Reconstruction of Channel and Barform Architecture in a Pennsylvanian Fluvio-Deltaic Succession: Brimham Grit, Northern England*

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Search and Discovery Article #50884 (2013)**
Posted October 31, 2013

*Adapted from poster presentation given at AAPG 2013 Annual Convention and Exhibition, Pittsburgh, Pennsylvania, May 19-22, 2013
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Abstract

Pebbly fluvio-deltaic sandstones of the Brimham Grit (Kinderscoutian, northern England) form a complex array of Millstone Grit tor outcrops, which enable 3-D lithofacies architecture to be determined in detail whereby relationships between adjacent sand-bodies representing a range of channel, barform, dune and sheet-like elements can be used to reconstruct the flow behavior of a braided channel network.

Although the depositional paleoenvironment was supplied with sediment delivered from a range of provenances, the dominant supply was from eroded remnants of Scottish and Norwegian Caledonian Mountains located ~450 and ~950 km towards the north and northeast, respectively. Previous studies suggest that the system evolved from a shelf-edge- to slope-ramp delta, which ultimately delivered sediment to a series of submarine fans developing in the deep-water depocenter of the Craven Basin.

A detailed depositional model depicting the fluvial processes responsible for generating the preserved stratigraphic architecture has been developed through high-resolution architectural analysis utilizing 1D sedimentary logs, 2-D architectural panels, pseudo-3-D fence diagrams and paleocurrent rose diagrams. Sedimentary lithofacies include trough- and planar cross-bedded sets, compound co-sets of cross-strata, planar-bedded sandstones and gravel beds, collectively organized to define a variety of architectural elements including single-story, multilateral- and multi-story channel elements, downstream- and laterally-accreting macroforms. Architectural elements are typified internally by distinctive lithofacies arrangements with highly variable paleocurrent distributions that are indicative of barforms that systematically changed from lateral to downstream accretion, with accumulation occurring in a poorly-confined network of fluvial channels allied with major sandy barforms, indicative of a frequently avulsing braided fluvial system in an upper-delta plain setting. The presence of plant fossils (e.g. calamites stem remnants) implies local swamp-like conditions adjacent to active channel belts and a degree of channel-bank stability.

Data from this study are contributing to a broader research program investigating the linkage of fluvio-deltaic successions from shelf-edge deltas to slope and submarine-fan successions, with a focus on the influence of basin morphology on sediment delivery mechanisms in the Craven, South Pennine and North Staffordshire Basins of the UK.
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Abstract

Pennsylvanian fluvio-deltaic sequences in Northern England are underlain by the Brimham Grit, a member of the Lower Carboniferous Brimham Group. This paper presents a channel and barform architecture and the processes involved in the sedimentary architecture of the Lower Brimham Grit in the Brimham Rocks area of North Yorkshire, UK. The Brimham Grit is interpreted to have been deposited during the Dinantian extensional episode associated with the Variscan Orogeny. This extensional episode led to the development of the Northern Pennines, the Lower South Pennine and the North Staffordshire Basins. The Lower Brimham Grit has been divided into two depositional units: the Lower Brimham Grit and the Top Kinderscoutian Brimham Grit. The lower unit is dominated by clastic depositional systems, including sheet facies and channel-bounding barforms, whereas the upper unit is dominated by fluvial and deltaic depositional systems. The study area is characterized by a series of channel and barform architectures and depositional systems that are controlled by the tectonic setting and the regional palaeogeography.