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Forcing of temporal and spatial changes in sediment movement within a fluvial system

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Temporal and spatial changes in the fluvial geomorphic record and in downstream sediment flux in regions directly affected by the last glaciation are the cumulative response to the complexity of forcing and conditioning factors. To understand the behaviour of the fluvial system requires a well-dated geomorphic record and independent histories of the external forces on the catchment, namely base-level (sea-level), land-use and climate. However of critical importance is the sediment transmission behaviour of the fluvial system, which incorporates and moderates the responses to these external drivers and their influence on and propagation through local scale cycles of erosion, sediment supply, storage and remobilisation downstream. To explore these themes the Ribble Valley in northwest England has been selected as a system that is representative of this formerly glaciated region and has been targeted for detailed analysis under English Heritage's Aggregate Levy Sustainability Fund (ALSF) research programme.

The research incorporated detailed geomorphic mapping supported by borehole interventions and radiocarbon dating, which means the geomorphic and depositional record is supported by close to one hundred radiocarbon dates. The geochronological framework covers hillslope geomorphic systems in the headwater reaches, three main tributary reaches (Hodder, Ribble and Calder) and the main lower Ribble trunk stream. The staircases of river terrace were investigated by coring and dating of several palaeochannels, using a strategy that targeted basal and uppermost flood layers in the palaeochannel fills. For almost all contexts plant-specific macrofossils were used and for a large number of contexts radiocarbon dates were duplicated using different plant macrofossils. Statistical analysis and Bayesian modelling of the sets of radiocarbon dates have combined to improve confidence in the geochronological model.

These approaches allow the following themes to be addressed:

- Relative impacts of different forcing/conditioning factors vary in their importance, with base level change critical during the early Holocene increase in eustatic sea level, and climate and human impact more important during the mid- to late-Holocene.
- Sediment transmission and storage play a critical role in moderating the response to external forcing, and the switching between terrace levels may be time transgressive between sediment sinks/stores even between nearby meanders.
- Securing accurate chronologies for fluvial systems is inherently difficult owing to the scale and magnitude of reworking of organic materials, a problem only overcome by careful selection of target materials and a large number of dates. Small numbers of dates obtained from bulk or organic fractions have the potential to confuse rather than clarify the geochronology.