Modelling of an Ancient Fluvial Depositional Environment Using 3D-Photogrammetry and Paleohydrology, the Middle Pennsylvanian Allegheny Formation, South-Central West Virginia, USA

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ABSTRACT

This project uses state of the art 3D photogrammetry combined with paleohydrologic analysis of an ancient fluvial system to better define the facies architecture and facies association of the ancient fluvial channel. Fluvial systems are composed of sedimentary deposits in channelized environments dominated by flowing water. The morphology of fluvial systems is influenced by sediment supply, accommodation space and intensity of flow within the channel. Fluvial geomorphic response to these factors are characterized by a change in channel geometry and the formation of distinct sedimentary features which are distinguished based on geometry, scale and facies. Paleohydrologic analysis employs empirical equations for estimating paleochannel dimensions. The paleochannel dimensions estimated for static modelling, include paleochannel depth and width. 3D photogrammetry is used to construct a 3D photomosaic which captures sedimentary features from an outcrop of an ancient fluvial deposit. This data is then combined with channel dimension information acquired through Paleohydrologic analysis, and data from measured outcrop section, to develop a 3D model of the ancient fluvial depositional environment. The 3D photogrammetry and paleohydrologic analysis were used to investigate and model the Middle Pennsylvanian Allegheny Formation (MPAF). The MPAF is a north-west prograding clastic wedge which originated from tectonically uplifted highlands along the east-central Appalachian basin. Preliminary sedimentary data showed that sandstone deposits below the Lower Kittanning Coal (LKC) member of the MPAF were more arenitic than the sandstone deposits above the LKC. Preliminary estimates of channel dimensions revealed channel flow depth ranging from 7m to 11m for the MPAF deposits immediately above the LKC and, 7m to 12m for the MPAF deposits immediately below the LKC. The use of 3D Photogrammetry to construct a photomosaic, combined with paleohydrologic analysis of ancient fluvial deposits improves the ability to define accurately, the facies architecture and facies association of the ancient fluvial channel from an outcrop data. The ability to determine the thickness and width of a channel is essential in estimating reservoir extent in exploration and development of petroleum resources of a fluvial depositional system.