

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

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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.

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

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Abstract

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Data Conditioning

From OpendTect Manual (Feb. 2010) used with permission of dGB Earth Sciences B.V.

- Algorithm calculates positions for tracked horizons used as the basis for the chronostratigraphy
- A data driven model uses a steering cube to calculate chronostratigraphy between two interpreted horizons

Defining Systems Tracts

From Opend Tect Manual (Feb. 2010) after Catuneanu (2002) used with permission of dGB Earth Sciences B.V.

Interpreter looks for geometries and stacking patterns on the seismic data and the relative position with respect to 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)*
- (4) Lowstand systems tract (LST)

* e.g., Plint & Nummedal (2000)

Derive 2D Grid from 3D Volume

3D Survey: Case 1
Southern Rub' Al-Khali,
Lower Cretaceous
Shu'aiba Formation

- View seismic in "true" depositional dip and strike orientation relative to basin

Approximate position of basin

Same work flow applied to both case studies

