

Michael John Heap

1. Personal Information

DOB 12th March 1983
Nationality English
E-mail m.heap@ucl.ac.uk

2. Employment and Education

May 2009- **Year post-doc at Ludwig-Maximilians-Universität München (LMU), Sektion für Mineralogie, Petrologie und Geochemie (SMPG) funded by the German Federation of Materials Science and Engineering (BV MatWerk) and the German Research Foundation (DFG)**

May 2009- **Honorary Research Associate, Rock and Ice Physics Laboratory, University College London**

April 2009 **Maître de conférences invité (invited lecturer) at Ecole et Observatoire des Sciences de la Terre (Université Louis Pasteur, Strasbourg)**

2005 – 2008 **Studying for a PhD, Rock and Ice Physics Laboratory, University College London (Funded until March 2006, VIVA on 3rd April 2009)**

- Awarded £600 Graduate School Travel Grant to attend American Geophysical Union annual general meeting, San Francisco, USA.
- Awarded 'Young Researcher' financial support to attend the annual general meeting of the European Geophysical Union (EGU) 2008 in Vienna, Austria, to present findings on 'The influence of effective stress and pore fluid pressure on brittle creep in water-saturated Darley dale sandstone'
- Paper 'Quantifying the evolution of static elastic properties in variably fractured crystalline rock' [Heap and Faulkner, 2008] nominated for the TSG Ramsay Medal (best publication to appear within two years of a doctoral award)
- Awarded 'Young Researcher' financial support to attend Euro-Conference of 'Rock Physics and Geomechanics' on Natural hazards: thermo-hydro-mechanical processes in rocks in Erice, Sicily
- Awarded £75 for 2nd prize in departmental poster competition.
- Runner-up to best poster at Geological Society of London Tectonics Studies Group, Manchester
- Awarded £200 Geological Society of London Tectonics Study Group (TSG) travel grant to attend Gordon Rock Deformation conference, Big Sky, Montana
- Awarded £602 Graduate School Travel Grant to attend Gordon Rock Deformation conference, Big Sky, Montana
- Awarded University College London NERC studentship for 3 years

2001 – 2005 **First Class (Hons) MEng in Geology, University of Liverpool**

- Awarded 94% for masters project

- Hunter Prize for 'excellence in geology' 2005
- Awarded £1,358 Nuffield Research Bursary to study 'quantifying the static elastic evolution of crystalline rock approaching failure' at the Rock Deformation Laboratory, University of Liverpool. Publications: Faulkner *et al.* [2006] and Heap and Faulkner [2008]
- Awarded 79% for honours mapping project; Dave Johnston Mapping Prize nominee 2005 (for the best mapping project in the UK and Ireland)
- Runner-up to best poster at Geological Society of London Tectonics Studies Group annual general meeting, Plymouth 2005
- Newell Prize for 'excellence in geology' 2004
- Mineralogical Society Student of the Year 2003

3. Membership of professional bodies

European Geophysical Union: 2008-
 Fellow of the Geological Society of London: 2005-
 American Geophysical Union: 2004-
 UK Mineralogical Society: 2003-2005

4. Main Topics of Research

Time-dependent rock deformation

Time-dependent brittle deformation is a fundamental and ongoing process in the Earth's upper crust. The characterization of time-dependent processes is a critical precursor for the understanding of the long-term behaviour and strength of the brittle crust. I have therefore studied this process by performing laboratory 'brittle creep' experiments on sandstones and basalt. Publications: [Heap *et al.*, 2009a, JGR, in press; Heap *et al.*, 2009b, GRL, submitted, Ventura *et al.*, 2009, in press; 2 more are currently in an advanced stage of preparation].

Elastic and mechanical properties of Etna basalt

Volcanic edifices are characterised by pressurization/de-pressurization cycles due to magma intrusion and high temperatures at shallow depths. I have therefore simulated cyclic stressing by performing increasing-amplitude, stress-cycling experiments on Etna basalt to investigate the degradation of elastic moduli with increasing crack damage. Publications: [Heap *et al.*, 2009c, Tectonophysics, 2 more are currently in an advanced stage of preparation].

Elastic property development in variably fractured crystalline rock

Awarded a Nuffield Undergraduate Bursary for £1,358 in 2004 to study elastic property development in variably fractured rock at the Rock Deformation Laboratory, University of Liverpool. Publications: [Faulkner *et al.*, 2006, Nature; Heap and Faulkner, 2008, IJRMMS].

5. Teaching experience

- Demonstrator for three practical classes at UCL: Map Analysis, Dynamic Earth and Structural Geology.
- Field demonstrating experience: two mapping trips to Cantabria (Spain), mapping trip to Coniston (Lake District) and field trip to SW England.
- Invited lecture on 'Creep in the crust' for undergraduate course at Ecole et Observatoire des Sciences de la Terre (Université Louis Pasteur, Strasbourg) and on 'Brittle rock deformation' at LMU, München.

6. Laboratory experience

I have extensive experience in:

- Running triaxial experiments in conjunction with a 10-channel Vallen and a PCI-2 based MISTRAS AE recording system and at elevated temperatures using an internal electric heater.
- Running uniaxial compression experiments and tensile 'brazil' experiments.
- Performing permeability and ultrasonic wave velocity measurements at elevated confining pressures using a hydrostatic pressure vessel or 'permeameter'.
- Performing benchtop ultrasonic wave velocity anisotropy analysis and anisotropy of magnetic susceptibility (AMS) measurements.
- Microcrack density analysis using optical microscopy and feSEM.
- Design, construction and modification of experimental rock physics equipment.
- I am extremely proficient in rock sample preparation including coring, grinding and sawing apparatus.

7. Journals reviewed

- Reviewed papers for a special issue of Pure and Applied Geophysics, the Journal of Geophysical Research and International Journal of Rock Mechanics and Mining Sciences.

8. Peer-reviewed publications

[6] **Heap, M. J.**, Baud, P., Meredith, P. G., 2009. The influence of temperature on brittle creep in sandstones. *Geophys. Res. Lett.*, *submitted*.

[5] Ventura, G., Vinciguerra, S., Moretti, S., Meredith, P. G., **Heap, M. J.**, Baud, P., Shapiro, S. A., Dinske, C. and Kummerow, J., 2009. Understanding slow deformation before dynamic failure. *UNESCO International Year of Planet Earth special issue book series (Ed: Tom Beer)*.

[4] **Heap, M. J.**, Baud, P., Meredith, P. G., Bell, A. F. and Main, I. G., 2009. Time-dependent brittle deformation in Darley Dale sandstone. *J. Geophys. Res.* *In press*.

[3] **Heap, M. J.**, S. Vinciguerra, P. G. Meredith, 2009. The evolution of elastic moduli with increasing damage during cyclic stressing of a basalt from Mt. Etna volcano. *Tectonophysics*, 471, 153-160.

[2] **Heap, M. J.** and D. R. Faulkner, 2008. Quantifying the static elastic evolution of crystalline rock approaching failure. *International Journal of Rock Mechanics and Mining Sciences*, 45/4, 564-573.

[1] Faulkner, D. R., T. M. Mitchell, D. Healy and **M. J. Heap**, 2006. Slip on 'weak' faults by the rotation of remotely-applied stresses in the fracture damage zone. *Nature*, 444, 922-925.

9. Conference abstracts

[28] **M. J. Heap**, P. Baud, P. G. Meredith, 2009. Time-dependent brittle creep in sandstone: influence of confining pressure and temperature. Abstract, Deformation, Rheology and Tectonics, Liverpool/Manchester.

[27] **M. J. Heap**, P. Baud, P. G. Meredith, A. F. Bell and I. G. Main, 2009. Time-dependent brittle deformation in Darley Dale sandstone. Abstract, European Geosciences Union, Vienna, Austria.

[26] **Heap, M. J.**, P. Baud, P. G. Meredith, 2009. Influence of temperature on brittle creep in sandstones. Abstract, European Geosciences Union, Vienna, Austria.

[25] **Heap, M. J.**, P. Baud, P. G. Meredith, S. Vinciguerra, A. F. Bell and I. G. Main, 2009. Time-dependent brittle deformation (creep) in Mt. Etna volcano. Abstract, European Geosciences Union, Vienna, Austria.

[24] Vinciguerra, S., Benson, P. Burlini, L., Caricchi, L., **Heap, M. J.**, Meredith, P. G., 2009. Understanding pre-eruptive patterns: the rock physics interpretation. Abstract, European Geosciences Union, Vienna, Austria.

[23] Grindrod, P. M., **Heap, M. J.**, Meredith, P. G. and Sammonds, P. R., 2009. Strength and elastic moduli of magnesium sulfate hydrates under Martian conditions. Lunar and Planetary Sciences Conference, Houston, USA.

[22] Grindrod, P. M., **Heap, M. J.**, Meredith, P. G. and Sammonds, P. R., 2009. Mechanical properties of magnesium sulfate hydrates on Mars. RAS Specialist Discussion Meeting (UK) Participation in Aurora.

[21] Main, I. G., Bell, A. F., **Heap, M. J.** and Meredith, P. G., 2009. Role of failure by static fatigue (creep) in passive eruptions: integration of laboratory, and field results. Abstract, IASPEI, Cape Town, South Africa.

[20] Baud, P., **M. J. Heap**, P. G. Meredith, S. Vinciguerra, A. F. Bell and I. G. Main, 2008. Time-dependent brittle deformation in Etna basalt. Abstract, AGU San Francisco, USA.

[19] **Heap, M. J.**, P. Baud, P. G. Meredith, A. F. Bell and I. G. Main, 2008. Time-dependent brittle deformation in Darley Dale sandstone. Abstract, AGU San Francisco, USA.

[18] Main, I. G., A. Bell, **M. J. Heap**, and P. G. Meredith, 2008. Volcanic seismicity as an indicator of damage evolution prior to volcanic eruptions: a field and laboratory perspective. Abstract, ESF, Obergurgl, Austria.

[17] Faulkner, D. R., T. M. Mitchell and **M. J Heap**, 2008. On stress rotations in fault damage zones. Abstract, Asia Oceania Geosciences Society (AOGS), Busan, Korea, 2008.

[16] Faulkner, D. R., T. M. Mitchell, **M. J. Heap**, S. Vinciguerra and P. G. Meredith, 2008. On stress rotations in fault damage zones. Geophysical Research Abstracts, Vol. 10.

[15] **Heap, M. J.**, S. Vinciguerra, P. Meredith and P. Baud, 2008. Changes in elastic moduli and time-dependent brittle deformation of Etna basalt. Geophysical Research Abstracts, Vol. 10, 03301.

[14] **Heap, M. J.**, P. Baud and P. G. Meredith, 2008. The influence of effective stress and pore fluid pressure on brittle creep in water-saturated Darley Dale sandstone. Geophysical Research Abstracts, Vol. 10, 00263.

[13] **Heap, M. J.**, P. G. Meredith, S. Vinciguerra and S. Boon, 2007. The evolution of elastic moduli with increasing crack damage during cyclic stressing of Etna basalt. Abstract, AGU San Francisco, USA

[12] **Heap, M. J.**, S. Vinciguerra, P. G. Meredith and S. Boon, 2007. The evolution of elastic moduli with increasing damage during cyclic loading of Etna basalt. Abstract, Euro-Conference of Rock Physics and Geomechanics, Erice, Italy.

[11] Faulkner, D. R., T. M. Mitchell, D. Healy and **M. J. Heap**, 2007. Slip on 'weak' faults by the rotation of regional stress in the fracture damage zone. Geophysical Research Abstracts, Vol. 9, 08294.

[10] Vinciguerra, S., P.M. Benson, P. Del Gaudio, **M. J. Heap**, M.T. Mariucci, F. Marra, P.G. Meredith, P. Montone, S. Pierdominici, P. Scarlato, 2007. Physical properties of tuffs from a scientific borehole at Albani hills volcanic district (central Italy). Geophysical Research Abstracts, Vol. 9, 07574.

[9] **Heap, M. J.**, P. Baud, P. G. Meredith and T. Reuschle, 2007. Time-dependent brittle creep in Sandstone. Geophysical Research Abstracts, Vol. 9, 06691.

[8] **Heap, M. J.**, O. Lewis, P. G. Meredith, and S. Vinciguerra, 2007. Elastic and mechanical properties of Etna basalt. Geophysical Research Abstracts, Vol. 9, 06750.

[7] Faulkner, D. R., D. Healy, T. M. Mitchell and **M. J. Heap**, 2006. Slip on 'weak' faults by the rotation of remotely-applied stresses in the fracture damage zone. Abstract, AGU San Francisco, USA.

[6] Faulkner, D. R., D. Healy, T. M. Mitchell and **M. J. Heap**, 2006. Slip on 'weak' faults by the rotation of remotely-applied stresses in the fracture damage zone. Abstract, Gordon Rock Deformation Conference, Montana, USA.

[5] **Heap, M. J.**, P. Baud and P. G. Meredith, 2006. Quantifying the critical damage threshold at the onset of tertiary brittle creep. Abstract, Gordon Rock Deformation Conference, Montana, USA.

[4] Faulkner, D. R., D. Healy, T. M. Mitchell and **M. J. Heap**, 2006. The re-orientation of stress in fault zones. Abstract, Geological Society of London Tectonics Group Annual Meeting, Manchester.

[3] **Heap, M. J.**, P. G. Meredith and P. Baud, 2006. Time-dependent brittle deformation in the laboratory and in a deep-sea observatory. Abstract, Geological Society of London Tectonics Group Annual Meeting, Manchester.

[2] **Heap, M. J.** and D. R. Faulkner, 2005. Elastic property development in variably fractured crystalline rock. Abstract, AGU San Francisco, USA.

[1] **Heap, M. J.** and D. R. Faulkner, 2005. Elastic property development in variably fractured rocks. Abstract, Geological Society of London Tectonics Group Annual Meeting, Plymouth.

9. Referees

Prof. Phil Meredith, Professor of rock physics at University College London [p.meredith@ucl.ac.uk].

Dr. Dan Faulkner, Senior Lecturer in rock deformation at University of Liverpool [faulkner@liv.ac.uk].

Prof. Patrick Baud, Professor of rock physics at EOST, Strasbourg, France. [Patrick.Baud@eost.u-strasbg.fr].