# University of Birmingham

# Professor Ian Fairchild PhD

Professor of Geosystems

**School of Geography, Earth and Environmental Sciences (/schools/gees/index.aspx)**

## Contact details


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## About

Ian Fairchild is a geoscientist with broad interests in the geochemistry of the Earth's surface, climate change and Quaternary and Neoproterozoic earth history. He employs this breadth of knowledge in teaching, in public outreach, and professional activities such as examining and research assessment. He is equally at home in the field and the laboratory with a wealth of experience in glacial environments, caves, rock successions and at national and international geochemical research facilities.

## Qualifications

- BSc University of Nottingham
- PhD University of Nottingham

## Biography

Ian is a Chartered Geologist and a Fellow of the Royal Geographical Society. His research on geochemical aspects of earth surface processes and systems commenced in 1990 and has encompassed climatic, glacial, karstic and experimental themes, complementing a longer-standing interest in carbonates and ice ages in deep time. His academic career started with undergraduate study of geology at Nottingham (BSc 1974) before undertaking research on sedimentology of Scottish metasediments (PhD 1978). During his PhD studies he took up a demonstratorship at Cambridge in January 1977 before being appointed lecturer in Sedimentology at Birmingham in June 1980. After promotion to Senior Lecturer in 1993, he moved to Keele University in January 1996 as Professor of Earth Surface Processes. He was successively a Head of Department (1998-2001) and Dean of the Faculty of Natural Sciences and member of the University's senior management team (2001-2003) at Keele.

He returned to the University of Birmingham in September 2003 as Professor of Physical Geography and became retitled Professor of Geosystems in 2010 reflecting his change of academic leadership responsibilities. Ian has been the Chief Editor of the *Journal of the Geological Society* (1996-2000) and an Editor of *Reviews of Geophysics* (2005-2010). He has much experience with the Natural Environmental Research Council and is a member of the sub-panel for Earth Systems and Environmental Sciences in the Research Excellent Framework 2014. He was Head of the School of Geography, Earth and Environmental Sciences at Birmingham for the calendar years 2012 and 2013.

## Teaching

Ian has taught on a range of modules in undergraduate and postrgraduate programmes in geography, earth sciences and environmental sciences and on the . He is able to illustrate a large proportion of his lectures with examples taken from his research experience on modern environments and carries this through to advising undergraduates on their own field-based projects.

He makes contributes to the year 1 Earth Systems module taken by nearly all students entering the School. Ian teaches half of the year 2 module on Geomorphological Processes in which he deals with karstic, coastal and glacial environments as well as methods of dating landscape change. He also teaches the first half of the year 2 module on Reconstructing Quaternary Environments in which he foucses on the nature of Quateranry archives. Both physical geography and joint honours geology-geography students populate these modules. Ian overviews Quaternary science as part of a year 3 module on Climates of the Past available to both geography and earth science programmes. Ian supervises geography and joint honours dissertations and MSci projects.

## Postgraduate supervision

Ian Fairchild has supervised 31 research students and post-docs who have successfully completed their projects. Current research students are listed below:

- **Rosemary Dartnall (http://www.birmingham.ac.uk/schools/gees/people/dr-students/dartnall-rosemary.aspx)** (started PhD studies, October 2011) Geology of the Gwna Melange
- **Jonathan Dredge (http://www.gees.bham.ac.uk/staff/dredgej.shtml)** (started PhD studies 2010) Aerosol contributions to speleothem chemistry
- Ed Fleming (started PhD studies 2010) Application of anisotropy of magnetic susceptibility to glacial sediments (**Dr. Carl Stevenson (/staff/profiles/gees/stevenson-carl.aspx)** is the lead supervisor)

Overseas students:

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| Pilar Aliaga | For PhD | 2010- | Mexican government | Rare earth elements in speleothems<br><br>External member of thesis advisory committee, National University of Mexico. Pily visited Birmingham for 4 months in 2012. |
| Robert Klaebe | For PhD | 2012- | Australian | Chemistry of Neoproterozoic carbonates. University of Adelaide |

government

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| Rena Karanouh | For MSc | 2012- | American U. of Beirut | Paleo-climatic conditions of the eastern Mediterranean based on stable isotope variations from two stalagmites |

## Research

**Research groups**

- Geosystems
- Water Sciences

**Research interests**

- **Speleothems and Climate Change (/research/activity/geosystems/themes/speleothem.aspx)**, especially the development of palaeoclimate proxies and the understanding of karst processes including their hydrology. See also **www.speleothemscience.info (http://www.speleothemscience.info/)**
- Glaciation and carbonates in deep time - The Cryogenian. See **GAINS project (http://www.birmingham.ac.uk/research/activity/geosystems/projects/gains2010/index.aspx)**
- Aqueous Geochemistry in relation to weathering reactions and hydrology in glacial and riverine environments (Iceland, Himalayas).
- Experimental studies of mineral-water interactions

For an overview see Ian's **Inaugural lecture (18 May 2004): Caves, Climate, $CO_2$ and Civilization (PDF - 3.94MB) (/Documents/college-les/gees/staff/fairchild-inaugural.pdf)**

**Current / recent research**

- 2014-15 co-investigator of Australian Research Council grant "To what extent does fire affect karst processes? Burning questions for fire management"
- 2014-16 co-investigator of NERC standard grant SCENT (Soil Carbon Export revealed using Novel Tracers on multiple timescales), led by Dr. Rebecca Bartlett
- 2011-14 co-investigator of Australian Research Council grant Were abrupt changes in the Precambrian global carbon cycle the trigger for animal appearance and radiation on Earth?
- 2010-2013 ***Glacial Activity in Neoproterozoic Svalbard (GAINS)*** **(/research/activity/geosystems/projects/gains2010/index.aspx)** Principal investigator and project leader of a project funded by a NERC standard grant involving five UK and eight overseas institutions
- 2010-2011 *Interrogating trees as archives of environmental sulphur variability*
  Co-investigator of a NERC small grant led by Dr. Peter Wynn of Lancaster University
- 2010-2012 *Palaeoenvironmental change and hominid migration in Australia*
  Investigator of this NERC standard grant led by Dr. Alison Blyth of the Open University
- 2009-2012 *A calibrated climate record from Gibraltar speleothem: the instrumental era, the Holocene and the last interglacial*
  Co-investigator of NERC standard grant, Professor David Mattey of Royal Holloway
- 2009-2011 *Last millennium climate reconstruction in Ethiopia using multiple stalagmite parameters*
  Co-investigator of NERC standard grant. Led by **Dr.Martin Widmann (/staff/profiles/gees/widmann-martin.aspx)** (Birmingham). Project originally led by Professor Andy Baker (now University of New South Wales). Also co-investigator of NERC isoe facility project entitled *Early Human migration out of Ethiopia: stalagmite isoic evidence of a climatic forcing during 130-160 ka*.
- 2009-2010 *Activating the speleothem archives*
  Leverhulme Study Abroad Fellowship
- 2009-2010 *Elemental Signals in Karst: from Soil to Speleothem*
  Principal Investigator of NERC small grant. Co-investigators **Professor Jamie Lead (/staff/profiles/gees/lead-jamie.aspx)** (Birmingham) and Dr. Hao Zhang (Lancaster)
- 2009 NERC radiocarbon allocation *Atmospheric carbon sequestration in hyperalkaline speleothems*
- 2008-2010 Supervisor of Marie Curie Fellow, Dr David Domínguez-Villar(EU Marie Curie Fellowship), *PROCAVET: Proxies from cave deposits: testing their sensitivity using the current period of global change*
- 2008 NERC ion microprobe facility grant: *Annual sulphate cycles in an Alpine speleothem: winter temperature proxy*
- 2005-2009 ***Atmospheric forcing of sulphate in speleothem carbonate*** **(/research/activity/geosystems/projects/atmosphericforcing.aspx)** Principal Investigator of NERC standard grant, co-I Dr. Andy Baker (Birmingham) and Dr. Neil Loader (Swansea) with Dr. Peter Thomas (Keele) and Dr. Jonathan Lageard (MMU) as additional collaborators. Post-docs Dr. Peter Wynn (now Lancaster University), Ms Anna de Momi. Associated European Synchtron Facility grant: High-resolution elemental variability in stalagmites: new archive of atmospheric chemistry changes; Nuffield Foundation undergraduate bursary grant Incorporation of sulphate into calcite crystals and several associated grants from NERC ICP facility allocation.
- 2003-2007 ***Atlantic Seaboard Climatic Reconstructions Including Bounding Errors (Ascribe)*** **(http://www.gees.bham.ac.uk/research/projects/ascribe/index.shtml)**
  PI and project leader of NERC standard grant

## Other activities

**Voting Member of the Cryogenian sub-commission of the International Commission on Stratigraphy**

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| European Synchrotron Research Facility, Grenoble, France | Beamtime Allocation Panel Chair Panel C07, 2011-2015 |

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| Open University | Science Programme Adviser | 2013 | 2015 |

## Publications


Anderson, R.P., **Fairchild**, I.J., Tosca, N.J. & Knoll, A.H. 2013 Microstructures in metasedimentary rocks from the Neoproterozoic Bonahaven Formation, Scotland: Microconcretions, microtektites, or microfossils? *Precambrian Research*, 233, 59-72.

Domínguez-Villar, D., **Fairchild**, I.J., Baker, A., Carrasco, R.M. & Pedraza, J. 2013 Reconstruction of cave air temperature based on surface atmosphere temperature and vegetation changes: implications for speleothem palaeoclimate records. *Earth and Planetary Science Letters*, 369, 158-168.

Mattey, D.P., Fisher, R., Lowry, D., Atkinson, T.C., Lain, J.-P., Durrell, R., Ainsworth, M. & **Fairchild**, I.J. 2013 Methane in Gibraltar karst. *Earth and Planetary Science Letters*, 374, 71-80.

Wynn, P.M., Borsato, A., Baker, A., Frisia, S., Miorandi, R. & **Fairchild**, I.J. 2013 Biogeochemical cycling of sulphur in karst and transfer into speleothem archives at Grotta di Ernesto, Italy. *Biogeochemistry*, 114, 255-267.

Treble, P.C., Bradley, C., Wood, A., Baker, A., Jex, C.N., **Fairchild**, I.J., Gagan, M.K., Cowley, J. & Azcurra, C. 2013 An isotopic and modelling study of flow paths and storage in Quaternary calcarenite, SW Australia: implications for speleothem paleoclimate records. *Quaternary Science Reviews,* 64, 90-103.

Dredge, J., **Fairchild**, I.J., Harrison, R.M., Fernandez-Cortes, A., Sánchez-Moral, S., Jurado, J., Gunn, J., Smith, A., Spötl, C., Mattey, D., Wynn, P. & Grassineau, N. 2013 Cave aerosols: distribution and contribution to speleothem geochemistry. *Quaternary Science Reviews*, 63, 23-41.

Domínguez-Villar, D., Baker, A., **Fairchild**, I.J. & Edwards, R.L. 2012 A method to anchor floating chronologies in annually laminated speleothems with U-Th dates. *Quaternary Geochronology,* 14, 57-66

Baker, A., Bradley, C., Phipps, S.J., Fischer, M., **Fairchild**, I.J., Fuller, L., Spötl, C. & Azcurra, C. 2012 Millennial-length forward models and pseudoproxies of stalagmite $d^{18}O$: an example from NW Scotland. *Climate of the Past* 8, 1153-1167

Baker, A. and **Fairchild, I.J.** 2012 **Dripwater hydrology and speleothems. (http://www.nature.com/scitable/knowledge/library/drip-water-hydrology-and-speleothems-26394838)** *Nature Education Knowledge* 3(3):16

**Fairchild, I.J.** & Baker, A. 2012 *Speleothem Science. From Process to Past Environment.* Wiley-Blackwell. See **www.speleothemscience.info (http://www.speleothemscience.info)**

Hartland, A., **Fairchild, I.J.** Lead, J.R., Borsato, A., Baker, A., Frisia, S. & Baalousha, M. 2012 From soil to cave: transport of trace metals by natural organic matter in karst dripwaters. *Chemical Geology*, 304-305, 68-82.

Arnaud, E. & **Fairchild, I.J.** 2011 The Port Askaig Formation, Dalradian Supergroup, Scotland In: Arnaud, E., Halverson, G. P. & Shields-Zhou, G. (eds) The Geological Record of Neoproterozoic glaciations. *Geological Society of London, Memoir*, 36, 635-642.

Hartland, A., **Fairchild, I.J.** Lead, J.R., Zhang, H. & Baalousha, M. 2011 Size, speciation and lability of NOM-metal complexes in hyperalkaline cave dripwater. *Geochimica et Cosmochimica Acta*,75, 7531-7577.

McDermott, F., Atkinson, T.C., **Fairchild, I.J.**, Baldini, L.M. & Mattey, D.P. 2011 A first evaluation of the spatial gradients in $d^{18}O$ recorded by European Holocene speleothems. *Global and Planetary Change*. 79, 275-287.

Baker, A., Wilson, R., **Fairchild, I.J.**, Franke, J., Spötl, C., Mattey, D., Trouet, V. & Fuller, L. 2011 High resolution $d^{18}O$ and $d^{13}C$ records climate from an annually laminated Scottish stalagmite and relationship with last millennium climate. *Global and Planetary Change* 79, 303-311.

Jex, C., Baker, A., Eden, J., Eastwood, W.J., **Fairchild, I.J.**, Leng, M.J. & Thomas, L. 2011 A 500-year speleothem-derived reconstruction of late autumn-winter precipitation, North East Turkey. *Quaternary Research*, 75, 399-405.

Frisia, S., **Fairchild, I.J.**, Fohlmeister, J., Miorandi, R. Spötl, C. & Borsato, A. 2011 Carbon mass-balance modelling and carbon isotope exchange processes in dynamic caves. *Geochimica Cosmochimica Acta.* 75, 380-400.

Domínguez-Villar, D., **Fairchild, I.J.**, Carrasco, R.M., Pedraza, J. & Baker A. 2010 The effect of visitors in a touristic cave and the resulting constraints on natural thermal conditions for palaeoclimate studies (Eagle Cave, central Spain). *Acta Carsologica,* 39, 491-502.

**Fairchild, I.J.** & Hartland, A. 2010 Trace element variations in stalagmites: controls by climate and by karst system processes. In: Stoll, H. and Prieto, M., editors. *Ion partitioning in ambient temperature aqueous systems: from fundamentals to applications in climate proxies and environmental geochemistry*. European Mineralogical Union Notes in Mineralogy, 10, 259-287.

Miorandi, R., Borsato, A., Frisia, S., **Fairchild, I.J.** & Richter, D.K. 2010 Epikarst hydrology and implications for stalagmite capture of climate changes at Grotta di Ernesto (N.E. Italy): results from long-term monitoring. *Hydrological Processes*, 24, 3101-3114.

Hartland, A., **Fairchild, I.J.**, Lead, J.R. & Baker, A. Fluorescent properties of organic carbon in cave dripwaters: effects of filtration, temperature and pH. *Science of the Total Environment*, 408, 5940-5950.

Baker, A., Asrat, A., **Fairchild, I.J.**, Leng, M., Thomas, L., Widmann, M., Jex, C., Dong, B., van Calsteren, P. & Bryant, C. 2010 Decadal-scale rainfall variability in Ethiopia recorded in an annually laminated, Holocene-age, stalagmite. *The Holocene*, 20, 827-836.

Mattey, D.P., **Fairchild, I.J.**, Atkinson, T.C., Latin, J.-P., Ainsworth, M. & Durrell, R. 2010 Seasonal microclimate controls on calcite fabrics, stable isoes and trace elements in modern speleothem from St. Michaels Cave, Gibraltar. Tufas and Speleothems: Unravelling the Microbial and Physical Controls. *Geological Society, London, Special Publication*, 336, 323-344.

**Fairchild, I.J.**, Spötl, C., Frisia, S., Borsato, A., Susini, J., Wynn, P.M., Cauzid, J. & EIMF 2010 Petrology and geochemistry of annually laminated stalagmites from an Alpine cave (Obir, Austria): seasonal cave physiology. In: Pedley, H.M.& Rogerson, M. (eds) Tufas and Speleothems: Unravelling the Microbial and Physical Controls. *Geological Society, London, Special Publication*, 336, 295–321.

Muller, C.L., Kidd, C., **Fairchild, I.J.** and Baker, A. 2010 Investigation into clouds and precipitation over an urban area using micro rain radars, satellite remote sensing and fluorescence spectrophotometry. *Atmospheric Research*, 96, 241-255.

Jex, C., Baker, A., **Fairchild, I.J.** Eastwood, W.J., Leng, M.J., Sloane, H.J., Thomas, L. & Bekaroglu, E. 2010. Calibration of speleothem □18O with instrumental climate records from Turkey. *Global and Planetary Change,* 71, 207-217.

Hartland, A., **Fairchild, I.J.**, Lead, J.R., Dominguez-Villar, D., Baker, A., Gunn, J., Baalousha, M. & Ju-Nam, Y. 2010 (for 2009) The dripwaters and speleothems of Poole's Cavern: a review of recent and ongoing research. *Cave and Karst Science*, 36, 37-46.

Wynn, P.M., **Fairchild, I.J.**, Frisia, S., Spötl, C., Baker, A., Borsato, A. & EIMF. 2010 High-resolution sulphur isoe analysis of speleothem carbonate by secondary

ionization mass spectrometry. *Chemical Geology*, 271, 101-107.

Cook, S.J., Robinson, Z.P., **Fairchild, I.J.**, Knight, P.G., Waller, R.I. and Boomer, I. 2010. The role of glaciohydraulic supercooling in the formation of stratified facies basal ice: Svínafellsjökull and Skaftafellsjökull, southeast Iceland. *Boreas*, 39, 24-38.

Dominguez-Villar, D., **Fairchild, I.J.**, Baker, A., Wang, X., Edwards, R.L. & Cheng, H. 2009. Oxygen isoe precipitation anomaly in the North Atlantic region during the 8.2 ka event. *Geology*, 37, 1095-1098.

Robinson, Z.P., **Fairchild, I.J.** and Spiro, B. 2009 The sulphur isoe and hydrochemical characteristics of Skeiðarársandur, Iceland: identification of solute sources and implications for weathering processes *Hydrological Processes*, 23, 2212-2224.

**Fairchild, I.J**., Loader, N.J., Wynn, P.M., Frisia, S., Thomas, P.A., Lageard, J.G.A., de Momi, A., Hartland, A., Borsato, A., La Porta, N. and Susini, J. 2009 Sulfur fixation in wood mapped by synchrotron X-ray studies: implications for environmental archives. *Environmental Science and Technology,* 43, 1310–1315.

Bao, H., **Fairchild, I.J**., Wynn, P.M. and Spötl, C. 2009 Stretching the envelope of past surface environments: Neoproterozoic glacial lakes from Svalbard. *Science,* 323, 119-122

**Fairchild, I.J**. and Treble, P.C. 2009 Trace elements in speleothems as recorders of environmental change. *Quaternary Science Reviews*, DOI 28, 449-468.

Smith, C.L., **Fairchild, I.J.**, Spötl, C., Frisia, S., Borsato, A., Moreton, S.G. and Wynn, P.M. 2009 Chronology-building using objective identification of annual signals in trace element profiles of stalagmites. *Quaternary Geochronology* 4, 11-21.

Muller, C.L., Baker, A., Hutchinson, R., **Fairchild, I.J**., Kidd, C., 2008. Analysis of rainwater dissolved organic carbon using fluorescence spectrophotometry, *Atmospheric Environment* 42, 8036-8035.

Baker, A., Smith, C.L., Jex, C., **Fairchild, I.J**., Genty, D. and Fuller, L. 2008 Annually laminated speleothems: a review. *International Journal of Speleology* 37, 193-206.

Treble, P., **Fairchild, I.J.** and Fischer, M.J. 2008 Understanding climate proxies in southwest-Australian speleothems. *PAGES News*, 16(3), 17-19.

Fuller, L., Baker, A., **Fairchild, I.J.**, Spötl, C., Marca-Bell, A., Rowe, P. and Dennis, P.F. 2008 Isoe hydrology of dripwaters in a Scottish cave and implications for stalagmite palaeoclimate research. *Hydrology and Earth System Science*, 12, 1065-1074.

Wynn, P.M., **Fairchild, I.J**., Baker, A., Baldini, J.U.L. and McDermott, F. 2008 Isoic archives of sulphate in speleothems. *Geochimica Cosmochimica Acta*, 72, 2465-2477.

Robinson, Z.P., **Fairchild, I.J**. and Russell, A.J. 2008 Hydrogeological implications of glacial landscape evolution at Skeiðarársandur, SE Iceland. *Geomorphology*, 97, 218-236

Baker, A., Asrat, A., **Fairchild, I.J**., Leng, M.J., Wynn, P.M., Bryant, C., Genty, D and Umer, M. 2007 Analysis of the climate signal contained within d18O and growth rate parameters in two Ethiopian stalagmites. *Geochimica Cosmochimica Act*a, 71, 2975-2988

**Fairchild, I.J**. and Kennedy, M.J. 2007 Neoproterozoic glaciation in the Earth System. *Journal of the Geological Society*, London, 164, 895-921

**Fairchild, I.J**. and McMillan, E.A. 2007 Speleothems as indicators of wet and dry periods. International *Journal of Speleology*, 36, 79-84

**Fairchild, I.J**., Frisia, S., Borsato, A. and Tooth, A.F. 2007. Speleothems. In: *Geochemical Sediments and Landscapes* (ed. Nash, D.J. and McLaren, S.J.), Blackwell, Oxford, p. 200-245

Borsato, A. Frisia, S., **Fairchild, I.J.**, Somogyi, A. and Susini, J. 2007 Trace element distribution in annual stalagmite laminae mapped by micrometer-resolution X-ray fluorescence: implications for incorporation of environmentally significant species. *Geochimica Cosmochimica Acta,* 71, 1494-1512

Baldini, J.U.L., McDermott, F. and **Fairchild, I.J**. 2006 Spatial variability in cave drip water hydrochemistry: Implications for stalagmite paleoclimate records. *Chemical Geology*, 235, 290-304

Smith, C.L., Baker, A., **Fairchild, I.J**., Frisia, S. and Borsato, A. 2006 Reconstructing hemispheric-scale climates from multiple stalagmite records. *International Journal of Climatology*, 26, 1417-1424.

McGillen, M. and **Fairchild, I.J**. 2005. An experimental study of the controls on incongruent dissolution of CaCO3 under analogue glacial conditions. *Journal of Glaciology*, 51, 383-390.

**Fairchild, I.J.**, Smith, C.L., Baker, A., Fuller, L., Spötl, C., Mattey, D., McDermott, F. and E.I.M.F. 2006 Modification and preservation of environmental signals in speleothems. *Earth Science Reviews* 75, 105-153.

**Fairchild, I.J**., Tuckwell, G.W., Baker, A. and Tooth, A.F. 2006. Modelling of dripwater hydrology and hydrogeochemistry in a weakly karstified aquifer (Bath, UK): implications for climate change studies. *Journal of Hydrology* 321, 213-231.

## Expertise

Climate change past and present; limestone and water supply in limestone areas; caves and their deposits; water quality