What sets the size and internal architecture of mouth bar complexes?

Supervisors: Dr Robert Duller (University of Liverpool), Dr Rhodri Jerrett (University of Manchester), Dr Nicoletta Leonardi (University of Liverpool), Dr Silvio De Angelis (University of Liverpool)

Contact: Robert Duller (rduller@liv.ac.uk)

Is this a CASE studentship? YES

Introduction: Mouth bars form at the river mouth where fluvial outflow decelerates into a standing body of water and deposits the coarse fraction of its sediment load (Bates, 1953; Wright, 1977). River mouth bars stop prograding when the depth over the bar is equal to or less than 40% of the inlet depth because fluid pressure on the upstream side of the bar is large enough to divert flow around the bar (Edmonds and Slingerland, 2007). Continued deposition will eventually cause 'choking' of the distributary channel, forcing bifurcation of the distributary channel around the mouth bar (Olariu and Bhattacharya, 2006; Edmonds and Slingerland, 2007) or upstream avulsion and abandonment of the distributary channel (Bhattacharya, 2006). In either case, the active mouth bar will eventually become abandoned, and a new mouth bar will form at the new position of the distributary channel mouth. Recent results indicate that the distance from the subaerial distributary channel tip to the final stagnated bar is a function of dimensionless jet momentum flux and jet stability number (Canestrelli *et al*., 2014). Over geological time individual mouth bars stack compensationally to form a mouth bar complex (Wang *et al*., 2011; Jerrett *et al*., 2016). Therefore the geometry, volume, longevity and resultant facies assemblages of mouth bars and mouth bar complexes are a function of sediment flux, short-term mouth bar dynamics and rates of accommodation generation. The purpose of the project is to test the idea that mouth bars and mouth bar complexes are a self-organising phenomenon and therefore generate sedimentary architectures that are predictable within a mass balance framework (e.g. Strong *et al*., 2005).

Project Summary: The project will contain a dominant (80%) component of field data collection and analysis supplemented by numerical simulations (20%) using Delft3D (Leonardi *et al*., 2014). Field data collection will take place on the Roda Formation (Eocene, southern Pyrenean foreland, Spain) and the Breathitt Group (Pennsylvanian, central Appalachian foreland, USA). The latter will be augmented by subsurface data from densely-spaced wells in the region. Field data collection will be via field mapping and collection of sedimentary logs, supplemented with UAV-derived photogrammetry and structure-from-motion to aid in large scale architectural analysis. The broad objectives of the project will be to: (i) reconstruct the geometry and volume of individual mouth bars and mouth bar complexes; (ii) map out facies proportions and key stratigraphic boundaries; (iii) assess whether self-organisation and mass balance are driving '(i)' and '(ii)'; (iv) run numerical simulations over geological timescales to simulate the conditions of mouth bar construction and compare facies assemblages and volumetric data to validate '(iii)'. The student will receive extensive training in field sedimentology and quantitative analysis of stratigraphy that will equip them for a career in sedimentary geology, and in the analysis of hydrocarbon reservoir geometry and heterogeneity. Training in numerical methods using Delft 3D will also be provided.

Image 1

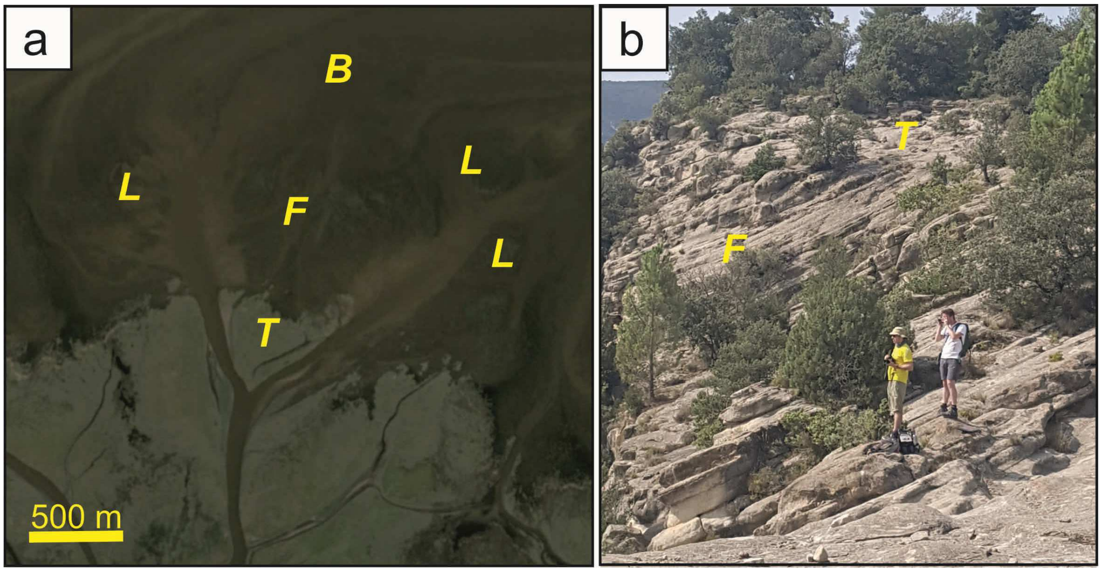

Image 1 (a) Plan view of part of the Athabasca Delta, Lake Athabasca, Canada, displaying a classically-developed mouth bar with a pear-shaped plan-view morphology. The subaerially-exposed topsets (T) and subaqueous basinward-dipping foresets (F) and bottomsets (B) of the mouth bar are marked. Note bifurcation of distributary channels around the mouth bar, and subaqueous levees (L). From Google Earth. (b) Cross sectional view of part of a preserved mouth bar in the Eocene Roda Formation, southern Pyrenean Foreland Basin. Flat topset beds (T) and foreset beds (F) dipping towards the basin are indicated.

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