High Frequency Sequence Stratigraphic Surfaces and Associated Reservoir Facies in Lower Cretaceous Ratawi Shale Formation in Kuwait*

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Abstract

The Lower Cretaceous Ratawi Shale Formation in Kuwait is a predominantly silicic lastic unit overlying a thick succession of platform carbonates. Lithofacies within it are variable both spatially and temporally. It consists dominantly of shale with sandstone, siltstone and limestone interbeds. Appreciable amounts of sandstone facies are developed within the 3rd order lowstand systems tract in the middle of the formation. Sandstone development is more prominent in the western part of Kuwait. Overall, both the lower and upper parts of the formation were deposited under transgressive conditions. The formation displays one complete 3rd order sequence and another incomplete 3rd order sequence with recognizable transgressive systems tract, and locally possibly a part of a highstand systems tract as well. It is possibly locally eroded by the overlying Late Valanginian unconformity.

High frequency sequences and important related surfaces were identified and described from the cores studied. The regressive surface of marine erosion (RSME) is usually sharp and wavy, separating the underlying offshore muddier facies from the overlying shoreface sandier facies. The sequence boundary is marked by exposed surface locally represented by rooted interfluves, by the weathered horizons and still in others by incised fluvial surfaces. The transgressive surfaces and/or major flooding surfaces usually make thin burrowed horizons with a fining and deepening upward trend. The reservoir facies are variably associated with the falling stage systems tract (e.g. shoreface sandstone above the RSME), and with the lowstand systems tract (e.g. delta plain sediments). An insight into the sequence stratigraphic setup, along with the paleoenvironmental regime as obtained from the study of core and log data, is crucial for identification and distribution of reservoir facies. Such study may lead to deciphering the potentially prospective areas for hydrocarbon exploration.

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References Cited

Sharland, P.R., R. Archer, D.M. Casey, R.B. Davies, S.H. Hall, A.P. Heward, A.D. Horbury and M.D. Simmons, 2001, Arabian Plate sequence stratigraphy: GeoArabia Special Publication 2, Gulf PetroLink, Bahrain, 371 p., with 3 charts.

Catuneanu, O., 2002, Sequence stratigraphy of clastic systems; concepts, merits and pitfalls: Journal of African Earth Sciences, v. 35/1, p. 1-43.

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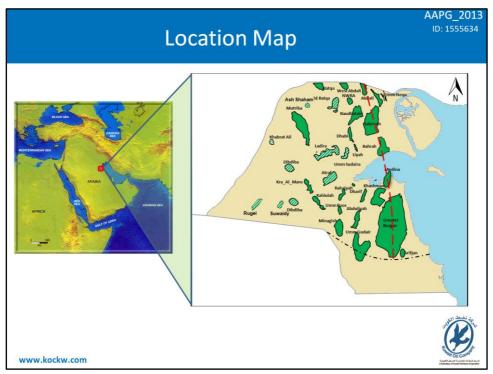
Exploration Studies Team
Exploration Group
Kuwait Oil Company



Acknowledgements

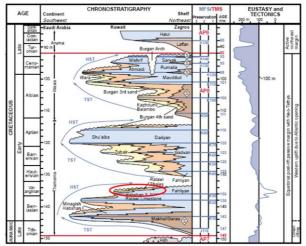
Appreciation is extended to the Ministry of Oil and the management of the Kuwait Oil Company for granting permission and sponsoring the presentation of this paper.





Presenter's notes: $110\,\mathrm{km}$ width * $150\,\mathrm{km}$ Main fields, Burgan, the world's biggest sandstone reservoir field (80 bb), Kuwait Arch

Chronostratigraphic section of the early to mid-Cretaceous across the Arabian Gulf Area



Three 2nd order transgressive-regressive cycles within megasequence AP8. The Valanginian Ratawi Shale Formation is at the upper part of the basal 2nd order cycle.

Sharland et al., 2001



Layout

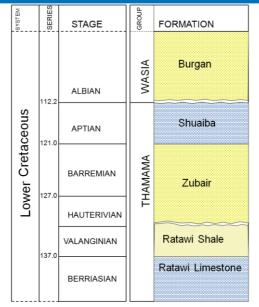
- Ratawi Shale stratigraphy
- Depositional environments; Lateral facies change
- Recognition of important sequence stratigraphic surfaces in cores
- Issues for correlation and FSST related reservoir distribution
- Basin configuration and facies development



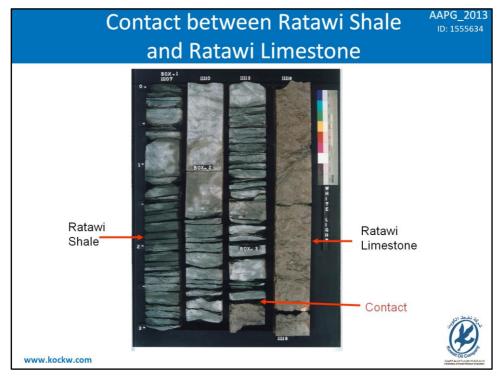
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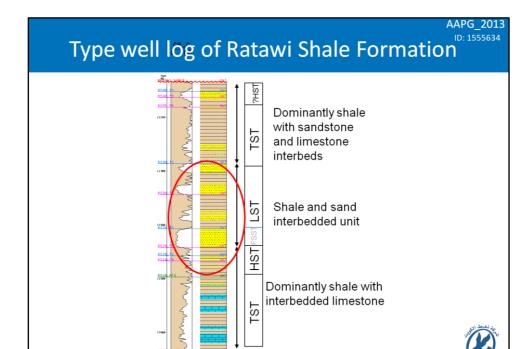
Cretaceous in Kuwait.

Stratigraphy of part Lower





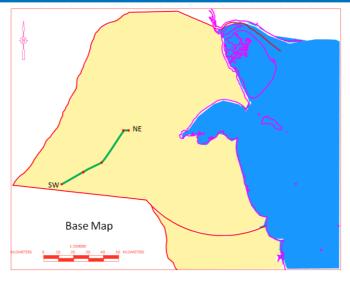




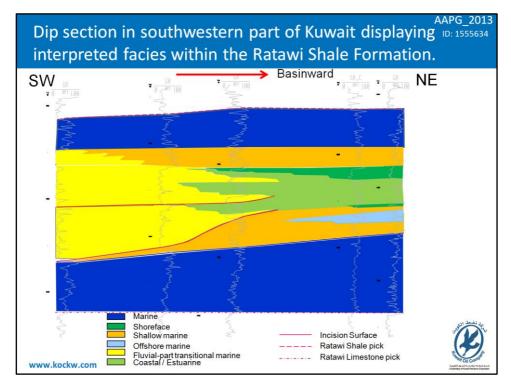
Presenter's notes: About 500 feet thick

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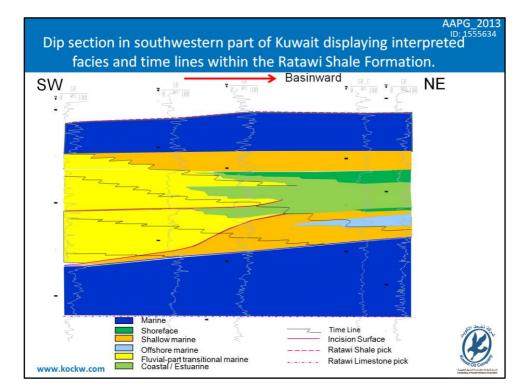
NE-SW section line in southwestern part of Kuwait



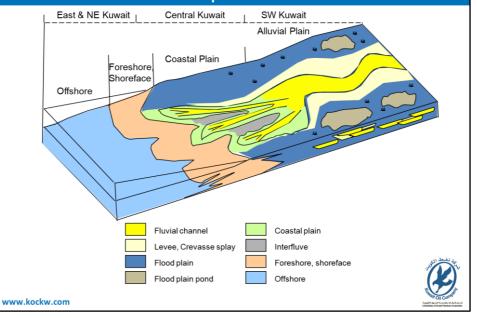




Presenter's notes: Section 60km across; incised valley in SW.



Simplified and generalized model for Ratawi Shale deposition in Kuwait.



Sequence Stratigraphy

- Reconstruction of allogenic controls
- Prediction of facies architecture in unexplored areas.

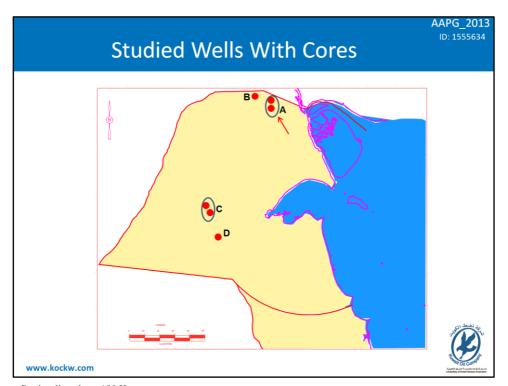
The state of the s

Facies Development in Ratawi Shale

Variables:

Type of coastal setting, sediment source and input, basin configuration, basin energy, existing paleohighs, effect of small changes in relative sea level





Presenter's notes: Section line about 100 Km across.

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Environments and HF surfaces



Bioturbated, shaley sandstonesiltstone, siderite nodules near bottom,bioclastic. Lower Shoreface

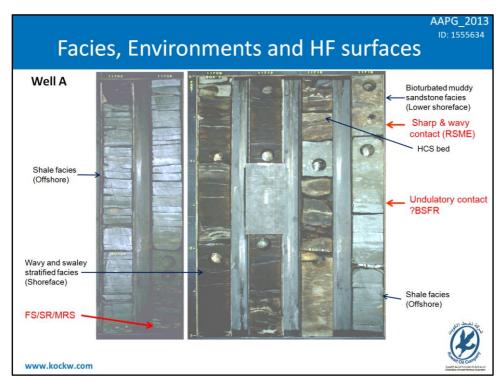
Offshore



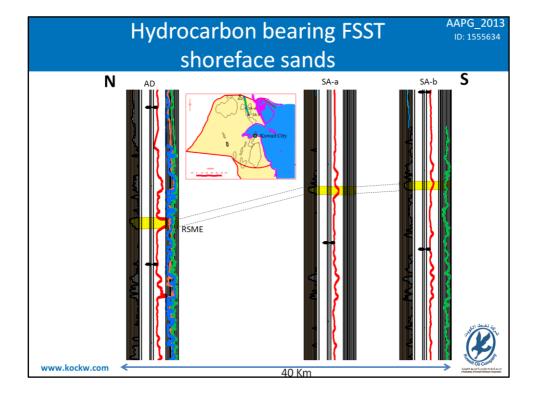
Presenter's notes: Ratawi Shale (AD) similar shoreface facies development.

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One likely scenerio: Coastal intrashelf basin is getting more open marine in nature at this location and possibly further in NE.



Presenter's notes: AD



Environments, HF surfaces

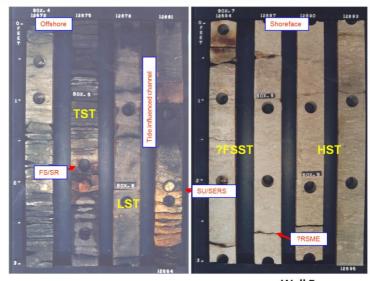




Well B

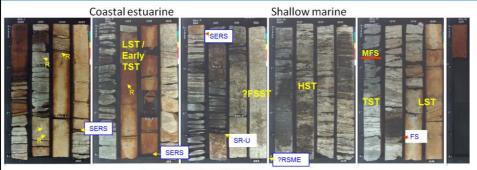


Environments, HF surfaces and systems tracts



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Environments, HF surfaces and systems tracts

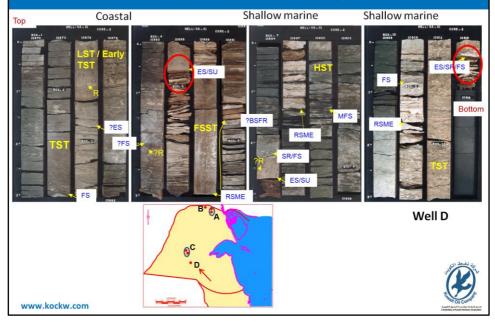


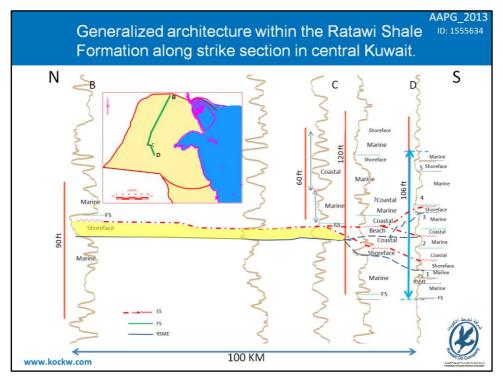


Well C



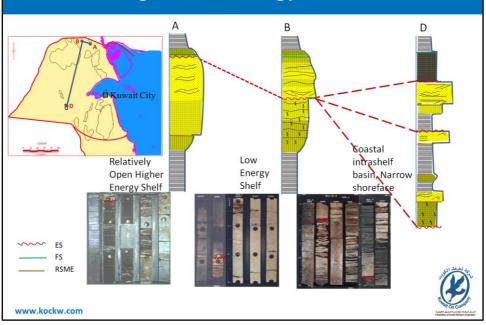
Environments, HF surfaces and systems tracts





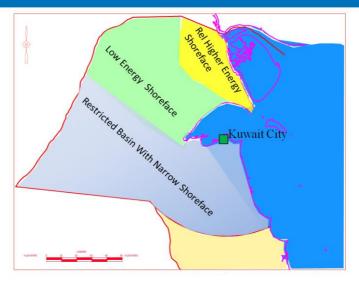
Presenter's notes: Facies variations at micro-environmental level depend upon many variables such as existing paleohigh, coastal setting, source availability, basin configuration, effect of small change in relative sea level etc. Coastal intrashelf basin narrow with limited lateral extent; abrupt facies changes; difficult to correlate laterally. Example facies in two close by KM wells. Stranded shoreface deposits (FSST) are more likely have better development in open marine wider shelf setting.

Basin configuration, Energy Level and Facies



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Basin configuration and Energy Level





Conclusions

- Reservoir sandstone facies in the Ratawi Shale in central Kuwait: shoreface, tidal channel, coastal (estuarine) channels.
- Basin configuration and energy level most important parameters for the development of shoreface facies type and its distribution.
- Better chances of correlation and prediction of FSST reservoir facies for open marine shelf settings.

