

Dr. Mikael ATTAL, PhD

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Date of birth: 12/09/1977

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EDUCATION AND PROFESSIONAL EXPERIENCE

- Since 2020:** Reader in Geomorphology, Univ. of Edinburgh - School of GeoSciences, Edinburgh, UK.
2016-2020: Senior Lecturer in Geomorphology, Univ. of Edinburgh - School of GeoSciences, Edinburgh, UK.
2007-2016: Lecturer in Geomorphology, 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 - LGCA, Grenoble, France.
1999-2003: PhD in Geomorphology, Université J. Fourier - LGCA, 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 2020: Reader in Geomorphology (University of Edinburgh, UK).

I combine the analysis of real landscapes (collection of field data, topographic analysis) with numerical modelling and experimental studies to constrain the relationships between tectonics, erosion and the development of topography. My current 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. My work can help extracting tectonic information from topography, with implication for assessing seismic and landslide hazard. Understanding the release and transfer of sediment can also help retrieving past tectonic and climatic signals in the geological archive (stratigraphy), as well as mitigating risks in sedimentary basins. The risks I am particularly interested in include flooding risk from in-channel sediment aggradation (e.g., response of Himalayan rivers to the recent Nepal 2015 earthquakes), and siltation and heavy metal pollution (e.g., project on the environmental impact of nickel mining in the Philippines).

2016-2020: Senior Lecturer in Geomorphology (University of Edinburgh, UK).

2007-2016: Lecturer in Geomorphology (University of Edinburgh, UK).

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). We characterised the response in the field and compared it 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.

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 results 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 (Himalaya).

- **Participation in a palaeoseismic study in the Himalaya, 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 units on 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 (*indicates 1st author PhD student)

- *Domingo, J.P.T., Attal, M., Mudd, S.M., Ngwenya, B.T., David, C.P.C. Seasonal fluxes and sediment routing in tropical catchments affected by nickel mining. *Earth Surface Processes and Landforms*, <https://doi.org/10.1002/esp.5198>, **2021**.
- *Harries, R.M., Gailleton, B., Kirstein, L.A., Attal, M., Whittaker, A.C., and Mudd, S.M. Impact of climate on landscape form, sediment transfer, and the sedimentary record. *Earth Surface Processes and Landforms*, <https://doi.org/10.1002/esp.5075>, **2021**.
- *Dingle, E.H., Creed, M.J., Sinclair, H.D., Gautam, D., Gourmelen, N., Borthwick, A.G.L., and Attal, M. Dynamic flood topographies in the Terai region of Nepal. *Earth Surface Processes and Landforms*, DOI: 10.1002/esp.4953, **2020**.
- *Dingle, E.H., Sinclair, H.D., Venditti, J.G., Attal, M., Kinnaird, T.C., Creed, M., Quick, L., Nittrouer, J.A., and Gautam, D. Sediment dynamics across gravel-sand transitions: Implications for river stability and floodplain recycling. *Geology*, doi: <https://doi.org/10.1130/G46909.1>, **2020**.
- *Fieman, D.M., Attal, M., and Addy S. Geomorphic response of a mountain gravel-bed river to an extreme flood in Aberdeenshire, Scotland. *Scottish Journal of Geology*, <https://doi.org/10.1144/sjg2019-005>, **2020**.
- *Quick, L., Sinclair, H.D., Attal, M., and Singh, V. Conglomerate recycling in the Himalayan foreland basin: Implications for grain size and provenance. *Geological Society of America Bulletin*, doi: <https://doi.org/10.1130/B35334.1>, **2020**.

- *Harries, R.M., Kirstein, L.A., Whittaker, A.C., Attal, M., and Main, I. Impact of recycling and lateral sediment input on grain size fining trends—Implications for reconstructing tectonic and climate forcings in ancient sedimentary systems. *Basin Research*, <https://doi.org/10.1111/bre.12349>, **2019**.
- *Strong, C.M., Attal, M., Mudd, S.M., and Sinclair, H.D. Lithological control on the geomorphic evolution of the Shillong Plateau in Northeast India. *Geomorphology*, 330, 133-150, <https://doi.org/10.1016/j.geomorph.2019.01.016>, **2019**.
- *Lavarini, C., Attal, M., da Costa Filho, C.A., and Kirstein, L.A. Does pebble abrasion influence detrital age population statistics? A numerical investigation of natural datasets. *Journal of Geophysical Research*, 123, 2577-2601, <https://doi.org/10.1029/2018JF004610>, **2018**.
- *Harries, R.M., Kirstein, L.A., Whittaker, A.C., Attal, M., Peralta, S., and Brooke, S. Evidence for self-similar bedload transport on Andean alluvial fans, Iglesia basin, south Central Argentina. *Journal of Geophysical Research*, 123, 2292-2315, <https://doi.org/10.1029/2017JF004501>, **2018**.
- Marrero, S.M., Hein, A.S., Naylor, M., Attal, M., Shanks, R., Winter, K., Woodward, J., Dunning, S., Westoby, M., and Sugden, D. Controls on subaerial erosion rates in Antarctica. *Earth and Planetary Science Letters*, 501, 56-66, <https://doi.org/10.1016/j.epsl.2018.08.018>, **2018**.
- *Baynes, E.R.C., Lague, D., Attal, M., Gangloff, A., Kirstein, L.A., and Dugmore, A.J. River self-organisation inhibits discharge control on waterfall migration. *Nature Scientific Reports*, 8, 2444, doi:10.1038/s41598-018-20767-6, **2018**.
- *Dingle, E.H., Sinclair, H.D., Attal, M., Rodes, A., and Singh, V. Temporal variability in detrital ¹⁰Be concentrations in large Himalayan catchments. *Earth Surface Dynamics*, 6, 611-635, <https://doi.org/10.5194/esurf-6-611-2018>, **2018**.
- Practical Action - Univ. Edinburgh. Improving understanding of flooding and resilience in the Terai, Nepal. Policy Brief presenting the outcomes of our work supported by the UK Global Challenges Research Fund (GCRF) and Natural Environment Research Council (NERC), including grants NE/P015905/1 and NE/N01300X/1, **2017**.
- *Dingle, E.H., Attal, M., and Sinclair, H.D. Abrasion-set limits on Himalayan gravel flux. *Nature*, 544, 471–474, doi:10.1038/nature22039, **2017**.
- Temme, A.J.A.M., Armitage, J., Attal, M., van Gorp, W., Coulthard, T.J., and Schoorl, J.M. Developing, choosing and using landscape evolution models to inform field-based landscape reconstruction studies. *Earth Surface Processes and Landforms*, doi: 10.1002/esp.4162, **2017**.
- Attal, M. Linkage between sediment transport and supply in mountain rivers. In: Tsutsumi, D., and Laronne, J.B., eds., “*Gravel-Bed Rivers, Processes and Disasters*”, 329-353, Wiley-Blackwell, 832 pp, **2017**.
- *Dingle, E.H., Sinclair, H.D., Attal, M., Milodowski, D.T., and Singh, V. Subsidence control on river morphology and grain size in the Ganga Plain. *American Journal of Science*, 316 (8), 778-812, doi: 10.2475/08.2016.03, **2016**.
- *Clubb, F.J., Mudd, S.M., Attal, M., Milodowski, D.T., and Grieve, S.W.D. The relationship between drainage density, erosion rate, and hilltop curvature: implications for sediment transport processes. *Journal of Geophysical Research*, 121, DOI: 10.1002/2015JF003747, **2016**.
- Harel, M.-A., Mudd, S.M., and Attal, M. Global analysis of the stream power law parameters based on worldwide ¹⁰Be denudation rates. *Geomorphology*, doi:10.1016/j.geomorph.2016.05.035, **2016**.
- *Baynes, E.R.C., Attal, M., Dugmore, A.J., Kirstein, L.A., and Whaler, K.A. Catastrophic impact of extreme flood events on the morphology and evolution of the lower Jökulsá á Fjöllum (North-East Iceland) during the Holocene. *Geomorphology*, 250, 422-436, doi:10.1016/j.geomorph.2015.05.009, **2015**.
- Whitbread, K., Jansen, J., Bishop, P., and Attal, M. Substrate, sediment, and slope controls on bedrock channel geometry in postglacial streams. *Journal of Geophysical Research*, 120, doi:10.1002/2014JF003295, **2015**.
- Attal, M., Mudd, S.M., Hurst, M.D., Weinman, B., Yoo, K., and Naylor, M. Impact of change in erosion rate and landscape steepness on hillslope and fluvial sediments grain size in the Feather River Basin (Sierra Nevada, California). *Earth Surface Dynamics*, 3, 201-222, doi:10.5194/esurf-3-201-2015, **2015**.
- *Baynes, E.R.C., Attal, M., Niedermann, S., Kirstein, L.A., Dugmore, A.J., and Naylor, M. Erosion during extreme flood events dominates Holocene canyon evolution in North-East Iceland. *Proceedings of the National Academy of Sciences*, doi: 10.1073/pnas.1415443112, **2015**.

- Mudd, S.M., Attal, M., Milodowski, D.T., Grieve, S.W.D., and Valters, D.A. A statistical framework to quantify spatial variation in channel gradients using the integral method of channel profile analysis. *Journal of Geophysical Research*, 119, 1-15, doi:10.1002/2013JF002981, **2014**.

- *Hurst, M. D., Mudd, S. M., Attal, M., and Hilley, G. Hillslopes record the growth and decay of landscapes. *Science*, 341, 868-871, doi: 10.1126/science.1241791, **2013**.
- *Hurst, M. D., Mudd, S. M., Yoo, K., Attal, M., and Walcott, R. Influence of lithology on hillslope morphology and response to tectonic forcing in the northern Sierra Nevada of California. *Journal of Geophysical Research*, 118, 1-20, doi: 10.1002/jgrf.20049, **2013**.
- *Bekaddour, T., Schlunegger, F., Attal, M., Norton, K. P. Lateral sediment sources and knickzones as controls on spatio-temporal variations of sediment transport in an Alpine river. *Sedimentology*, 60, 342–357, doi: 10.1111/sed.12009, **2013**.

- *Hurst, M. D., Mudd, S. M., Walcott, R., Attal, M., and Yoo, K. Using hilltop curvature to derive the spatial distribution of erosion rates. *Journal of Geophysical Research*, 117, F02017, doi:10.1029/2011JF002057, **2012**.

- 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., Hobbey, 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**.

- 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**.

NEWS & VIEWS / EDITOR'S HIGHLIGHTS

- [Attal, M.](#) Running Water on Topographic Data to Better Delineate Channels. *Eos*, **2022**.
- [Attal, M.](#) Impacts by Moving Gravel Cause River Channels to Widen or Narrow. *Eos*, **2021**.
- [Attal, M.](#) Meteoric ¹⁰Be Reveals Lithological Control on Erosion Rates. *Eos*, **2020**.
- [Attal, M.](#) Enabling Dynamic, Regional-Scale Modelling of Outburst Floods. *Eos*, **2019**.
- [Attal, M.](#) Rivers split as mountains grow. *Nature Geoscience – News and views*, 2, 747-748, doi:10.1038/ngeo675, **2009**.

COMMUNICATION (last five years)

- **August 2021:** GFZ Potsdam, Germany (invited virtual talk).
- **November 2020:** Landscapes Live seminar: Faulting and Landscapes, a tribute to P. Cowie, with A. Whittaker.
- **June 2020:** "Earth Talks", Kazi Nazrul University, India (invited webinar).
- **November 2019:** University of the Philippines Diliman, Quezon City (invited lectures).
- **October 2019:** Galileo Conference - "Perturbation of Earth Surface Dynamics caused by extreme events", Nepal (talk).
- **May 2019:** "non-equilibrium flow and landform coupling" workshop, Loughborough (invited talk).
- **February 2019:** Universidad Nacional Autónoma de México (UNAM), Hermosillo (invited talk).
- **December 2018:** 57th British Sedimentological Research Group annual meeting, Edinburgh (talk).
- **October 2018:** University of the Third Age (U3A), Haddington, Scotland (invited talk).
- **September 2018:** British Society for Geomorphology, Aberystwyth, Wales (talk).
- **2017-18:** Featuring in international TV documentary "Killer Floods" ("Volatile Earth" series).

TEACHING EXPERIENCE

In the UK: teaching Geomorphology, Geology and Sedimentology (lectures + practicals) and demonstrating during Geology and Geomorphology field trips (230 days in Iceland, Spain and Scotland) to students from 1st year to Master level at the University of Edinburgh (since 2005). Demonstrating during a Geology field trip in the Apennines (Italy) to Master students at Imperial College, London (2008, 10 days). Degree coordinator for the Geology and Physical Geography degree at the University of Edinburgh (since 2015).

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).

PhD SUPERVISION

Principal Supervisor: Dr Edwin Baynes, Dr Justine Domingo. Current: Emma Graf, Callum Strong, Masood Rehman, Anthony Hoskins.

Co-Supervisor: Dr Martin Hurst, Dr Fiona Clubb, Dr Lizzie Dingle, Dr Rebekah Harries, Dr Chrystiann Lavarini, Dr Boris Gailleton, Dr Laura Quick. Current: Anya Towers, Qiuyang Chen, Saraswati Thapa, Prakash Pokhrel.

SERVICE

Editor for the *Journal of Geophysical Research – Earth Surface* (since April 2021)

Associate Editor for the *Journal of Geophysical Research – Earth Surface* (Jan. 2016 – Apr. 2021), and *Geo: Geography and Environment* (2014-2018).

Degree coordinator: Earth Science, University of Edinburgh (since 2020).

Degree programme convenor: Geology and Physical Geography, University of Edinburgh (2015-2019).

Honorary Treasurer: British Society for Geomorphology (2018-2021).

Reviewer for, in the last five years: the *Journal of Geophysical Research*, *AGU Advances*, *Earth-Science Reviews*, *Earth Surface Dynamics*, *Ecohydrology and Hydrobiology*, *Geological Society of America Bulletin*, *Geomorphology*, *Iranian Journal of Earth Sciences*, *Journal of Sedimentary Research*, *Open Geosciences*, *Proceedings of the National Academy of Sciences*, *Science Diliman*, *Zeitschrift für Geomorphologie*.

Reviewer for, in the last five years: the UK Natural Environment Research Council (NERC), the Swiss National Science Foundation (SNSF), the National Centre of Science and Technology of Kazakhstan, the Chilean Research Council (Fondecyt), the Natural Sciences and Engineering Research Council of Canada, the Minerva Fellowship and the Pazy Foundation (Israel), and CIVIS3i (Europe).

Session chair: American Geophysical Union, San Francisco, California (2016, 2019); European Geoscience Union, Vienna, Austria (2018, 2019, Union session in 2021).

Organiser: 1-week “Modelling Tectonics and Topography” workshop, SUBITOP European Training Network (April 2017). Sixth meeting of the FACSIMILE working group, Bergantes catchment, Spain (October 2018).

PhD examiner: D. Hobley, University of Edinburgh (2010); M. Castillo-Rodriguez, University of Glasgow (2011); K. Whitbread, University of Glasgow (2012); M. Nexer, University of Caen, France (2015); H. Guillon, University of Grenoble, France (2016); S. Watkins, Imperial College London (2019); S. Swarnkar, Indian Institute of Technology Kanpur (2020); J. Zondervan, University of Plymouth (2021).

LANGUAGES

French: native language.

English: fluent.

Italian: read, written and spoken.