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Delineating 3D Sand body Geometry Using New Generation Dip Modeling Software Application: A Nobel Methodology for Effective Well Planning for Horizontal Well Placement

Titas Bhattacharya*, Somenath Kar, Koushik Sikdar, Indrajit Basu, *Schlumberger*

Summary

In the present work, the methodology of 3D reservoir architectural modeling using image-derived dip data has been showcased. The computed structural dip and the projection away from the borehole have been used to create the surface from the well tops. Finally, using this surface, a 3D reservoir model has been generated. This dip optimizes the horizontal well planning for proper well placement. It can help in reducing the structural uncertainty and thus drilling hazards.

Keywords: *Reservoir Modeling, Dip Modeling, Well Planning, Image logs*

Introduction

Understanding near wellbore intricate sub surface structural and sedimentological based static model can be used effectively to framework is extremely difficult from coarse resolution seismic datasets alone. Therefore, a number of ambiguities exist in planning and placing a new well in a complex geological setting with a typical static reservoir model. Different petroliferous basins in India are no exception in terms of such geological intricacy.

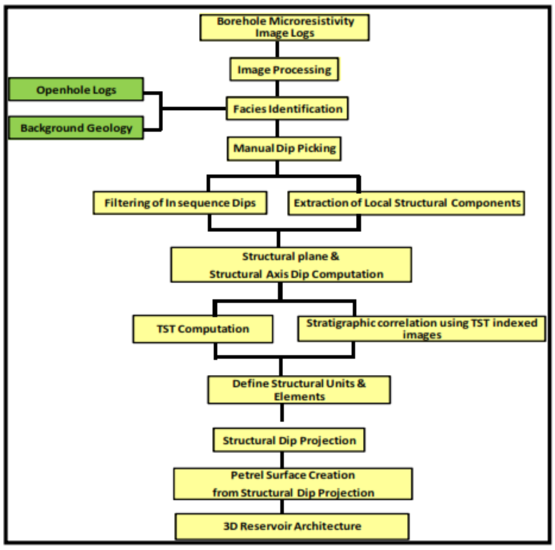


Figure 1: Workflow

This workflow (fig.1) aims at establishing the high-resolution, near-wellbore geological architecture based on the structural and sedimentary dip data derived from multiwell image logs using a new 3D visualization dip interpretation and modeling software. This dip and image log-based application can resolve the fine scale geological complexities, and it considerably reduces structural uncertainties in an existing 3D reservoir model to optimize the Well Planning for Horizontal Well Placement.

Methodology

In this study, detailed multiwell image log analysis and manual dip interpretation (which act as the primary input of this 3D dip modeling workflow) was carried out.

Titas Bhattacharya, Schlumberger Asia Services Ltd
Email:TBhattacharya@slb.com

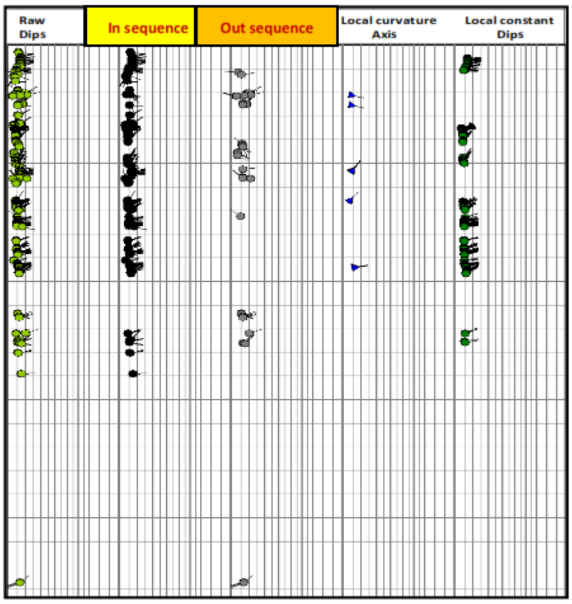


Figure 2: Dip Filtering

Subsequently, logical filtering of the dip data (fig.2) was performed to extract different local structural components by dip sequence analysis process. The structural plane and structural axis dip were computed by making different structural zones (fig.3) from the filtered dips. TST (true stratigraphic thickness) at borehole level was computed followed by stratigraphic correlation using TST indexed images/logs and well tops (fig.5). Structural units are identified (fig.4) as structurally and stratigraphically independent volumes of space in the TST indexed images. Different structural units are further sub characterized into several structural elements (fig.4) with a definite structural axis and translational plane in each. This TST data, along with the well tops updated with the structural dip, was further used to create accurate isopach maps (fig. 6) for every stratigraphic zone drilled in the mapping area.

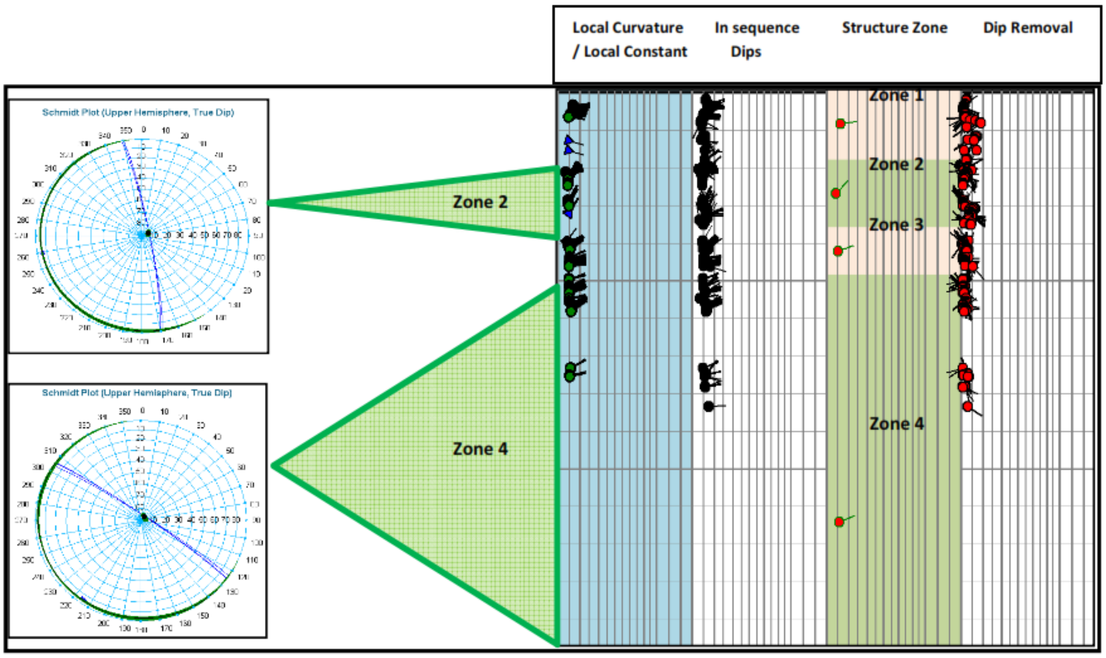
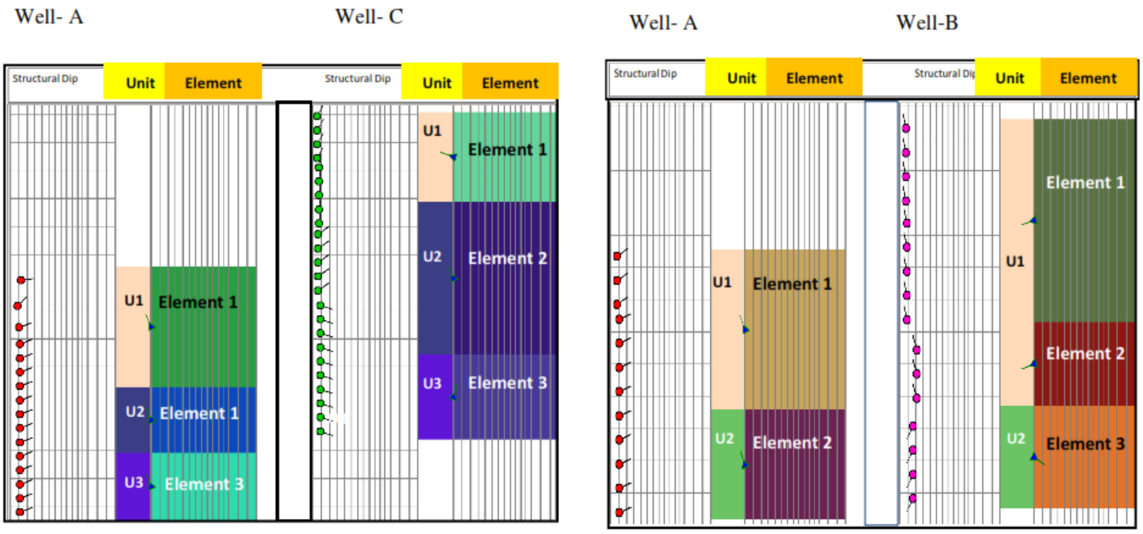


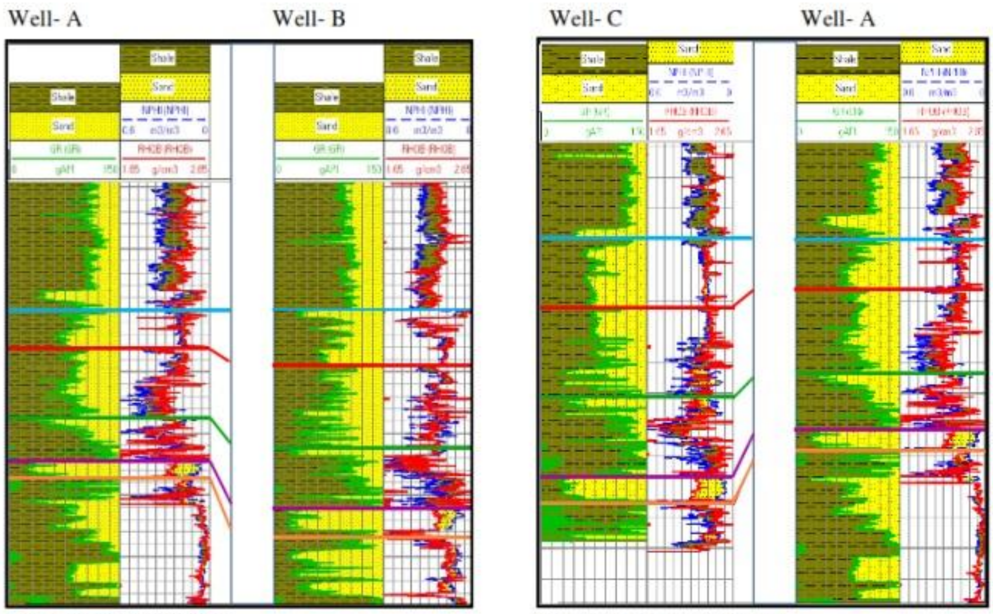
Figure 3: Structural Zonations



Wells A & C in Strike Section

Wells A & B in Dip Section

Figure 4: Unit and Element Identification for the Three Wells



Wells A & B in Dip Section

Wells A & C in Strike Section

Figure 5: Stratigraphic Correlation Using TST Indexed Logs

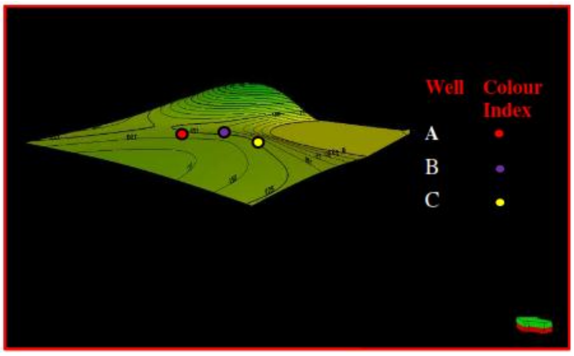
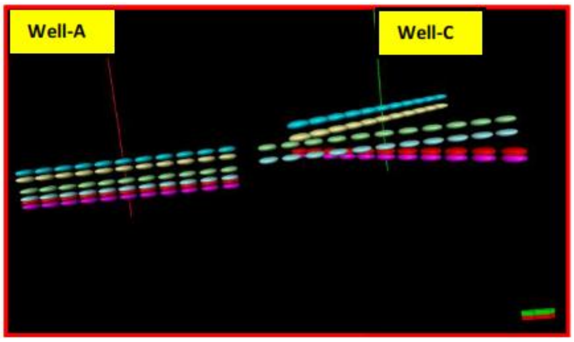
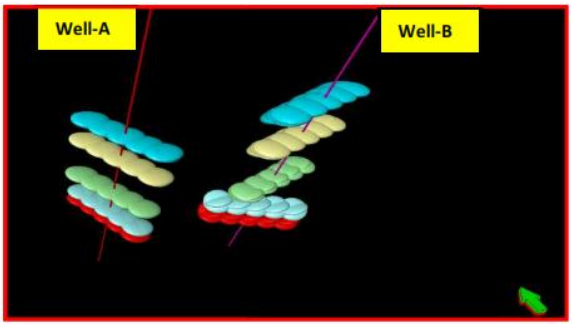


Figure 6: Isopach Map Generation

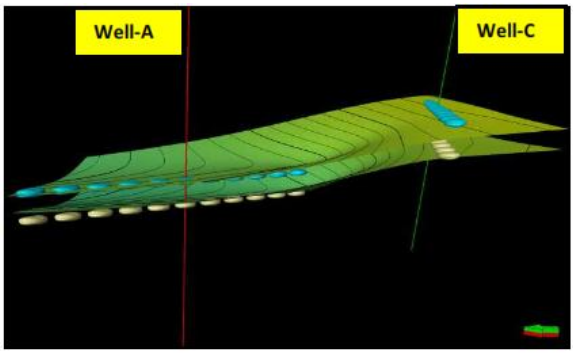
Structural dips are projected (fig.7) away from the well into the various horizons identified in the respective structural units already identified to be modeled. The point sets generated from the structural dip projection process act as inputs for the surface creation in the 3D modeling software in subsequent stages.



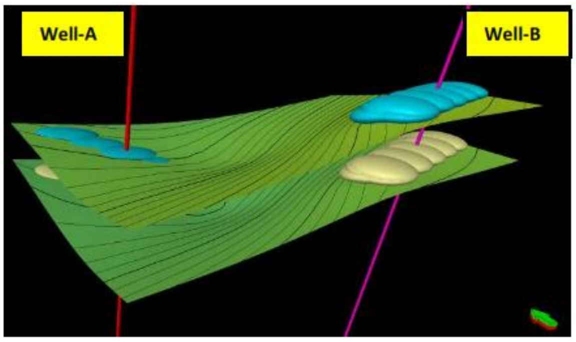
Wells A & C in Strike Section



Wells A & B in Dip Section



Wells A & C in Strike Section

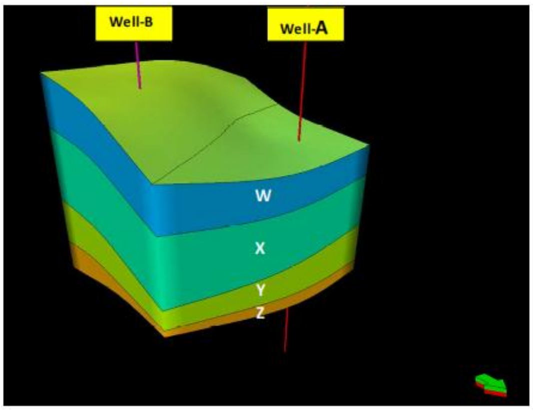


Wells A & B in Dip Section

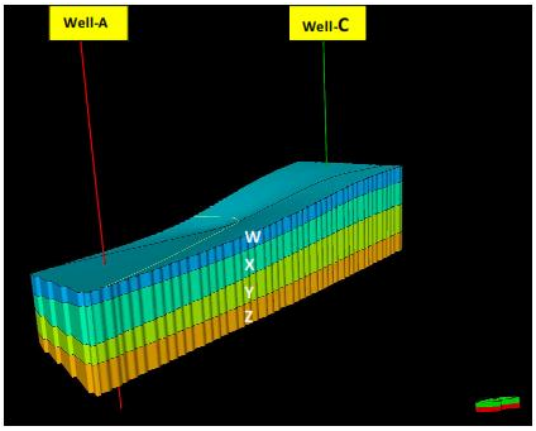
Figure 7: Surface Projection Away from Well bore

Conclusion

A 3D structural model was generated using key surfaces incorporating the sub seismic complexities and their bearing on reservoir distribution.



Apparent Dip Section Model



Apparent Strike Section Model
Figure 8: 3D Structural Model Generation

Different geological surfaces (fig.8) were modeled honoring actual structural dip data from high-resolution images. Cross sections along strike and dip directions (fig.9) of the 3D model clearly reveal the spatial variations in reservoir architecture.

Identification of near-wellbore geological architecture of the reservoir plays a pivotal role in updating the existing static reservoir model.

The apparent strike section and dip section reveal thinning of the Y reservoir layer towards NE.

The updated reservoir geometry can help in preparing a better well planning and effective development strategy based on well-level geological inputs.

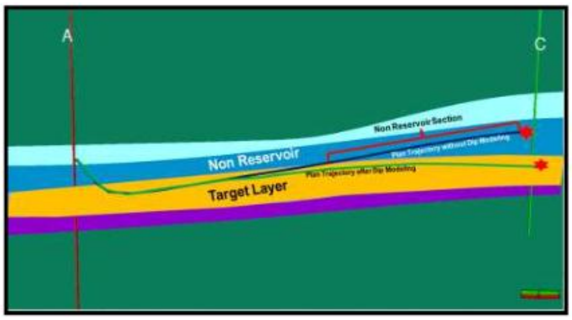


Figure 9: Well planning Optimization

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