

PS Chronostratigraphy of Two Carbonate Successions: Lower Cretaceous Shu'aiba Formation and Jurassic Platform Hanifa-Arab to Gotnia Basin Transition, Saudi Arabia*

D. Mark Steinhaufl¹ and Arthur E. Gregory²

Search and Discovery Article #50607 (2012)**

Posted May 28, 2012

*Adapted from poster presentation at AAPG International Conference and Exhibition, Milan, Italy, October 23-26, 2011

**AAPG©2012 Serial rights given by author. For all other rights contact author directly.

¹EXPEC Advanced Research Center, Saudi Aramco, Dhahran Saudi Arabia (david.steinhaufl@aramco.com)

²Exploration Resource Assessment Department, Saudi Aramco, Dhahran Saudi Arabia

Abstract

Recent advances in chronostratigraphic and visualization software allows rapid and detailed analysis of 3D seismic data previously not possible. The interpreter defines geometries and stacking patterns with respect to relative position in the basin and assigns packages characterized by particular geometries to one of four categories: (1) highstand systems tract (HST), (2) transgressive stage systems tract (TST), (3) falling stage systems tract (FSST), and (4) lowstand systems tract (LST). Here we interpret two complex carbonate systems over large (+9500 sq km) 3D, onshore, seismic volumes to address complex stratigraphic issues over wide geographic areas.

Analysis of the southern Rub' Al-Khali, Lower Cretaceous Shu'aiba Formation shows that (1) relative position with respect to the shelf, basin margin, and basin determined where the sequences were deposited, (2) the number of interpreted sequence boundaries and sequences fall within the range reported by others working nearby, (3) the average duration of the systems tracts likely ranges from about 6.5 to 1.5 Ma, suggesting that most are 3rd order sequences with some possibly being 4th order, (4) the top Shu'aiba typically coincides with a FSST or LST, (5) the base Shu'aiba is a consistent seismic marker, typically coinciding with a HST or FSST, and (6) the top Shu'aiba is a less consistent seismic marker than the base. A top Shu'aiba surface terminating with a FSST or LST is consistent with subaerial exposure reported by others (e.g., Yose et al., 2006).

Along the northern Saudi Arabian Jurassic platform to basin transition, seismic flattening on the Dhurma Shale event combined with filtering significantly improved 3D seismic data quality and the subsequent stratigraphic event correlation and mapping. Analysis of the Hanifa-Arab platform and Gotnia basin shows that the Gotnia salt sequences (north of the Gotnia margin) may predate the Arab-D sequence in this area. This analysis further suggests that the salt was deposited during a post-Hanifa, basin-wide sea level fall.

These results illustrate breakthroughs that would have been difficult, if not impossible, to achieve using other methods. In the first case, a much better understanding of the timing, number, and relative importance of various systems tracts was rapidly gained over a two-week period. In the second, new insights on the relative timing of platform and basin successions were achieved in an area where biostratigraphic control linking the platform and basin was limited.

References

Cantrell, D.L., G.W. Hughes, R.K. Sadler, R.F. Lindsay, and P.K. Swart, 2004, Stratigraphic architecture and reservoir quality controls on the Shu'aiba Reservoir, Shaybah Field, Saudi Arabia: *GeoArabia Manama*, v. 9/1, p. 54.

Catuneanu, O., 2002, Sequence Stratigraphy of Clastics Systems: Concepts, merits, and Pitfalls: *Journal of African Earth Sciences*, v. 35/1, p. 1-43.

Goldhammer, R. K., P.A. Dunn, and L.A. Hardie, 1990, Depositional cycles, composite sea-level changes, cycle stacking patterns, and the hierarchy of stratigraphic forcing: Examples from Alpine Triassic platform carbonates: *GSA Bulletin*, v. 102/5, p. 535–562.

Plint, A.G., and D. Nummedal, 2000, The falling stage systems tract; recognition and importance in sequence stratigraphic analysis, *in* D. Hunt, and R.L. Gawthorpe, (eds.), *Sedimentary responses to forced regressions: Geological Society Special Publications*, v. 172, p. 1-17.

Yose, L.A., A.S. Ruf, C.J. Strohmenger, J.S. Schuelke, A. Gombos, I. Al-Hosani, S. Al-Maskary, G. Bloch, Y. Al-Mehairi, and I.G. Johnson, 2006, Three dimensional characterization of a heterogeneous carbonate reservoir, Lower Cretaceous, Abu Dhabi (United Arab Emirates), *in* P. M. Harris and L. J. Weber, (eds.), *Giant hydrocarbon reservoirs of the world: From rocks to reservoir characterization and modeling: AAPG Memoir 88 / SEPM Special Publication*, p. 173-212.

CHRONOSTRATIGRAPHY OF TWO CARBONATE SUCCESSIONS: LOWER CRETACEOUS SHU'AIBA FORMATION AND JURASSIC PLATFORM HANIFA-ARAB TO GOTNIA BASIN TRANSITION, SAUDI ARABIA

D. Mark Steinhaff* and Arthur E. Gregory**

* EXPEC Advanced Research Center, Saudi Aramco, Dhahran Saudi Arabia

** Exploration Resource Assessment Department, Saudi Aramco, Dhahran Saudi Arabia

Abstract

Recent advances in chronostratigraphic and visualization software allows rapid and detailed analysis of 3D seismic data previously not possible. The interpreter defines geometries and stacking patterns with respect to relative position in the basin and assigns packages characterized by particular geometries to one of four categories: (1) highstand systems tract (HST), (2) transgressive stage systems tract (TST), (3) falling stage systems tract (FSST), and (4) lowstand systems tract (LST). Here we interpret two complex carbonate systems over large (+9500 sq. km) 3D, onshore, seismic volumes to address complex stratigraphic issues over wide geographic areas.

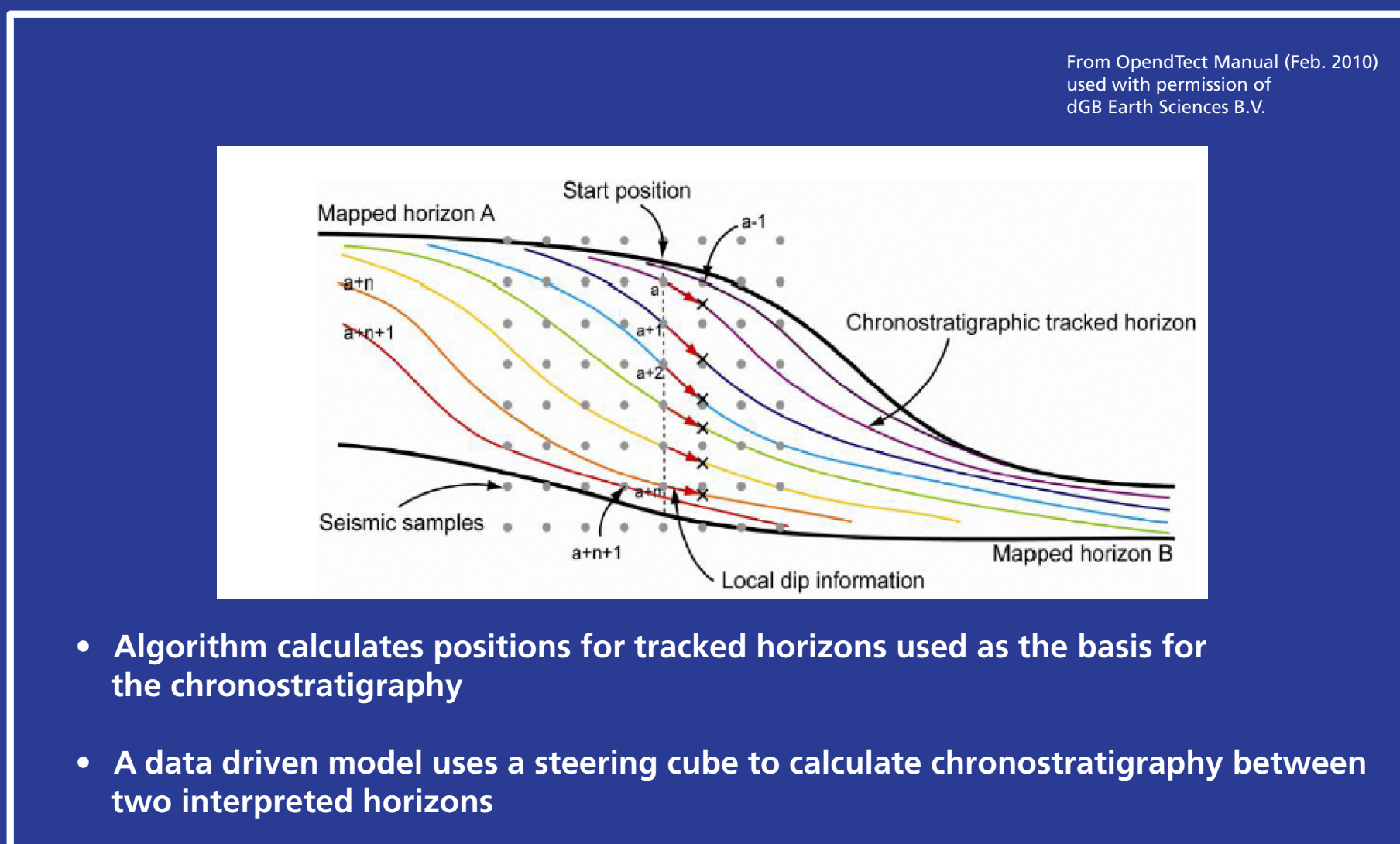
Analysis of the southern Rub' Al-Khali, Lower Cretaceous Shu'aiba Formation shows that (1) relative position with respect to the shelf, basin margin, and basin determined where the sequences were deposited, (2) the number of interpreted sequence boundaries and sequences fall within the range reported by others working nearby, (3) the average duration of the systems tracts likely ranges from about 6.5 to 1.5 Ma, suggesting that most are 3rd order sequences with some possibly being 4th order, (4) the top Shu'aiba typically coincides with a FSST or LST, (5) the base Shu'aiba is a consistent seismic marker, typically coinciding with a HST or FSST, and (6) the top Shu'aiba is a less consistent seismic marker than the

base. A top Shu'aiba surface terminating with a FSST or LST is consistent with subaerial exposure reported by others (e.g., Yose et al., 2006).

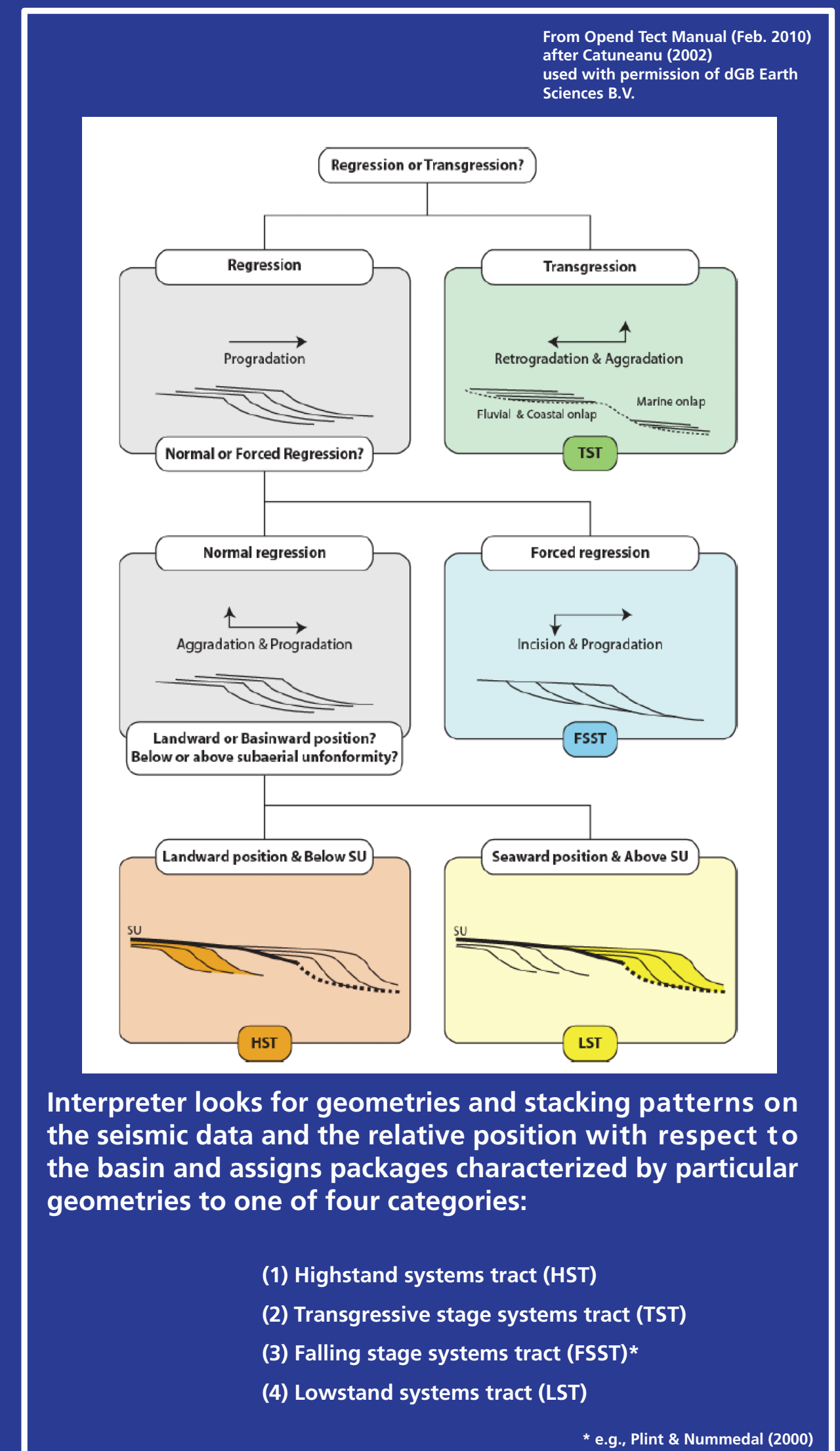
Along the northern Saudi Arabian Jurassic platform to basin transition, seismic flattening on the Dhurma Shale event combined with filtering significantly improved 3D seismic data quality and the subsequent stratigraphic event correlation and mapping. Analysis of the Hanifa-Arab platform and Gotnia basin shows that the Gotnia salt sequences (north of the Gotnia margin) may predate the Arab-D sequence in this area. This analysis further suggests that the salt was deposited during a post-Hanifa, basin-wide sea level fall.

These results illustrate breakthroughs that would have been difficult, if not impossible, to achieve using other methods. In the first case, a much better understanding of the timing, number, and relative importance of various systems tracts was rapidly gained over a two-week period. In the second, new insight on the relative timing of platform and basin successions was achieved in an area where biostratigraphic control linking the platform and basin was limited.

Data Conditioning



Defining Systems Tracts



Derive 2D Grid from 3D Volume

