Project Title: Continental Uplift and Erosion From Drainage Patterns: Predicting Sedimentary Flux to Passive Margins

Host institution: Imperial College London

Supervisor 1: Gareth Roberts

Supervisor 2: Matthew Piggott

Additional Supervisor (s):

Project description: This project will develop novel computational tools to predict sedimentary flux from digital elevation data. Notwithstanding their importance, tools that quantitatively link onshore uplift, fluvial erosion and deposition of sediment at passive margins on timescales and length scales pertinent to basin formation are scant. Understanding where and when sediment was produced has implications for how we constrain regional uplift, the history of hydrocarbon plays, gross depositional environments and lithologies. Tools that can successfully predict sedimentary flux in frontier settings clearly benefit the hydrocarbon industry. We will build on our recent advances inverting river profiles for uplift and erosion rate histories. These techniques showed for the first time that continental-scale drainage networks contain commonalities that can be used to make testable predictions of uplift and sedimentary flux on geological timescales. In this project predicted sedimentary flux will be benchmarked against measured isopachs using industry seismic and well data. We will develop landscape evolution models to predict volumes of sedimentary delivered to passive margins through time, calibrate erosion rates and test results using the history of solid sedimentary flux at passive margins (e.g. West Africa, North Sea, Gulf of Mexico). The history of sedimentary flux to passive margins is an important control on the distribution and evolution of hydrocarbon systems.

Objectives and Deliverable outcomes This project will develop predictive computational tools that link uplift and erosion onshore to deposition of sediment in frontier settings. It will produce a suite of sedimentary flux measurements and predictions, continental scale uplift and erosion records, and continental scale drainage inventories.

Plan The candidate will gain experience acquiring and processing geological, geomorphological and geophysical data. They will join a team that combines observations (e.g. well and seismic data) with novel computational and numerical techniques (e.g. inverse theory, wavelet spectra) to constrain evolution of Earth's surface through space and time. The candidate will develop computational models to predict histories of flux from onshore topography. We will work with our industry colleagues to calculate sedimentary flux histories using reflection and well data. We will start by constraining sedimentary flux to the North Sea. This dataset will be used to test predictive models of sedimentary flux. Datasets to calibrate erosional models (e.g. incision measurements) and to constrain regional uplift patterns will be acquire during fieldwork and with our isotope geochemist colleagues. The candidate will gain experience producing and analysing geophysical and geological data. They will acquire transferable computational, coding and numerical skills useful in industry or academia. Publishing results and presenting at national and international conferences will give the candidate excellent opportunities to develop written and presentational skills, and for networking.

This project will suit a geologist or geophysicist who wants to combine and develop a range of computational and field-based skills.

Research context: The candidate will join a team of PhD students, postdoctoral fellows and academics at Imperial who work at the interface of geomorphology, stratigraphy and modelling. This team work on a range of problems that link, for example the deep Earth with its surface, climate, tectonics and sedimentology, and hydrocarbon systems. We work closely with industry on a range of projects. The student will benefit from links with Imperial's Earth and Planets, Petroleum Geoscience and Engineering, and Applied Mathematics and Computation groups.