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The Sedimentology of Resource Plays

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Summary

The oil and gas industry in Canada and the US has undergone a transformation over the past few years with a dramatic shift to so-called unconventional oil and gas plays, or resource plays. Typically these plays involve relatively unstructured, extremely low permeability deposits which are drilled up with horizontal wells and then fractured at extremely high pressures to open conduits to hydrocarbon flow. Three main classes can be recognised: basin centred (or tight) gas, oil and gas shales, along with oil sand deposits.

New sedimentological strategies including reservoir facies analysis, sequence stratigraphic analysis and correlation, the use of isopachs to define facies architecture, the use of outcrop analogues and an understanding of diagenetic character can all be used to improve our understanding of reservoir architecture and potential performance in a variety of clastic reservoirs in western Canada.

Introduction

While some fields can be drilled up as “factory fields” i.e. on a “drill to a pattern”, well by well basis with almost no technical input, sedimentology has a significant role to play both in targeting so-called sweet spots for production, and also in improving overall yields. Tight gas plays produce from tight, low permeability rocks, and an understanding of reservoir architecture is critical. Oil and gas “shales” often comprise siltstones and/or fine grained carbonates, with carrier beds of coarser deposits. Mapping of such interbeds is critical in drilling into the correct horizons. Interpretation of electronic logs can also facilitate the development of accurate geological models that lead to increased understanding of reservoir behaviour.

Method

A combination of techniques are utilized to ensure that a full picture is gained of the sedimentological character of the reservoir interval. This can be subdivided as follows:

- An analysis of relevant well logs in Accumap or similar package

- Correlation of such logs to yield spatial variation in properties
- An analysis of any production data and behavior
- Logging of any available core, and identification of significant surfaces
- Mapping of isopachs to estimate the extent of facies elements
- Identification of suitable outcrop analogues

Al l of this data may be relevant in building up a depositional picture of the subsurface. Facies architecture can be illuminated by all of the above datasets.

Examples

Several examples will be presented incorporating data from the following formations:

Cadotte – shoreface orientations and dimensions will be mapped out using production and gamma ray log data. In addition provenance data will be considered that identify chert rich zones that may relate to differential diagenetic cementation, and hence variation in reservoir productivity

Cadomin and Nikanassin – outcrop data will be used to establish dimensions of sedimentary bodies, and to identify significant surfaces that can be used to construct a sequence stratigraphic framework

In addition theoretical examples will be presented incorporating earthquake data, sedimentological mapping of structures, provenance and cement mapping, to identify reservoir architecture. The efficacy of using outcrop data cannot be overestimated, and will also be addressed.

Conclusions

There is no doubt that a better understanding of sedimentologically related reservoir architecture will lead to better drilling solutions to maximise hydrocarbon recovery. The use of the techniques described above can help to elucidate reservoir distribution in a variety of clastic depositional settings. A move away from purely factory hydrocarbon mining to one that incorporates this data will lead to cheaper and more efficient production.

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