Newcastle upon Tyne. 251pp.
- Amezaga, Jaime M., 2005, Harmonising Policy and Technology: Environmental Regulation of Mine Waters in the United Kingdom and European Union. PhD Thesis, University of Newcastle. Newcastle upon Tyne. 249pp.
- Dudgeon, Bruce A., 2005, Hydrogeochemistry of seepage entering deep tunnels in crystalline rock: Cruachan Power Station, Scotland. PhD Thesis, School of Civil Engineering and Geosciences, University of Newcastle upon Tyne. 183pp plus appendices.
- Moustafa, Mahmoud, 2006, Characterization and modelling of the performance of a novel hybrid passive treatment system for acidic mine drainage. PhD Thesis, School of Civil Engineering and Geosciences, University of Newcastle upon Tyne. 188pp plus appendices.
- Kruse, Natalie A.S., 2007, Simulation of hydrogeochemical processes in abandoned underground mines. PhD Thesis School of Civil Engineering and Geosciences, Newcastle University, UK. 182pp. plus appendices.
- Hall, J.A., 2007, Sources and pathways of hazardous gases in disused mine workings. PhD Thesis School of Civil Engineering and Geosciences, Newcastle University, UK. 254pp. plus appendices.

M.Phil. Thesis Supervised as Principal Supervisor

- Everett, S.A., 1997, The hydrogeology of the Greenhow Mining Area and its relationship with the Eagle Level Water Supply. M.Phil. Thesis, Department of Civil Engineering, University of Newcastle. 188pp plus appendices.

PhD Theses Examined as External Examiner

- Bright, Mildred, 1997, Attenuation of leachate organic micro-pollutants by geochemically designed, high-attenuation landfill liners. University of Birmingham, School of Earth Sciences.
- Brown, Melanie E., 1997, The amelioration of contaminated mine water by wetlands. Camborne School of Mines, University of Exeter.
- Everett, Nicholas A., 1998, Continental basin sedimentation in the northern Bolivian Andes in the late Miocene – Pliocene. University of Aberdeen.
- Malcolm, Robert, 1998, The hydrology of a restored coastal dune slack, St Fergus, north-east Scotland: an integrated field and modelling approach. University of Aberdeen.
- Parekhar, Mansoor, 1998, Recharge processes under arid and semi-arid conditions: laboratory experiments and modelling. Cranfield University.

- Boshoff, G.A., 1999, Development of integrated biological processing for the biodesalination of sulphate- and metal-rich wastewaters. Rhodes University, Grahamstown, South Africa. 164pp.
- Ordóñez Alonso, M.A., 1999, *Sistemas de tratamiento pasivo para aguas ácidas de mina. Experiencias de laboratorio, diseño y ejecución.* PhD Thesis, Escuela de Minas (School of Mines), Oviedo, Spain. 643pp. (*Viva* in Spanish).
- Hongze, Gao, 1999, “Modelling geochemical interactions with groundwater transport processes: an application to acid mine drainage”. Imperial College.
- Brown, David, 1999, An investigation into the controls on groundwater flow at increasing scales in the Carboniferous Limestone of Middlebarrow Quarry, S Cumbria, UK”. University of Lancaster.
- Alloisio, S., 2000, Multiobjective evolutionary optimisation in groundwater management. University of Birmingham. 313pp.
- Zhang, Beiyan, 2000, Modelling groundwater flow to adit systems in UK chalk aquifers. University of Sheffield. 123pp.
- Dumpleton, S., 2001, The effects of coal mining on some hydraulic properties of the Sherwood Sandstone and Drift in the Selby area, North Yorkshire. University of Sheffield. 700pp.
- Birk, Steffen, 2001, Characterisation of karst systems by simulating aquifer genesis and spring responses: Model development and application to gypsum karst. Universität Tübingen, Germany. 123pp.
- Thompson, Sally M., 2002, Structural and lithological controls upon fluid migration within the Chalk and Upper Greensand aquifers. Royal Holloway, University of London. 401pp.
- van Hille, Robert Paul, 2002, Biological generation of reactive alkaline species and their application in a sustainable bioprocess for the remediation of acid and metal contaminated wastewaters. Rhodes University, South Africa. 238pp.
- Malcolm, Iain A., 2002, Groundwater - surface water interactions in the hyporheic zone of salmon spawning streams: hydrology, hydrochemistry and ecological response. University of Aberdeen. 235pp.
- Dekker, Leendert G., 2002, Development of integrated algal ponding systems in the treatment of wine distillery wastewaters. Rhodes University, S Africa. 143pp.
- Ellis, Paul A., 2003, The impact of urban groundwater upon surface water quality: Birmingham - River Tame Study, UK. University of Birmingham. 358pp.
- Odutola, Adetute O., 2003, Sorption of chlorinated and fuel-derived hydrocarbons in limestone. Queen's University of Belfast. 204pp.
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EXPERT WITNESS EXPERIENCE

1. Principal technical specialist engaged in successful prosecution by National Rivers Authority of perpetrator of an illegal impoundment, 1990.
2. Formal training in expert witness procedures, in-house at the National Rivers Authority, Northumbria Region, 1991.
3. Expert Witness retained by the Environment Agency in relation to a major pollution incident in North West Region (settled out of court in EA's favour 1999).
4. Expert Witness jointly instructed by the British Association of Colliery Managers and National Union of Mineworkers: industrial tribunal relating to improper notices of redundancy following water ingress in a deep mine. Case won 2007.
5. Expert Witness retained by the plaintiff in a case of damage to water resources, ecology and amenity value of watercourses following inadequate restoration of an opencast coal site. Settled out of court, Dec 2007.
6. Expert Witness retained by a local authority over a case of mine gas ingress to a private property. Case pending.

MEDIA EXPERIENCE

1. Formal training for effective broadcast media appearances (Newcastle University Staff Development Unit, 2003)
2. TV appearances: numerous occasions, from Nov 1992 to present, including both news programmes and documentaries.
 - Earliest: BBC ‘Look North’: concerning environmental risks associated with proposed rapid closure of the Durham Coalfield)
 - Documentaries as principal individual featured:
 - Frontline Scotland: ‘Iron Brew: the mine water pollution threat in Scotland’, broadcast 8th February 1996
 - ITV Tyne-Tees Documentary: “Alternative energy sources for North East England”, February 2006

Examples of recent TV appearances:

- ITV News October 2007, concerning prospects for clean coal technology with carbon capture and storage
- Interviewed by George Aligaya on BBC News 24 concerning red mud disaster in Hungary, October 2010

3. Radio programmes: numerous occasions, from Nov 1992 to present, including many regional and national news programmes, plus documentaries and scientific panel programmes.
 - Most notable radio news feature: interviewed by Sue MacGregor on Radio 4’s Today Programme about field experiments in Bolivia on acid mine drainage remediation using llama droppings, 31st January 2002.
 - Documentaries: twice the principal individual featured on BBC Radio 4’s “Changing Places” programme, in 1998 and again in 2001.
 - Scientific panel programmes:
 - Radio 4 ‘Material World’ (presenter: Quentin Cooper), live recording of audience debate: “How can we make clean water available for everyone?”, broadcast 22nd December 2005
 - Radio 4 ‘Home Planet’ (presenter Richard Daniel) live recording of audience debate on extremophiles, recycling, waste management, nuclear energy and carbon footprints. Broadcast 7th August 2007
 - BBC Radio Berkshire re rescue of Chilean miners, Oct 2010
4. Newspapers:
 - Numerous articles in regional and national press on environmental management issues.
 - Author of regular weekly feature in Newcastle “Evening Chronicle” as part of their “Go Green” campaign, answering reader’s questions on environment / energy topics

SUMMARY OF PERSONAL BIBLIOGRAPHY¹

PhD Thesis:

Younger, P.L. (1990) **Stream-Aquifer Systems of the Thames Basin: Hydrogeology, Geochemistry and Modelling**. PhD Thesis, University of Newcastle Upon Tyne. 388pp.

Books as author:

Younger, P.L. (2007) **Groundwater in the Environment: an Introduction**. Blackwell Publishing, Oxford. 318pp.

Younger, P.L., and Sapsford, D.J. (2004) **Evaluating the potential impact of opencast coal mining on water quality (Groundwater Regulations 1998). An assessment framework for Scotland**. Manual prepared for the Scottish Environment Protection Agency (SEPA). Newcastle University / NuWater Ltd, Newcastle Upon Tyne, UK. 75pp.

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Younger, P.L., Lamont-Black, J., and Gandy, C.J., (guest editors), (2005) "Risk of subsidence due to evaporite solution" (ROSES) - a Special Issue of *Environmental Geology*. (48: 285 – 286).

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Prokop, G., Younger, P.L. and Roehl, K.E. (editors) (2003) **Groundwater Management in Mining Areas** (Proceedings of the 2nd IMAGE-TRAIN Advanced Study Course, Pecs, Hungary, 23-27 June 2003) Umweltbundesamt GmbH, Vienna. 110pp

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Younger, P.L., & Manning D.A.C. (2010) Hyper-permeable granite: lessons from test-pumping in the Eastgate Geothermal Borehole, Weardale, UK. *Quarterly Journal of Engineering Geology and Hydrogeology* 43: 5-10.

Younger, P.L. (2010) Reconnaissance assessment of the prospects for development of high-enthalpy geothermal energy resources, Montserrat. *Quarterly Journal of Engineering Geology and Hydrogeology* 43: 11-22.

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- Clarkson, M.H., Birks, D., Younger, P.L., Carter, A., and Cone, S. (2009) Groundwater cooling at the Royal Festival Hall, London. **Quarterly Journal of Engineering Geology and Hydrogeology** 42: 335-346.
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SUMMARY: EXPERIENCE OF ENGINEERING PRACTICE

1. Mine water management

A. PRIVATE SECTOR PROJECTS

Scottish Coal Ltd

- Expert Review: restoration strategy for Westfield Opencast Site, Fife. (in association with Babbie, Glasgow). (1996 – 1998).
- Assessment of possible pollution problems associated with eventual restoration of proposed Drumcooper opencast coal site, Scotland. (with Water Management Consultants Ltd). (1997).
- Conceptual design of a passive mine water treatment system for Westfield Opencast Coal Site, Fife, Scotland. (2002 – 2003).
- Development of a conceptual hydrogeological model to support water level management in the Westfield pit lake (2004).

UK Coal (Mining) Ltd

- Application of the GRAM model to evaluation of water management and future dewatering requirements at Maltby Colliery, South Yorkshire (2007)
- Review of mine water management in Nottinghamshire following the closure of Welbeck Colliery (2010 – 2011).

Anglo American plc

- Anglo Coal (South Africa) Ltd: Review of post-closure mine water management strategies for Vryheid Coronation Colliery and Natal Anthracite colliery, Kwazulu-Natal Coal Field, South Africa (January 2000)
- Anglo Base Metals (Ireland) Ltd: Investigation of possible pathways and remediation options for solid phase dispersal of metals in metals downstream of pumped mine water discharges from active workings and an ore processing plant (2006-2007).

ISCOR (South Africa)

- External Review Consultant, Hlobane Colliery Closure Mine Water Management Project (with PHD Inc) (October 2000)

Companhia Vale do Rio Doce (Brazil)

- Hydrogeotechnical study of the inundation risks associated with the Taquari Vassouras Potash Mine, Sergipe, Brasil (April 2002)

Solid Energy (NZ) Ltd

- Independent Review of company Acid Rock Drainage Management Strategy (2005)
- Predictive modelling of backfill leachate water quality evolution at Stockton Opencast Mine, South Island, New Zealand (2006-07)

Small independent mining companies

- Durham Industrial Minerals Ltd: Hydrological evaluation and passive treatment pilot study to optimise zinc removal from active mine drainage (part-funded by EU TSME Programme) (1998).
- Blenkinsopp Collieries Ltd: Appraisal of mine water management options for the closure of Blenkinsopp Colliery, Northumberland. (part-funded by EU ERMITE project) (2001 – 2002).
- M I Drilling Fluids (Mining) Ltd: Design, construction and monitoring of a pilot passive treatment system at Foss Barytes Mine, Aberfeldy, Scotland (1998 – 99).

Viridor Waste Management Ltd

- Reconnaissance field evaluation of pollution liabilities pertaining to 20 colliery spoil heaps in central and northern England (1995)
- Feasibility study for remediation of water pollution from Birch Coppice and Astley Green Colliery spoil heaps (1995-1996)
- Remediation design for five acidic/ferruginous discharges at Nailstone Colliery, Leicestershire, UK (1997 – 2000).

Non-mining companies affected by mine waters

- Preliminary appraisal of the risk posed to indigenous water resource systems by dewatering of an open-pit gold mine in Bolivia for YUNTA NGO (July 1996)

- Northumbrian Water Ltd: assessment of sewer-clogging problems in urban Cleveland caused by ferruginous discharges from ironstone mines abandoned 40 years previously (1998). (See also entry under ‘Coal Authority’ re combined passive treatment of sewage and mine water)
- Aguas del Illimani S.A., La Paz, Bolivia: Assessment of remediation options for mine water pollution in the Milluni Catchment (August 1999).
- Railtrack / First Engineering Ltd: Hydrogeological aspects of the subsidence problems associated with old mine workings beneath the East Coast Main Line near Prestonpans, Scotland. (July 2002).

B. PUBLIC SECTOR PROJECTS

Government Office for Science

- Prime Ministerial Delegation of Experts to assist the Government of Hungary in the remediation of the major spillage of red mud from a failed storage pond near Kolontár (2010)

Environment Agency (England & Wales):

- Environmental risk assessments for the closure of the following mined systems:
 - o Central Durham Coalfield (1994 – 1998)
 - o Point of Ayr Colliery, North Wales (1996)
 - o Whittle Colliery, Northumberland (1997 – 1998)
 - o Frazer’s Grove Fluorspar Mine, Weardale (1998)
 - o Gwynfynydd Gold Mine, N Wales (1999)
- External Technical Reviewer: Wheal Jane Mine Water Remediation Program, Cornwall (1994 – 1999).
- External Technical Reviewer: South Crofty Tin Mine Closure Evaluation, Cornwall (1997-2000).
- Design of Europe’s first passive treatment systems for abandoned coal mine waters, at Quaking Houses, Co Durham (1994-95), Pelenna III, South Wales (1995-96) and Ynysarwed, South Wales (1997)
- Investigation of zinc pollution from historic mines in the Nent Valley, Cumbria. (1996 – 1999).

SEPA: Scottish Environment Protection Agency (and predecessor Agencies)

- Environmental risk assessments for the closure of:
 - o The Dysart-Leven Coalfield, East Fife (1994/5)
 - o Polkemmet Colliery, West Lothian (1995)
- Appraisal of passive treatment options to remediate residual pollution after reclamation of Baads Bing (colliery spoil heap), East Lothian (1995).
- Assessment of mine water hazards to canal systems at Falkirk Wheel (1999).
- Development of guidelines for assessment of opencast coal mining proposals in compliance with the Groundwater Regulations 1998 (2005)

Coal Authority

- Conceptual Design of mine water diversion and wetland treatment for St Helen’s Engine Shaft coal mine water discharge, Co Durham. (jointly funded by English Partnerships) (1998).
- Monitoring and performance assessment of the Deerplay RAPS acid mine water treatment system, Lancashire. (with IMC Ltd) (2001 – 2003).
- Review of active treatment options for the Frances Colliery (2001).
- Pilot plant investigation of feasibility of conjunctive passive treatment of sewage effluent and ferruginous mine water (Kibblesworth, Co Durham) jointly funded by Northumbrian Water Ltd. (2002).
- Prediction of the timing and quality of future mine water discharge from the Blenkinsopp Colliery, Northumberland. (with W S Atkins Ltd) (2003).

UK Local Government

- Durham County Council:
 - o Design and construction of Bowden Close pilot RAPS treatment system (1999-2000).
 - o Conceptual design of a full-scale passive system (2 no. RAPS and wetland) for treatment of acidic mine drainage at Bowden Close, County Durham. (2001-2002).
- Anglesey Borough Council: Design of procedures, regulatory framework and engineering works to eliminate flood risk from water trapped in old copper mine workings, Mynydd Parys (2002 – 2003).
- Easington District Council: independent review of Coal Authority proposals for the control of mine water rebound by pump-and-treat strategies in the East Durham Coalfield. (2003 – 2004).

Public bodies overseas

- Assessment of environmental water management technologies for the mining sector in the Rio das Velhas catchment, Minas Gerais, Brasil. With Montgomery Watson Ltd/ESSE Consultoria and Engenharia, for FEAM/World Bank (June – August 1997).
- Specialist advisor to the Junta de Andalucía on remediation of the Aznalcóllar mine waste spill in the context of developing the Corredor Verde del Guadiamar (1998-99).
- Options for remediation of the Avoca mine water discharges, Republic of Ireland. For the Eastern Regional Fisheries Board, Blackrock, Dublin (2002-2003).
- Assessment of potential water management problems arising from the closure of the Gardanne Coal Basin, Provence, France. For Houllières du Bassin Centre et du Midi, Marseille (2003).
- Field training of engineering staff in techniques for mine water remediation. For Houllières du Bassin de Lorraine, France. (2004).
- Review of proposals and preliminary activities to manage mine water in the 1B Hydraulic System, Cape Breton Island. For Public Works and Government Services Canada (2006).

2. Water Resources and Pollution Control Engineering

National Rivers Authority, Yorkshire and Northumbria, 1989 – 1991:

- Drilling, geophysical logging and test pumping of two public supply wells at Thornton Steward and Ainderby Steeple, North Yorkshire (1989).
- Retro-fitting a wire-wound well screen to a major public supply well, with testing of well before and after, Lower Dunsforth, North Yorkshire (1990).
- Letting and management of contract for drilling and test-pumping of 14 exploration boreholes in the Fell Sandstone Aquifer, Berwick (1990-91).
- Letting and management of contract for drilling and test-pumping of 16 exploration boreholes in the Magnesian Limestone aquifer, Co Durham (1991).
- Environmental evaluation of numerous planning proposals in Yorkshire, Durham and Northumberland (1989 – 92).

United Nations Association / Centro YUNTA, La Paz, Bolivia

- drilling, testing and environmental assessment of public supply and irrigation wells, Bolivian Altiplano (1991-92).

Independent Consultancy prior to taking up first University post:

- Test-pumping and licence procurement for two public-supply wells in N Yorkshire (for Yorkshire Water Services Ltd) (August 1992).
- Conceptual modelling of the Vale of York - public enquiry on a proposed conjunctive use scheme. (For Yorkshire Water Services Ltd) (September 1992).

University-based consultancy:

- Hydrogeological investigation of Felling Riverside contaminated land site (for Gateshead Metropolitan Borough Council) (1996 – 1999).
- Drilling of 12 observation wells at Robertgate, Cumbria, rehabilitation of an artesian well supply, Robertgate Cumbria (for NIREX Ltd) (1997).
- Conceptual design of a wetland system to treat landfill leachate, Harecrag Landfill, Northumberland (for NEM Ltd) (1997 - 99)
- Evaluation of the water resources supply–demand balance for north Northumberland (for Northumbrian Water Ltd) (1997)
- Hydrogeological investigation of the Metro Riverside contaminated land site, Gateshead (for COSTCO Ltd) (1998).
- Conceptual design and pilot testing of a novel hydraulic control strategy for contaminated land leachate, St Anthony’s Tar Works, Newcastle (for Newcastle City Council) (1998-99).
- Review of leakage control strategy, Northumbrian Water Ltd (1999).
- Assessment of iron removal options for the Mosswood Water Treatment Works sludge site effluent, Northumbrian Water Ltd (2000 - 2001).
- Use of ferric hydroxide as a reagent for removal of phosphate from sewage effluent at sewage treatment works in County Durham, Northumbrian Water Ltd (2000 - 2001).

- External Technical Reviewer: Itchen Sustainability Study Groundwater Modelling Project. Environment Agency, Winchester (2001 - 2002).
- External Technical Reviewer: Lambourn-Kennet Sustainability Study. Environment Agency, Wallingford. (2002 - 2005).
- External Technical Reviewer: Selby area Groundwater Modelling Project. Environment Agency, Leeds (2003 - 2005).
- External Technical Reviewer: Permian Aquifer Conceptual Modelling Project. Environment Agency, Newcastle (2007 - 2009).

Project Dewatering Ltd (in part-time capacity of Director of Design)

- Dewatering wellfield designs: numerous small design projects involving wellfield specification and estimation of settlement due to dewatering. (1999 – present)

3. Geothermal energy

- Borehole exploration for a groundwater-sourced heat pump system, Eco-Office, Hebburn. Groundwork South Tyneside. (1998).
- Reconnaissance evaluation of high-temperature geothermal resources of the island of Montserrat, East Caribbean. For Montserrat Utilities Ltd (2005-6)
- Design, drilling and testing of the UK's first deep geothermal borehole in 20 years: the 1000m Eastgate Borehole, Weardale, Co Durham. With PB Power Ltd, for Wear Valley Task Force. (2004 – 2006).
- Principal Hydrogeological Design Advisor, Groundwater Cooling project, London Underground Ltd's "Cooling the Tube" programme. With Parsons Brinckerhoff (2005 – ongoing)
- Thermal response testing of closed-loop boreholes, Gateshead Town Centre redevelopment site, for Tesco Ltd (2007).
- Drilling of second deep borehole at Eastgate, Weardale, and fitting-out of Eastgate No 1 for operational use. Funded £460K by Deep Geothermal Challenge Fund of the UK Government's Department of Energy & Climate Change. (Jan – July 2010).
- Development of prospecting cases with Cluff Geothermal Ltd (2010 - present).