

How does a pre-vegetation (Precambrian) fluvial fan succession differ from vegetated (post-Silurian) fan successions: Insights from the Applecross Formation, Torridon

Introduction and Background

Fluvial fan systems developed under semi-arid climatic regimes commonly form marginal hydrocarbon plays in a number of major petroleum provinces (e.g. UK Southern and Central North Sea and East Irish Sea). In marginal plays such as these, accurate prediction and understanding of the three dimensional sand-body characteristics is key to successful field development and this is best achieved through reference to suitable outcrop analogues where the range of sand-body geometries and architectures and their styles of fill can be quantified. Although numerous detailed outcrop analogue studies have been undertaken for post-Silurian to Recent successions, there remain relatively few studies of early Palaeozoic and Precambrian fluvial fans, which date from a time prior to the development of land vegetation, which is known to act to bind and stabilize loose sediments, preventing erosion by overland flow (Long, 2006). This results in the stabilisation of channel banks, a reduction in erosion rates and a decrease in channel-belt migration rates. As such, the styles of fluvial fan succession developed and preserved since the advent of land plants are likely to be markedly different from their pre-vegetation counterparts. Additional studies of Precambrian fluvial fan successions are required to better understand hydrocarbon reservoirs developed in such successions (e.g. the Precambrian Verkhnechonskoye Field, East Siberia).

Post-Silurian fluvial fan systems developed in semi-arid climatic settings are especially sensitive to even modest changes in vegetation style of extent of cover that are influenced by subtle climatic fluctuations and these changes are known to have a significant impact on preserved fluvial architecture. By contrast, relatively little is known about the factors that control equivalent pre-vegetation fluvial fans.

Proposed Field-Based Study

The Torridonian (Neoproterozoic) Applecross Formation, North West Scotland formed during a phase of crustal extension, which culminated in the opening of the Iapetus ocean (Williams, 2001). Sediment sourced from an uplifted mountain front to the northwest of the Torridon area was transported southeastwards towards the Diabag-Moine Trough (Williams, 1966) and deposited on a Lewiain landsurface that was close to horizontal (Williams, 2001). The Applecross Formation is well exposed and has a lateral extent of 150km², with thicknesses approaching 3.5km. The quality and extent of exposure and relative ease of access of this only modestly deformed succession makes it an ideal candidate to explore how the controls on sedimentary style within a pre-vegetation alluvial/fluvial fan succession.

Aim

The aim of the project is to investigate how preserved sedimentary style differs between the Precambrian fluvial fan recorded by the Applecross Formation and that of a younger fluvial fan – the Permian Organ Rock formation, of SE Utah, studied previously by members of the sedimentology research group at Leeds. Specific

objectives are: (i) to document the sedimentary architecture and to examine the characteristics of the preserved palaeosol horizons, (ii) to determine how an absence of vegetation likely influenced fluvial flow behaviour and thresholds between erosion and deposition, and (iii) to develop a model to account for the main factors that influence reservoir potential in Precambrian fluvial fan successions. This proposed field-based research is not within the remit of my PhD research which focuses primarily on the stochastic modelling of fluvial channels in a semi arid environment, how climatic forcing can affect the resulting reservoir.

Methodology

Field work will be conducted in the Torridon area of North West Scotland during August-September 2010. During the study, sedimentary logs and architectural panels of the Applecross Formation will be collected, along with palaeocurrent data. Thirty samples will be taken from palaeosol horizons for thin sectioning. These data will be compared against an equivalent pre-existing dataset collected previously from the Permian Organ Rock Formation to identify key variations between the successions and to determine what controlling factors are dominant or absent in the two fans.

Outcomes

This study will help with the understanding of how the preservation of fluvial fan successions is dependent (or otherwise) on the stabilizing influence of vegetation relative to other controls (e.g. source area palaeogeography and tectonic basin setting). This study will form a valuable addition to the currently rather meagre set of case studies of Precambrian fluvial fan successions and will serve as a valuable analogue for similar Precambrian reservoir intervals. Results will be presented at the December 2010 BSRG annual meeting and will hopefully be published (e.g. *Scottish Journal of Geology*).

Breakdown of Funding Requested

Cost is calculated for driving from Leeds to Torridon and working for a period of 14 days in September. Accommodation will consist of a mixture of camping and/or youth hostels (depending on area of operation). Food costs and other minor expenses will be covered personally.

	Costs (£)
Travel Costs (Car)	200
Camping fees (14 Nights)	140
Equipment (OS & Geol. Maps & Thin section preparation)	150
Total	£490

References

- Long, D.G.F. (2006) Architecture of pre-vegetation sandy-braided perennial and ephemeral river deposits in the Paleoproterozoic Athabasca Group, northern Saskatchewan, Canada as indicators of Precambrian fluvial style. *Sedimentary Geology*, **190**, 71–95.
- Williams, G.E. (1966) Palaeogeography of the Torridonian Applecross Group. *Nature*, **209**, 1303 - 1306
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