Frontal Splay Geometry, Distribution, Connectivity and Reservoir Characterization in a Mid-Slope Environment: The Jubilee Field, Offshore Ghana*

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Abstract

Frontal Splay characterization from subsurface data has not yet been achieved in a fully integrated manner from producing oil fields. Fields reservoired in this type of deep-water system are rarely upscaled from rock facies to log and seismic scale, using analogues to narrow the uncertainty ranges in reservoir presence, quality, and connectivity. This paper aims to bridge that gap by going back to basics and incorporating rock facies, and facies associations, as pivotal to developing the static, as well as conceptual, models for field development, by using a spectacular core, wireline, seismic, and dynamic dataset from the Jubilee Field.

The Jubilee Field is in the Tano Basin, Offshore Ghana, on the flank of an early Cretaceous extensional fault block known as the Tano Nose. The reservoir sands occur within a system of Cretaceous Turonian to early Coniacian marine-slope turbidites, in sequences up to 250 m thick, and contained within a combination of structural and stratigraphic traps. A conceptual geological model was constructed based on core, well-log, and seismic and dynamic data (Figure 1). The workflow began with identification of facies types in core and grouping of these into 12 Facies Associations (FAs) at the wells, which formed the 'building blocks' for the 3D sand body identification. Each of the FAs can be further subdivided into five petrophysically-derived Rock Types, which reflect both original sand bedding textures and diagenetic overprinting. In the workflow, we use these recognizable, repeating packages that define the sand bodies in Jubilee (Figure 2). The facies scheme was applied across the wells to show how the rock properties tie.

The Jubilee system is a slope system, that developed basinwards from an erosionally-confined channel system with crevasse splays and master levees, into less confined frontal splay systems (Figure 3). There is considerable variation vertically and laterally, resulting in a complex distribution of reservoir sand bodies, often displaying offset-stacking, erosion of previous sequences, and diachronicity. Some of this complexity appears related to underlying structural controls on sand distribution, both in terms of topographic variation and subsequent compensational (lateral) stacking and migration of the sand bodies away from the main depositional axes.

We focus on the development of the conceptual geological model in this paper, to illustrate the nature of frontal splay accumulation in front of a confined slope channel complex system.

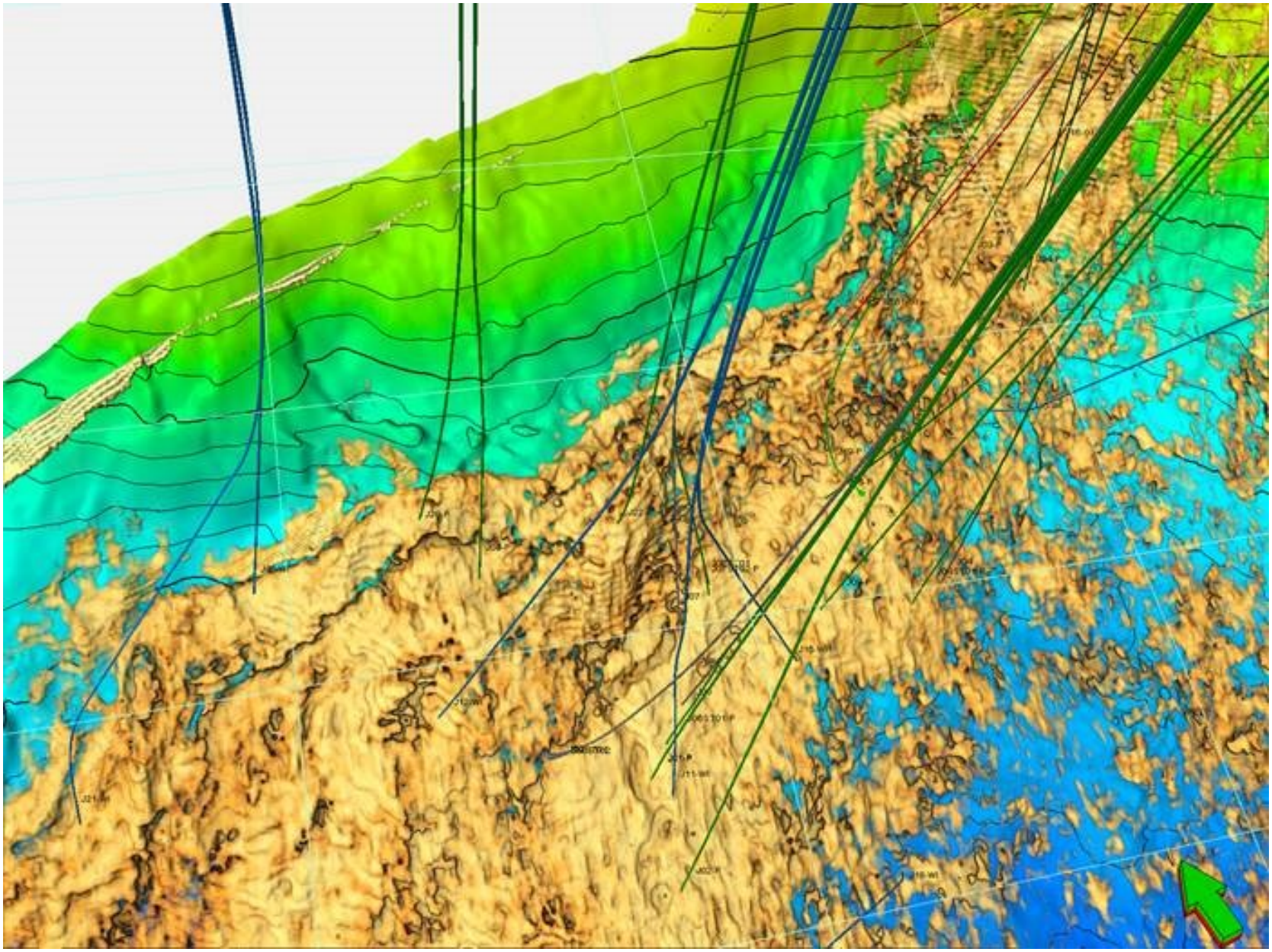

Figure 1. SNA map from 2013 3D seismic of the MH4 reservoir interval in Jubilee, showing offset-stacked frontal splay bodies extending downslope from the NE (upper right) from a confined slope channel complex.

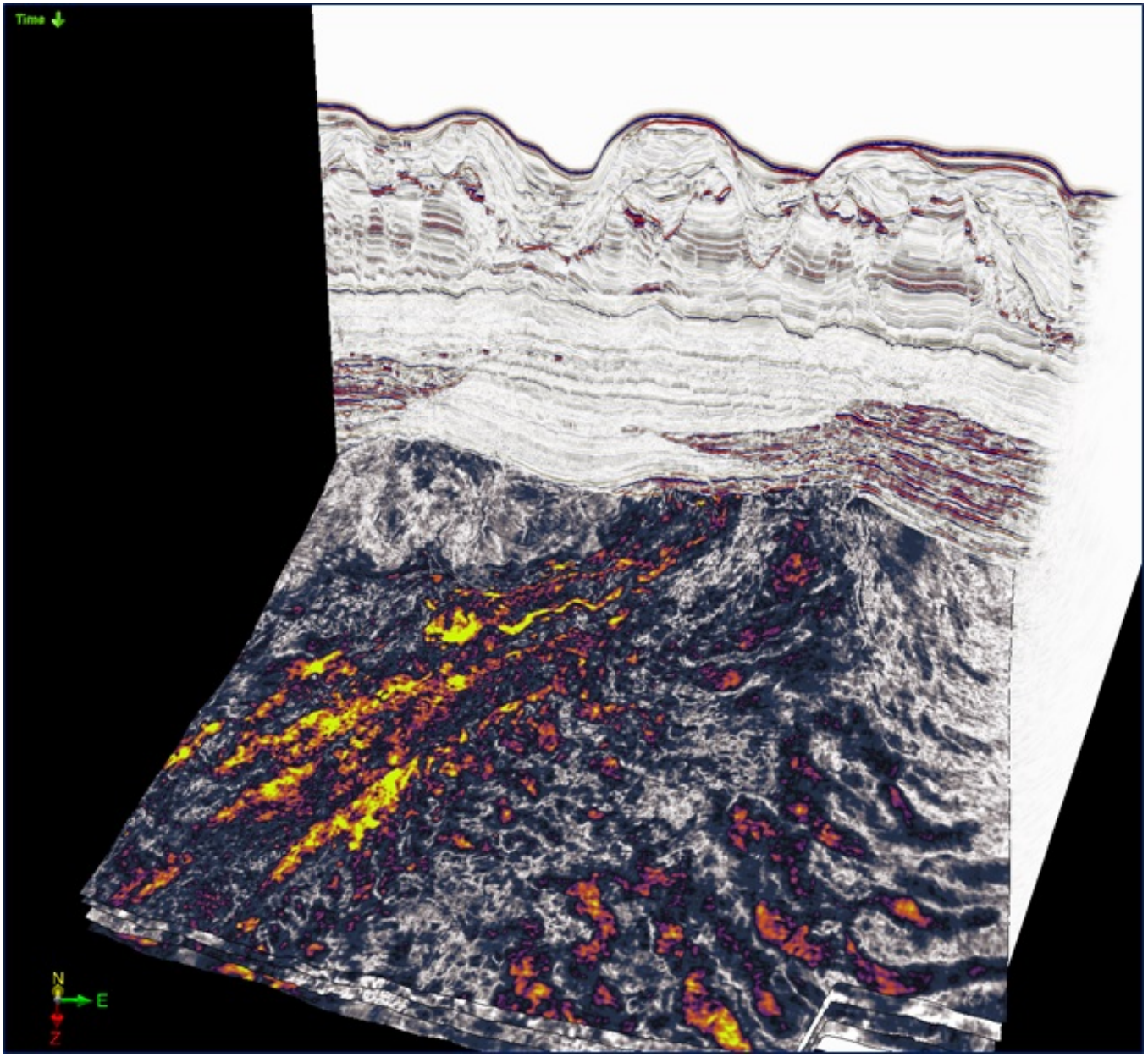

Figure 2. Paleoscan detail of finer-grained MH3 interval showing more elongate frontal splays fed by skinny channels from the NE, with sediment waves dominating the slope outboard the main sand-prone fairway.

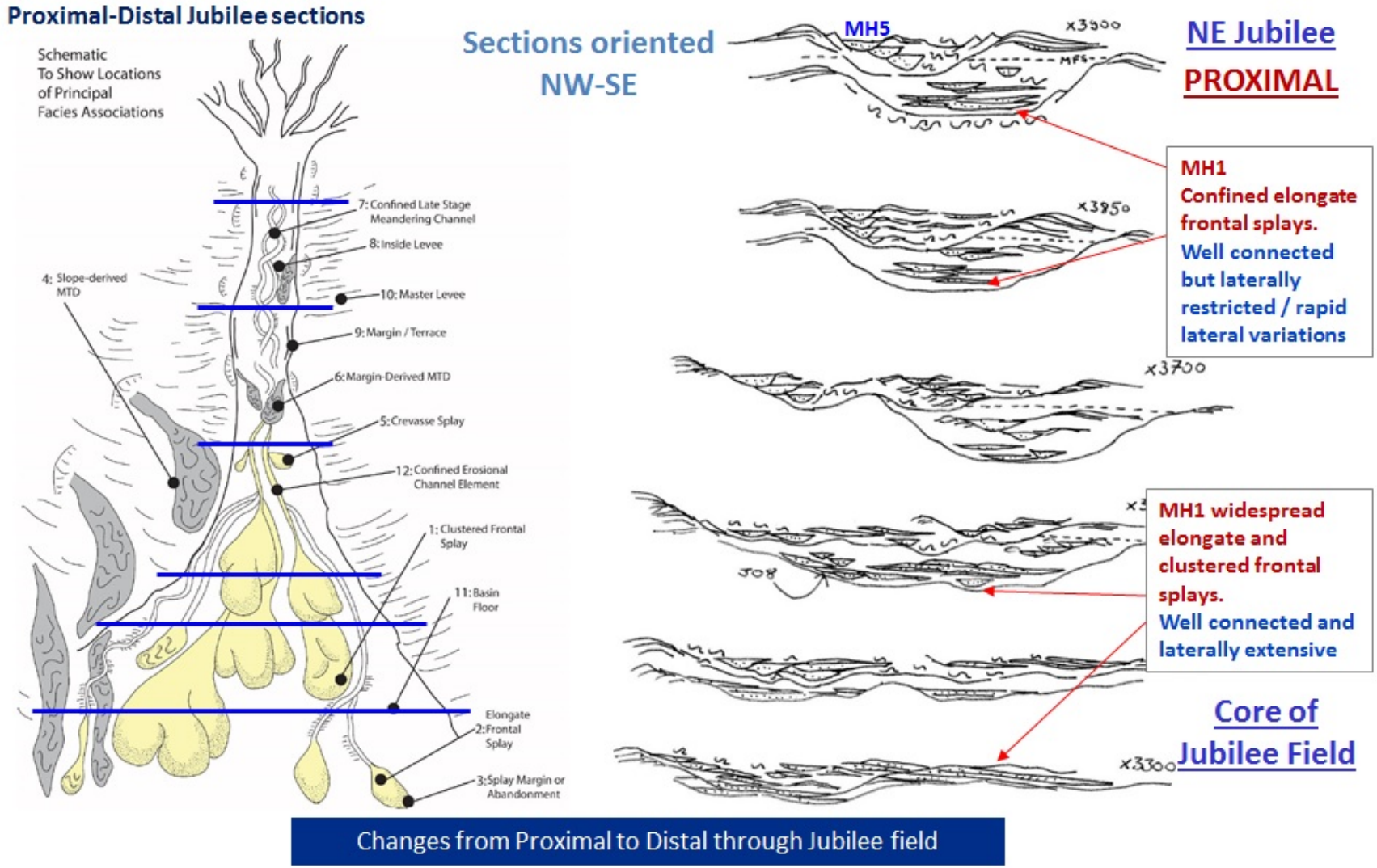

Figure 3. Conceptual geological model as a framework for development of the Jubilee Field.