Name: Lizzie Dingle

Academic Qualifications:

10/2016- 01/2017: Research Associate in Fluvial Geomorphology and Sediment Dynamics, University of Edinburgh. *Four month research position working on an EPSRC Global Challenges Institutional Sponsorship Award funded project predicting geomorphically-induced flood risk on the Karnali River, western Nepal.*

**09/2013- present: NERC funded PhD, University of Edinburgh**. "*River dynamics in the Himalayan foreland basin*". Supervised by Professor Hugh Sinclair and Dr Mikael Attal.

2010 –2011: MSc (by research), University of Durham (UKIERI/Social Sciences and Health Faculty Bursary funded) – "*The effects of differential uplift and sediment supply on major Himalayan rivers*". Supervised by Professor Alex Densmore.

2007-2010: BSc Natural Sciences (Earth Sciences and Geography), Durham University (First Class)

Training/Experience: During the first year of my PhD, I attended the Summer Institute of Earth System Dynamics (SIESD) held in St Anthony Falls, Minneapolis where the theme was complexity in depositional environments. Whilst based in St Anthony Falls, this ten day course involved lectures from a range of people in the US. As part of the course, participants were given the opportunity to design and run experiments using the Jurassic tank, flume facilities and outdoor stream lab based in the laboratory. I have also received training on the use of Acoustic Doppler Current Profilers (ADCPs) from GFZ Potsdam following the 2015 Gorkha earthquake, use of Real Time Kinematic (RTK) GPS equipment and data (NERC Geophysical Equipment Facility) and use of UAVs to generate Digital Elevation Models (DEMs) using Structure from Motion (SfM) technology. During my PhD I have also taken a two month interruption to gain industrial experience working with SEPA (Scottish Environmental Protection Agency) on a project assessing the morphological condition of rivers across Scotland. I am currently also a finishing a short research associate role which formed part of a EPSRC/Global Challenges Research Fund Institutional Sponsorship Award examining geomorphically-induced flood risk to the Nepalese Terai communities from the Karnali River in western Nepal.

Awards:

University of Edinburgh School of GeoSciences Postgraduate Research Conference: Prize for Excellence in Oral Presentation

EGU General Assembly 2016: Early Career Scientist Travel Award

IAS Postgraduate Travel Grant: 700 Euro (*to fund additional fieldwork in Nepal)*

BSG Postgraduate Research Grant: £1000 + £750 *(to fund additional fieldwork in Nepal and AGU 2016 conference attendance)*

EDUCT Centenary Fund: £1000 *(to fund additional fieldwork in Nepal)*

Publications:

**E. Dingle**, M. Attal, H. Sinclair (*accepted*) "Abrasion-set limits on Himalayan gravel flux". *Nature*

H. Sinclair, S. Mudd, **E. Dingle**, D. Hobley, R. Robinson and R. Walcott (2017) "Squeezing River Catchments Through Tectonics: Shortening and Erosion across the Indus Valley, NW Himalaya". *GSA Bulletin, v.129, no. 1-2 p.203-217, DOI 10.1130/B31435.1*

**E. Dingle**, H. Sinclair, M. Attal, D. Milodowski, and V. Singh (2016) "Subsidence control on river morphology and grain size in the Ganga Plain". *American Journal of Science, Vol. 316, p778-812, DOI 10.2475/08.2016.03*

Present/PhD research

**PhD Scope**: Many of the rivers downstream of the Himalaya in the Ganga Plain are prone to abrupt switching of channel courses (avulsion) causing devastating floods over some of the most densely populated regions on the globe. Despite this, our understanding of the factors that control the dynamics of these river systems downstream of the Himalayan mountain front is surprisingly limited. Systems discharging in the east Ganga Plain can be broadly defined as shallow aggrading channels that frequently avulse and flood, whilst those in the west are described as degrading systems with incised channels and extensive badland development (Sinha *et al*., 2005). In the Ganga Plain, alluvial river morphology and aggradation rates are likely driven by a combination of sediment flux, grain size and basin subsidence rates (van den Berg, 1995; Dade, 2000). Processes driving landscape evolution (tectonics, climate and lithology) will vary spatially and temporally in the mountain catchment, which will generate differing quantities and calibre of sediment that is exported into the foreland basin. It would therefore be expected for sediment flux and grain sizes to vary along the mountain front. Here, it is hypothesized that patterns of aggradation, incision and the observed river morphologies represent a balance of the sediment flux and sediment grain sizes delivered to the Ganga Plain from the mountain catchment, and the accommodation produced by subsidence in the underlying foreland basin.

**Work to date**: In the first part of my PhD, I developed a new basin-scale approach to quantifying floodplain and channel topography using a swath-based method that identifies areas where channels are super-elevated (e.g. the east Ganga Plain) or entrenched (e.g. the west Ganga Plain) relative to their adjacent floodplain (Dingle et al., 2016). The probable controls on these observations were explored through an analysis of basin subsidence rates, sediment grain size data and sediment supply from the main river systems that traverse the Plain. By integrating these observations, it was proposed that higher subsidence rates are responsible for a deeper basin in the east with perched, low gradient river systems that are relatively insensitive to climatically driven changes in base-level. In contrast, the lower subsidence rates in the west are associated with a higher elevation basin topography, and entrenched river systems recording climatically induced lowering of river base-levels during the Holocene.

**Current and future work**: Our current understanding of sediment flux into the Ganga foreland basin is based principally on suspended sediment data from gauging station networks, but the spatial coverage of these data is restricted. Advances in detrital cosmogenic radionuclide (CRN) analysis have allowed $^{10}$Be concentrations to be measured in modern river sediments, allowing approximation of average denudation rates from the source catchments over timescales of thousands of years. The concentrations of these radionuclide data give an indication of how sediment flux delivered to the foreland basin varies spatially between the major river systems that drain the Himalaya. However, estimates vary by up to a factor of three between sampling years of a single river, highlighting the difficulty in accurately quantifying sediment flux to the foreland basin using this approach (Lupker et al., 2012). Until we have a better understanding of the controls on the variability in $^{10}$Be concentrations, it remains difficult to quantify spatial variations in millennial-scale sediment supply rate from Himalayan catchments. In the final part of my PhD I will be analysing a series of Holocene and modern river sediments to test both the short and long-term variability in $^{10}$Be concentrations against existing $^{10}$Be concentrations and dated river terraces which can be related to extreme geomorphic events or periods of varying monsoon intensity.

Whilst absolute sediment fluxes to the basins are uncertain, approximately 90% of the total flux is thought to bypass the basin (Lupker et al., 2011) which would suggest that sediment availability does not limit these systems. The proximal position of the gravel-sand transition relative to the mountain front (~20-40 km downstream) further suggests that the majority of this bypassed sediment is likely to be transported in suspension. The amount of coarse sediment exported into the Plain could directly influence the morphology of these systems, as the entirety of this coarser sediment fraction is retained within the Plain. In this part of my PhD I have examined how the amount of coarse sediment exported into the Plain varies across rivers discharging in the Ganga Plain. Through an analysis of fan geometry, sediment grain size and lithology, I have demonstrated that coarse sediment flux from rivers draining the central Himalaya with contributing areas spanning three orders of magnitude is approximately constant. From rivers draining the highest mountains in the world, we see little more than sand-sized particles being exported into the Ganga Plain. I demonstrate that the distance to the gravel-sand transition is independent of total sediment flux and water discharge, where subsidence rates are comparable. Findings from this analysis show that abrasion of gravel during fluvial transport can explain this observation; most of the gravel sourced from more than 100 km upstream is converted into sand by the time it reaches the Plain. These results also indicate that earthquake-induced sediment pulses sourced from the Greater Himalaya, such as following the 2015 Gorkha earthquake, are unlikely to drive increased gravel aggradation at the mountain front (Figure 1). Instead, they should result in an elevated sand flux, with implications for future flood risk in the densely populated, low-relief Ganga Plain.

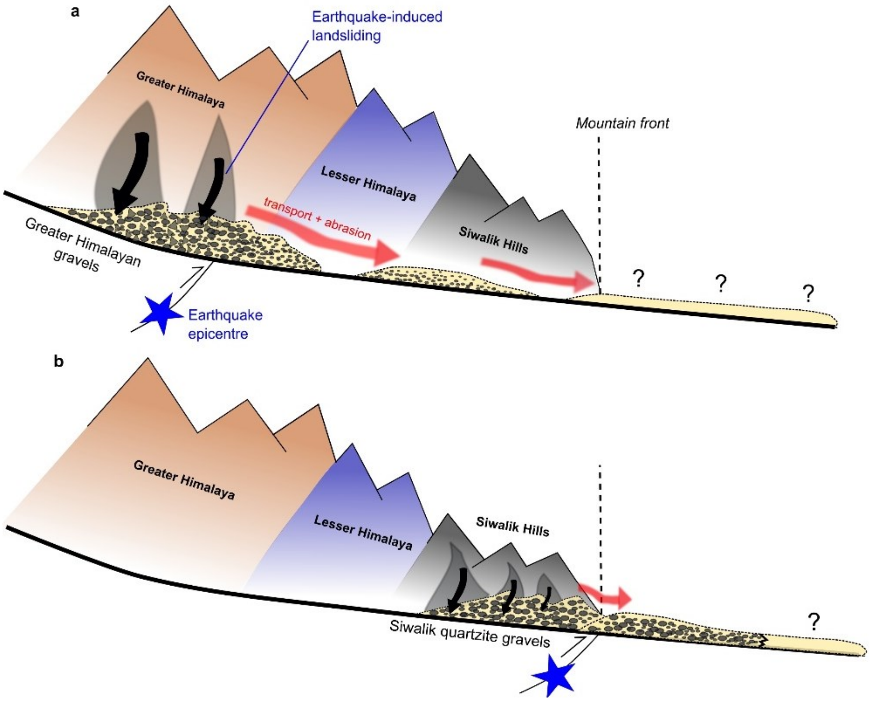


**Figure 1.** Schematic comparison of the evolution of coarse sediment pulses generated in the Greater Himalaya and Siwalik Hills, as a result of earthquake-induced landsliding. Both the transport distance and lithology of the source material control the gravel flux reaching the Ganga Plain and the amount of material trapped upstream of the gravel-sand transition.

If successful, I would use money from the Gill Harwood Memorial Fund to fund me to present this most recent work at the 2017 EGU conference in Vienna. At this point in my PhD, I am trying to increase my academic profile and develop new international connections. Following my PhD, I hope to submit fellowship proposals building on this work looking at the translation and evolution of sediment from the Himalayan orogen down into the Ganga Plain. Making myself internationally visible and developing new collaborations would greatly enhance the scope and strength of these applications. At previous conferences, I have tended to give oral presentations however I feel that I would benefit hugely from the opportunity to give a poster presentation at a large conference to receive more detailed and constructive feedback on my work and to engage more directly with scientists working in the same field. Experience in making and presenting a poster would also enhance my development as a young researcher, and provide me with a new and valuable skill set.

References


Dingle, E. *et al.* (2016) Subsidence control on river morphology and grain size in the Ganga Plain. *American Journal of Science*, Vol. 316, p. 778-812.

Lupker, M. *et al.* (2011), A Rouse-based method to integrate the chemical composition of river sediments: Application to the Ganga basin. *Journal of Geophysical Research Earth Surface*, v. 116, n. F4,

Lupker, M. *et al.* (2012), 10Be-derived Himalayan denudation rates and sediment budgets in the Ganga basin: *Earth and Planetary Science Letters*, v. 333–334, p. 146–156,

**Budget breakdown:**

Abstract submission and conference registration: 40+245 Euro = £245

Flights (Edinburgh – Vienna with EasyJet): ~£100

Accommodation (budget hotel/AirBnB): £25 per day = 5 x £25 = £125

Subsistence: £20 per day = 5 x £20 = £100

Poster printing = £20

<u>Total = £590</u>

<u>Total requested = £470</u>

My NERC Research Training Support Grant is nearly exhausted (I am in the fourth year of my PhD) but can cover the cost of the poster printing and flights. I have recently presented this research in a talk at the AGU fall meeting (2016) and my supervisor Hugh Sinclair also presented this work at the BSRG AGM in December 2016. Both presentations were well received and I would now like to extend this to a wider audience in Europe, where there are a number of research groups who would be highly interested in the findings from this work. This work forms the second paper from my PhD and has recently been accepted into Nature. I would hope to have it published prior to the EGU conference in April which would create further interest and discussion at the conference and maximise my experience there.