CASP Research Award for Geological Fieldwork- 2018 Award Winner

Applicants: Euan Soutter and Zoë Cumberpatch, University of Manchester

Project title: The influence of steep-sided basin physiography on deep-marine clastic depositional systems: an example from the Cretaceous turbidites of Azerbaijan.

Award: £,3000

Scientific question and rationale:

Observations from the seafloor, and from seismic data, reveal that deep-water clastic successions are commonly developed within bathymetrically complex basins. In these settings many of the conceptual sedimentological models upon which geologists rely, fall apart. For example, much recent work has focused on Tanqua Karoo, which is a simple unconfined system lacking topography; models from there are routinely applied to deep-water systems in topographically complex settings. Such settings are becoming increasingly important hydrocarbon exploration targets, both in mature (e.g. Palaeocene North Sea) and relatively frontier (e.g. Palaeogene Gulf of Mexico) basins. Inherited seafloor topography in these settings controls the behaviour of sediment gravity flows and their resultant deposits, which ultimately controls reservoir quality and geometry. In many basins this inherited seafloor topography is formed by carbonate platforms (e.g. Campos Basin, Offshore Brazil). This adds the complexity of a carbonate sediment source and steep slopes, complex onlap geometries and short length-scale facies variability which make sedimentological and stratigraphic prediction particularly challenging; outcrop analogues can therefore constrain reservoir architecture and heterogeneity. World class outcrops of deep-marine successions have long provided excellent outcrop analogues (e.g. Karoo Basin, South Africa and the Annot Basin, SE France), however in order to best study turbidite-platform relationships a more direct analogue must be selected. The Cretaceous Jek Formation, South Caspian Basin, Azerbaijan provides a unique opportunity to study the effect of steep-sided carbonate margins on subsequent clastic deep-water deposition. The aim of this study is to use the extensive and accessible Jet Formation as an analogue for reservoir quality and architectures within steep-sided carbonate platform plays.

Specific objectives and deliverables:

The purpose of this fieldwork is to understand how Cretaceous deep-marine clastic deposition was affected by the underlying unstable Jurassic carbonate margin of the South Caspian Basin. In order to do this we propose the following aims and objectives:

- Detailed desk-based study of literature and available remote-sensing data (journal publications, maps, satellite imagery, and aerial photography).
- Collect detailed sedimentary logs and correlation panels of facies changes approaching topography, which will highlight different types of onlap style and allow predictions of stratigraphic trap distribution.
- Quantify thinning rates, deformation types and fracture density through the non-affected stratigraphy towards carbonate platform deposits.
- Collect correlated lithological samples to quantifiably (e.g. QEMSCAN) assess grain-scale reservoir quality approaching the slope
- Take high quality, extensive drone images of the outcrops in order to 'revisit outcrops' and utilise geometries for potential input into reservoir models.
- Create concise geological maps and georeferenced type localities that will give an improved, high resolution understanding of the South Caspian Basin and will compliment regional work of the Geological Survey of Azerbaijan and CASP.
- Build a multi-scalar model for deep-marine clastic systems onlapping steep slopes.
- The overall objective of this project, combined with our current on-going research is to have a complete/well evidenced portfolio of outcrop analogues for deep-water slope configurations, ensuring the best, most representative field example is applied to individual subsurface exploration or production projects.

Proposed work plan:

Week 1:

- Initial screening of key Cretaceous sections in the field area, using published geological maps and GPS coordinates of already identified outcrops (attached Powerpoint presentation).
- Begin large scale (i.e. structural and formation scale) geological mapping using a GPS and digital mapping techniques (ZC has attended a Midland Valley training course).
- Collect geological data (sedimentary logs, correlation panels, appropriate samples, bedding measurements at each key outcrop visited.
- Drone each outcrop to better visualise large-scale relationships and better quantify outcrop geometries.

Week 2 and 3:

- Continue to collect geological data and more detailed – facies based geological maps.
- Daily assessment of data collected to maintain the regional picture.
- Supervisor visit mid-way through will enforce consolidation of ideas and hypothesis.
- Revisit areas which reveal the greatest complexity of have the best exposure at boundaries/contacts (help to constrain ideas).

Week 4:

- Consolidation of fieldwork, revisit to outcrops to fill in small gaps in data, and identify outcrops/sections for future study or more examination using the drone images.
- Final overview and preparation of samples for travelling back to the UK.

Proposed expenditure, including details of any other sources of funding:

Expenditure (for both):
Flights: £1000 (return Manchester to Baku direct with bags)
Visa: £32 (valid for 30 day duration)
Car rental: £750 (28 nights)
Fuel: ~£200
Accommodation: ~£400 (camping)
Food: £420 (£15 per day)
Supervisor visit: £500 (flights)
Materials (notebooks etc): £50
Total: £3352
(Shortfall of £352 to be covered by NERC PhD RSTG)