Andrew Whitham CASP Fieldwork Awards 2025 – Winner

Applicant: Xiang Yan
Project title: Grain-size and mineralogical trends in the Guadarrama River, Central Spain: a modern analogue for the Sherwood Sandstone Group
Award: £3,440

Scientific question and rationale:
Understanding source-to-sink trends in sediment grain size and mineralogy is crucial to understand carbon capture and storage (CCS) reservoir fairways: the former is a control on reservoir quality, and the latter for mineral trapping potential. However, sediment production and downsystem trends in ancient source-to-sink systems are often poorly constrained, owing to the non-preservation of the fluvial hinterland, the limited preservation of stratigraphy, and the effects of diagenesis. These trends are therefore ideally investigated by fieldwork in a modern river system.

The Guadarrama River in central Spain is geomorphically, lithologically and climatically comparable to the middle Triassic rivers of the Sherwood Sandstone Group (SSG), a key CCS target in the British Isles. By using the Guadarrama River as an analogue for the SSG, we will study how arkosic sediments are generated from granitic source areas, and how sediment mineralogy and grain size change with downstream transport, weathering and source dilution. Our results will not only improve our understanding of the SSG fairway, but provide a framework for fluvial sandstone reservoirs worldwide. My PhD had previously involved fieldwork in the UK on the SSG. This is an opportunity to study a comparable modern system and would substantially build on my previous work, but would also require more funding.

Specific objectives and deliverables:
• We aim to:
(1) Characterise the composition and physical properties of source lithologies.
(2) Appraise downstream trends in gravel composition and grain size.
(3) Appraise downstream trends in sand composition and grain size.
(4) integrate (1), (2) and (3) to understand the production of fluvial sediment from bedrock, and the breakdown of sediment from gravel grade to sand grade, with a focus on feldspar.
(5) Relate our results from the Guadarrama River to trends observed in the geological record, such as in the SSG.

Proposed work plan:

Fieldwork will be carried out by myself and a field assistant, for efficiency, safety and because lone working in the field is not permitted at Imperial. Our fieldwork will be carried out over 14 days. We will spend 4 days investigating the headwaters and bedrock around the Guadarrama River, and 10 days investigating sediment properties for 0-150 km downstream of the source area.
At each locality in the source area, we will characterise catchment source lithologies. We will record bedrock strength using a Schmidt Hammer, erodibility and observable weathering processes. This fulfils (1) and will take approximately 2-4 days. The rest of our field study (10-12 days) will be conducted downstream of the source. We aim to visit c. 20 downstream localities, which will be chosen for their accessibility where roads cross or run close to the Guadamarra River. We will make observations of key attributes of gravel-grade clasts, including lithology, roundness and clast size (fulfilling (2)), and collect sand-grade samples (c. 40 samples in total, 100g each). We will make in-situ geomorphic and sedimentological observations of the Guadarrama River, including observations of fluvial planform, channel dimensions, facies, and first-order gravel/sand/mud proportion.
The grain size and mineralogy of sand will be analysed in the laboratory (fulfilling (3)). The data we gather will be used to appraise downstream trends to fulfil objective (4). Our geomorphic and sedimentological observations will contextualise sediment generation and transport in the Guadarrama River, and we will compare our results to equivalent observations we have made of the SSG, which is explored in previous components of my PhD work. This fulfils objective (5).

Proposed expenditure, including details of any other sources of funding:
No other funding has been allocated for this fieldwork proposal. Expenditures given are totals for 2 people over 14 days. Transport: Rail travel to and from Heathrow Airport £20 (return, £10 per person), London-Madrid plane tickets £400 (return, £200 per person), compact car hire and insurance £600. Accommodation: £1300 (£50 per person per day for budget hotel or apartment). Consumables (food, fuel, …): £1120 (£40 per person per day). Equipment (sample bags, sediment sampler): £60. Postage and packaging of sand samples: £50
Total: £3550