

Dr. Mikaël ATTAL, PhD

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EDUCATION AND PROFESSIONAL EXPERIENCE

Since 2007: Lecturer in Landscape Dynamics, Univ. of Edinburgh - School of GeoSciences, Edinburgh, UK.

2005-2007: Postdoctoral Research fellow, University of Edinburgh - School of GeoSciences, Edinburgh, UK.

2003-2004: Teaching assistant, Ecole Nationale Supérieure de Géologie - Centre de Recherches Pétrographiques et Géochimiques, Nancy, France.

2002-2003: Teaching assistant, Université J. Fourier - Laboratoire de Géodynamique des Chaînes Alpines, Grenoble, France.

1999-2003: PhD in Geomorphology, Université J. Fourier - Laboratoire de Géodynamique des Chaînes Alpines, Grenoble, France.

1998-1999: Master "Dynamique de la Lithosphère", Université de Nice – Sophia-Antipolis, France.

1994-1998: Degree in Earth Sciences, Université de Nice – Sophia-Antipolis, France.

RESEARCH EXPERIENCE

Since 2007: Lecturer in Landscape Dynamics (Edinburgh, UK).

My research aims at producing a model of landscape evolution that would realistically predict how landscapes respond to a disturbance (tectonic or climatic) over a wide range of time scales (from days to millions of years). To do so, the model must track sediment particles (the “tools” for fluvial erosion) during their journey from hillslopes to sedimentary basins. My research focuses on understanding the coupling between hillslopes and rivers, characterizing and quantifying fluvial erosion and transport processes in mountain rivers and defining the role that sediments play in modulating fluvial erosion rates.

2005-2007: Postdoctoral Research fellow in Quantitative Geomorphology (Edinburgh, UK).

Project: “Testing fluvial erosion models using the transient response of bedrock rivers to tectonic forcing”.

Principal Investigator: Prof. Patience Cowie. Collaborators: Dr. Greg Tucker (Univ. of Colorado, Boulder), Dr. Gerald Roberts (Univ. College London), Dr. Alex Whittaker (School of GeoSciences, Edinburgh).

Summary: Understanding how landscapes respond to a tectonic or climatic disturbance represents one of the key issues in Quantitative Geomorphology. The goal of the project was to characterize the dynamics of landscapes responding to a tectonic perturbation in the Apennines (Italy). The transient response of the landscape was characterised in the field, where good constraints exist on the nature and the amplitude of the disturbance. It was compared to the response predicted by different fluvial erosion laws, using the “Channel Hillslope Integrated Landscape Development” (CHILD) model. This project has provided new constraints (1) on the mechanisms of river incision, (2) on the way rivers and landscapes respond to a given tectonic and/or climatic disturbance, (3) on the evolution of the distribution of sources of sediment across the landscape and (4) on the time it takes for landscapes to reach a new equilibrium with respect to the different tectonic and/or climatic forcing.

December 2004 – January 2005: The “Clipperton Expedition”.

Chief Geologist during a Conservation Expedition on the French desert island of Clipperton (East Pacific).

Project: “Mineralogical and petrographic inventory of Clipperton”.

Summary: systematic sampling and analysis of the different mineral species exposed on the atoll (carbonates, phosphates and volcanics) in order to better understand the evolution of the island, the volcanism associated with the Clipperton Transform Zone and the cycle of phosphate bio-mineralization.

1999-2003: PhD in Quantitative Geomorphology (Grenoble, France).

- **Project:** "Pebble abrasion during fluvial transport: experimental study and application to fluvial networks in active orogenic settings".
Supervisors: Dr. Jérôme Lavé & Dr. Jean-Louis Mugnier.
Summary: Terrestrial landscapes result from the competition between tectonics and erosion. Fluvial incision is the main process that controls erosion at the scale of mountain ranges; the sediment particles transported during floods as bedload are the tools for incision. The aim of this study was to characterize and quantify pebble abrasion during fluvial transport in order to better understand the downstream evolution of sediment characteristics and thus bring some constraints on the feedbacks between hillslope erosion, sediment transport, sediment erosion and fluvial incision. The project combined an experimental approach with a field study along the Marsyandi River (Himalayas).
- **Participation in a palaeoseismic study in the Himalayas, Nepal** (2001 and 2002, 15 days and 10 days).
Construction of a trench across the Main Frontal Thrust, identification of a megathrust earthquake ($M_w \approx 9.0$) around A.D. 1100.

1998-1999 : Master "Dynamique de la lithosphère" (Nice, France).

- **Project:** "Tectonic and thermodynamic study of the Permo-triassic formations of the Southern flank of the Argentera Massif (Southern Alps)".
Supervisors: Prof. Jean Delteil & Prof. Jean-François Stéphan.
Summary: This project aimed at defining the successive tectonic phases that led to the deformation of the South-Argentera Permo-triassic formations, from the maximum burying during the Oligocene to the recent exhumation. These phases were compared to the ones recorded in the post-Muschelkalk detached cover (Nice and Castellane arcs) and in the Argentera basement. The project involved structural analysis and thermobarometric study of fluid inclusions in quartz tension gashes.

PUBLICATIONS

- Attal, M., Mudd, S.M., Hurst, M.D., Weinman, B., and Yoo, K. Influence of the calibre of the sediment supplied to mountain rivers on fluvial sediment grain size: case study in the Sierra Nevada, California. *Earth Surface Processes and Landforms*, in review.
- Hurst, M.D., Mudd, S.M., Walcott, R., Attal, M., and Yoo, K. Using Hilltop Curvature to Predict Erosion Rates. *Journal of Geophysical Research*, in review.
- Yoo, K., Weinman, B., Mudd, S.M., Hurst, M.D., Attal, M., and Maher, K. Evolution of hillslope soils: The geomorphic theater and the geochemical play. *Applied Geochemistry*, 26, 149–153, doi:10.1016/j.apgeochem.2011.03.054, **2011**.
- Attal, M., Cowie, P.A., Whittaker, A.C., Hobley, D.E.J., Tucker G.E., and Roberts, G.P. Testing fluvial erosion models using the transient response of bedrock rivers to tectonic forcing in the Apennines, Italy. *Journal of Geophysical Research*, 116, F02005, doi:10.1029/2010JF001875, **2011**.
- Whittaker, A.C., Attal, M., and Allen, P.A. Characterizing the origin, nature and fate of sediment exported from catchments perturbed by active tectonics. *Basin Research*, 22, 809–828, doi: 10.1111/j.1365-2117.2009.00447.x, **2010**.
- Attal, M., and Lavé, J. Pebble abrasion during fluvial transport: experimental results and implications for the evolution of the sediment load along rivers. *Journal of Geophysical Research*, 114, F04023, doi:10.1029/2009JF001328, **2009**.
- Attal, M. Rivers split as mountains grow. *Nature Geoscience – News and views*, 2, 747–748, doi:10.1038/ngeo675, **2009**.
- Cowie, P.A., Whittaker, A.C., Attal, M., Roberts, G.P., Tucker G.E., and Ganas, A. New constraints on sediment-flux-dependent river incision: Implications for extracting tectonic signals from river profiles. *Geology*, 36 (7), 535–538, doi: 10.1130/G24681A.1, **2008**.
Paper highlighted in *Nature Geoscience*, 1, 492, **2008**.
- Attal, M., Tucker, G.E., Whittaker, A.C., Cowie, P.A., and Roberts, G.P. Modeling fluvial incision and transient landscape evolution: influence of dynamic channel adjustment. *Journal of Geophysical Research*, 113, F03013, doi:10.1029/2007JF000893, **2008**.
- Whittaker, A.C., Attal, M., Cowie, P.A., Tucker, G.E., and Roberts, G.P. Decoding temporal and spatial patterns of fault uplift using transient river long-profiles. *Geomorphology*, 100, 506–526, doi:10.1016/j.geomorph.2008.01.018, **2008**.
- Whittaker, A.C., Cowie, P.A., Attal, M., Tucker, G.E., and Roberts, G.P. Contrasting transient and steady-state rivers crossing active normal faults: new field observations from the Central Apennines, Italy. *Basin Research*, 19, 529–556, doi: 10.1111/j.1365-2117.2007.00337.x, **2007**.

- Garzanti, E., Vezzoli, G., Andò, S., Lavé, J., Attal, M., France-Lanord, C., and DeCelles, P. Quantifying sand provenance and erosion (Marsyandi River, Nepal Himalaya). *Earth and Planetary Science Letters*, 258 (3-4), 500-515, **2007**.
- Whittaker, A.C., Cowie, P.A., Attal, M., Tucker, G.E., and Roberts, G.P. Bedrock channel adjustment to tectonic forcing: Implications for predicting river incision rates. *Geology*, 35 (2), 103-106, **2007**.
- Cowie, P.A., Attal, M., Tucker, G.E., Whittaker, A.C., Naylor, M., Ganas, A., and Roberts, G.P. Investigating the surface process response to fault interaction and linkage using a numerical modeling approach. *Basin Research*, 18 (3), 231-266, **2006**.
- Attal, M., Lavé, J., and Masson, J.-P. New facility to study river abrasion processes. *Journal of Hydraulic Engineering*, 132 (6), 624-628, **2006**.
- Attal, M., and Lavé, J. Changes of bedload characteristics along the Marsyandi River (Central Nepal): implications for understanding hillslope sediment supply, sediment load evolution along fluvial networks and denudation in active orogenic belts. In Willett, S.D., Hovius, N., Brandon, M.T., and Fisher, D., eds., "Tectonics, Climate and Landscape Evolution", *Geological Society of America Special Paper 398*, 143-171, doi: 10.1130/2006.2398(09), **2006**.
- Lavé, J., Yule, D., Sapkota, S., Basant, K., Madden, C., Attal, M., and Pandey, R. Evidence for a great medieval earthquake (~1100 A.D.) in the Central Himalayas, Nepal. *Science*, 307, 1302-1305, **2005**.
- Delteil, J., Stéphan, J.-F., and Attal, M. Control of Permian and Triassic faults on Alpine basement deformation in the Argentera massif (external southern French Alps). *Bulletin de la Société Géologique de France*, 174 (5), 481- 498, **2003**.

COMMUNICATIONS DURING CONFERENCES OR SEMINARS

TALKS DURING SEMINARS-WORKSHOPS (last three years):

- 2011: University of Glasgow, UK; University of Newcastle, UK.
- 2010: University of Glasgow, UK (National Telford Institute – SAGES Joint Workshop)
- 2009: University of Leeds, UK.
- 2008: Imperial College London, UK; University of Newcastle, UK; University of Pau, France.

CONFERENCES (last three years):

- **December 2010:** American Geophysical Union, San Francisco, California. Attal, M., Cowie, P.A., Whittaker, A.C., Tucker, G.E., Mudd, S.M. and Hurst, M. (invited talk). Feedbacks between channel adjustment, sediment calibre and landscape dynamics in tectonically perturbed landscapes.
- **December 2009:** American Geophysical Union, San Francisco, California. Attal, M., Whittaker, A.C., Mudd, S.M., Lavé, J., Dodman, E. (talk). Sediment source control on fluvial sediment characteristics.
- **June 2009:** 6th European Surface Processes Meeting, Roscoff, France. Attal, M., and Lavé, J. (talk). Pebble abrasion during fluvial transport: experimental results and implications for the evolution of the sediment load along rivers.
- **December 2008:** American Geophysical Union, San Francisco, California. Attal, M., Hobbey, D., Cowie, P.A., Whittaker, A.C., Tucker, G.E., and Roberts, G.P. (poster). Influence of Threshold for Bedrock Erosion on River Long Profile Development and Knickzone Retreat in Response to Tectonic Perturbation.

TEACHING EXPERIENCE

In the UK: > 70 hours teaching Geomorphology, Geology and Sedimentology (lectures + practicals) and 60 days demonstrating during Geology and Geomorphology field trips (Iceland, Arran, Helmsdale, East Lothian) to students from 1st year to Master level at the University of Edinburgh (2005-2011). Demonstrating during a Geology field trip in the Apennines (Italy) to Master students at Imperial College, London (2008, 10 days).

In France: 480 hours teaching at the University of Grenoble (1999-2003) and at the Ecole Nationale Supérieure de Géologie de Nancy (2003-2004). Preparation, delivery and marking of practical work and lectures in Geology (to students in 1st and 3rd year), Structural Geology and Geodynamics (1st and 3rd year), Geomorphology (2nd year), Sedimentology (3rd year), Igneous, Sedimentary and Metamorphic Petrology (2nd year), and Palaeontology (2nd year). Demonstrating during field courses in Geology and Glaciology (to students from 1st to 4th year).

TRAINING COURSES

1999-2003 (PhD, University of Grenoble):

- **"Tectonics, Climate and Landscape Evolution", Penrose Conference, Taiwan** (January 2003, 7 days).
Illustration: the Taiwan Island, born from the collision between the Luzon arc and the Chinese margin 5 Ma ago. Uplift and erosion rates measured on the island are amongst the highest in the world.
Conference + 4-day field trip: geomorphologic imprint of the collision, quantification of the processes.
- **Training course in Sequential Stratigraphy, Vercors Massif, Western Alps** (June 2002, 4 days).
Presentation of the sequential stratigraphy concept and its contribution to the interpretation of the structure of platform carbonated series. Seminars + 3-day field trip.
- **"Sedimentation and Tectonics Intensive Program", Western Alps** (June-July 2001, 10 days).
Tectonic and sedimentation in compressive setting. Seminars + practical work + 4-day field trip.
- **Training field trip in Structural Geology, Elba Island, Italy** (April-May 2000, 8 days).
Geological context: the study area has been affected by the Alpine orogeny, the Apenninic orogeny and ultimately by the opening of the Tyrrhenian Sea. This latter event is associated with the intrusion of one of the youngest European granitic plutons (6 Ma).

1998-1999 (Master, University of Nice – Sophia-Antipolis):

- **Training field trip in structural geology**, North of the Lautaret Pass, Hautes-Alpes (10 days).
- **Training field trip in microtectonics**, East of Ghisoni, Corsica (10 days).
- **Acquisition and exploitation of seismic data** in the Ligurian Sea on the oceanographic ship *Téthys II* (3 days at sea).

1994-1998 (University of Nice – Sophia-Antipolis):

- **Pluridisciplinary field trip** in Corsica (10 days): geophysics, petrology, geological mapping, coastal geomorphology, etc.
- **Acquisition and exploitation of seismic data in the Ligurian Sea** on the oceanographic ship *Téthys II* (1 day sea-sick).
- **Training field trip in microtectonics** around the Tende Pass, Alpes-Maritimes (7 days).
- **12-day trip to La Réunion Island (Indian Ocean)** with fifteen students in geology in order to learn about and document “hot spot” magmatism. Following this trip, we gave a series of seminars on the topic.
- **Training field trip in structural geology** in the Verdon valley, Alpes de Haute-Provence (7 days).
- **Training field trip in petrology and structural geology** in the Maures Massif, Var (7 days).

SERVICE

Reviewer for the Journal of Geophysical Research, Nature Geoscience, Science, Earth Surface Processes and Landforms, Geomorphology, the Geological Society of London, Arctic, Antarctic and Alpine Research and the Journal of Archaeological Science,

Reviewer for the US National Science Foundation (NSF), the Swiss National Science Foundation (SNSF) and the UK Natural Environment Research Council (NERC).

Examiner of D. Hopley's PhD thesis entitled “Dynamics of long term fluvial response in post-glacial catchments of the Ladakh batholith, Northwest Indian Himalaya” (University of Edinburgh, UK).

Co-organizer of the Joint Workshop of the National Telford Institute (Civil Engineering) & The Scottish Alliance for Geoscience, Environment and Society (SAGES) on Applied Sediment Dynamics (University of Glasgow, 7th-8th January 2010).

Organizer/demonstrator at events for public understanding of science: organizer of the “MidiSciences”, series of weekly scientific talks intended for a wide audience at the University of Grenoble (2002); demonstrator during Science Festivals: “Fête de la Science” (Grenoble, 1999 to 2003), “Edinburgh Science Festival” (Edinburgh, 2006, 2008).

LANGUAGES

French: native language. English: fluent. Italian: read, written and spoken.

COMPUTING

Use of “basic” softwares: Word, Excel, Adobe Illustrator, CorelDraw, PowerPoint.

Use of ArcGIS for DEM analysis.

Use of the Channel-Hillslope Integrated Landscape Development (CHILD) model (developed by G. Tucker)

Use of MATLAB to visualize and analyze CHILD's outputs.

Use of MATLAB, C++ and Perl languages for programming purpose.