Reconstructing erosion and sediment supply from the continents to the oceans in deep time – examples from the Cretaceous.

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Motivation: Geological stratigraphy is the only physical record we have of mass movement across the surface of the Earth as a result of past environmental conditions. In detail, sedimentary deposits represent the time-integrated product of erosional fluxes from terrestrial catchments to depositional basins, as a result of their tectonic and climatic boundary conditions. Understanding how, when and where sediment was delivered from the continents to oceans therefore represents a major research challenge in the Earth Sciences. This PhD will develop novel strategies to reconstruct erosional sediment fluxes from the continents in deep time, focusing initially on time-slices within the Cretaceous. The project exploits new palaeo-geographies and palaeo-topographies of the globe, developed by Getech, to predict and understand sediment fluxes to the oceans for an important period in Earth history.

Methods:

The student will:

- Derive and extract palaeo-catchments from digital topographies of the continents during the Cretaceous.
- Estimate erosion rates and sediment fluxes from continental catchments using (i) the BQART modelling approach, driven by a suite of temperature, rainfall and other proxy palaeo-climate data; ii) the drainage network and a bulk diffusivity parameter; (iii) topographic steady-state assumptions. We will initially focus on North American examples.
- Compare estimates of sediment supply from our flux modelling approach with preserved depositional stratigraphies such as the Western Interior Seaway of the North America. We will use this to calibrate the sediment flux models.
- Locate and map the location of high sediment supply along the continents during the late Cretaceous, particularly focused on epi-continental seas.
- Evaluate the impact of tectonic and climate change on sediment flux rates during the Cretaceous. It is crucial to note that erosion and export of sediment to the ocean has a
major impact on atmospheric CO$_2$ and that the period of study includes the Cenomanian - Turonian anoxic episode.

**Outcomes:** The research programme will link tectonic geomorphology with sedimentological analysis to produce novel insights into the transfer of sediment from the continents to the oceans during deep time. Field and modelling results from the PhD will be published in high-impact journals and the student will also get the chance to present key findings both at UK conferences and at least one international meeting. Project results will be communicated with CASE partners Getech, to improve our understanding of sediment supply to basins at this important time of high sea level.

**Training:** This PhD is ideally suited for Earth scientists with a broad interest in the coupling between tectonics, climate, erosion and sedimentation in time and space. The student will receive a broad range of training in geomorphology, laboratory experience of proprietary GIS software such as ARC. S/he will be use digital elevation models (DEM) and will be exposed to numerical modelling techniques for predicting stratigraphic variations in grain size using Matlab. The project would provide an excellent starting point for a student looking for a future career in academia or in industry.

**Multidisciplinarity:** This project is inherently multi-disciplinary because it brings together a range of separate geo sciences which have to be linked to address this key science issue. The project encompasses (i) geomorphology and landscape dynamics; (ii) climatology and tectonics; (iii) sedimentology/stratigraphy; and (iv) numerical modelling in the earth-system. The supervisors have a wide disciplinary background to support the student as s/he becomes familiar with these separate, yet highly relevant research areas.

Getech in Leeds have agreed to be CASE partners and will provide Cretaceous DEMs and palaeoclimate data. Getech will also provide training in GIS methods and palaeogeographic reconstruction.

This project is eligible for NERC SSCP DTP funding for people who have residency in the United Kingdom.