Facies Study of the West Ells SAGD Project, Athabasca Oilsands*

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Abstract

A facies study was conducted over the four sections outlining the West Ells SAGD Project. The primary focus was to enhance reservoir characterization for modeling, simulation, and future well pair placement. Although limited in areal extent, the project also resulted in refinement of the existing depositional environment interpretations. Key surfaces and facies were picked from 42 cored wells, using standard log suites, core photos and Compact Microimager (CMI) logs. The facies data was then converted to LAS files and used to constrain core analysis cross plots to identify trends and correlations. Net facies maps were created to show any depositional trends over the project area. The final data is being used to refine the geomodel and run various reservoir simulations.

Introduction

The West Ells SAGD Project is located in the northwest Athabasca Oilsands Region, township 94, ranges 17 and 18 west of the 4th meridian (Figure 1). In the study area, the Cretaceous-aged (Lower Albian) Wabiskaw Member of the Clearwater formation overlies the McMurray formation and is capped by the Clearwater Shale. Currently, there is ongoing debate regarding the stratigraphic nomenclature in the area, but it is important to note that this study concerns itself with the sedimentology and does not attempt to discern which formation is, in fact, correct. Sunshine originally identified the strata as Wabiskaw and, for the sake of continuity; this study will regard the formation as such. It stands to reason that because facies are sedimentologically different they would possess relatively unique reservoir parameters. Depending on sedimentary structures, two distinct facies may have the same porosities, but different vertical permeabilities. For example, a massive, heavily bioturbated sand and wave-reworked, parallel-laminated sand could have average porosities around 30%, yet different vertical permeabilities due to the nature of sedimentary structures. The inter-relationship and distribution of these facies, both horizontally and vertically, are important input variables for geomodelling and reservoir simulations.

Theory and/or Method

Facies Definition, Identification and Data Manipulation

Before facies analysis was conducted, correlative surfaces were picked on well logs over the study area. The surfaces of interest were the Wabiskaw D mud, the Wabiskaw D top, the Lower C top, the Wabiskaw C top, and the top of the Wabiskaw. Following correlation of these surfaces, a review of core over the four sections of interest was conducted using standard logs, core photos and CMI logs. Physical cores were used selectively as a check on photo and image log-based interpretations. Facies were defined based on grain size, sorting, bedding, mud volume (Vsh), physical structures, and ichnology. Ultimately, eight facies were broken out, five falling within the reservoir interval. The facies depth intervals were recorded throughout each core and converted to an LAS curve. Cumulative thicknesses of each facies were recorded and used for net-isopach mapping. In total, facies were picked in forty-two cores over the study area. Permeability cross-plots were then generated to show any trends/relationships between the facies and core data. Following a review of the cross-plots, net facies maps were generated for the entire Wabiskaw package, and for each zone within the Wabiskaw to show any possible trends and to aid in modeling. The net maps only account for facies within the SAGDable reservoir. All data was exported for modeling purposes.

Depositional Environment Interpretation

The Depositional Environment within the West Ells SAGD Area is interpreted as marine bay with both tidal and wave influence, as well as an estuarine component that likely contributed seasonal influxes of mud (Figure 2). Deposition of sediment was heavily influenced by the topography of the underlying paleo-unconformity formed by exposure and erosion of Devonian-aged carbonates before deposition of the Cretaceous-aged McMurray and Wabiskaw clastic sediments. Based on the interpreted seismic structure of the pre-Cretaceous unconformity the local bay margin is assumed to be open to the south. The regional bay area connects to an open marine environment to the northeast. Fluctuations in base level and energy result in differing facies co-existing in one depositional environment. These fluctuations result in the stacking of facies preserved in core.

Conclusions

This study identified eight facies in the Wabiskaw formation over the West Ells SAGD Project, five of which fall within the reservoir interval. Reservoir characteristics are dictated by facies due to variations in sedimentology. The vertical juxtaposition, areal extent, frequency and distribution of these facies have an effect on steam chamber development. The data will be used to refine the geomodel and reservoir simulations. It will also be used as input for micro-modeling, well pad orientation and well pair placement/trajectories. Ongoing and future work includes the expansion of the study are to the north and south, encompassing Sunshine's adjacent asset areas.

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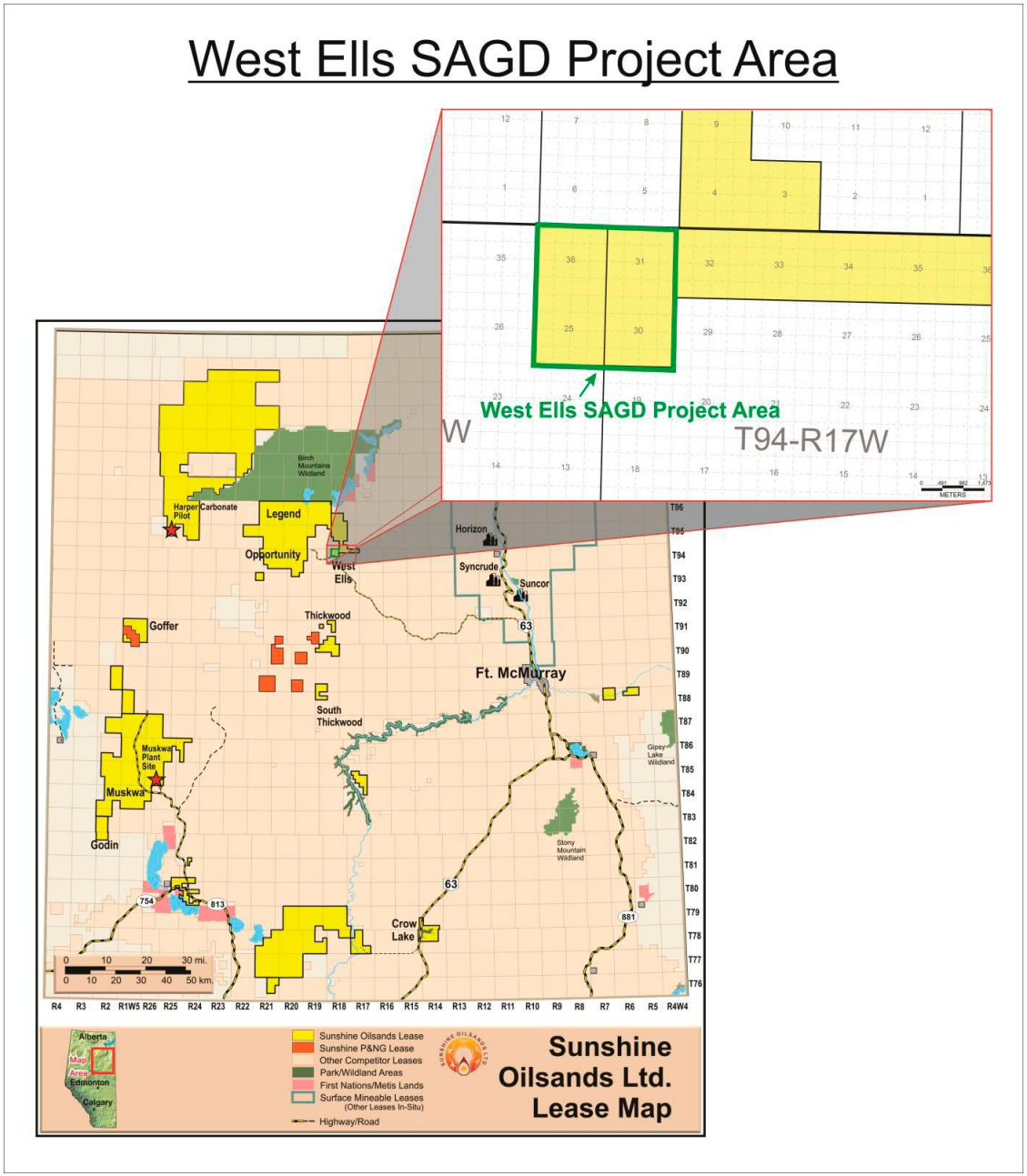

Figure 1. West Ells SAGD Project Study Area.

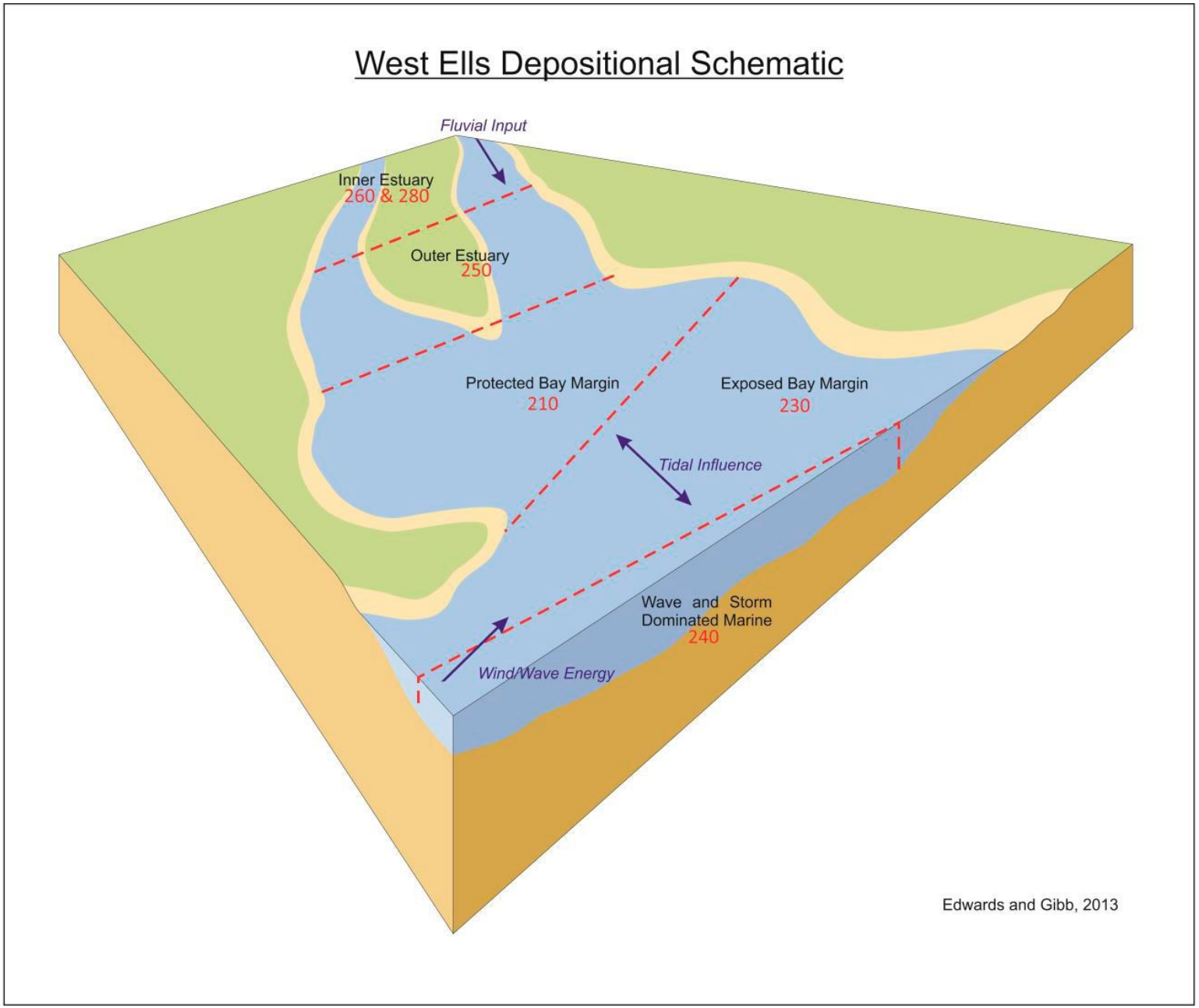

Figure 2. Depositional Environment Schematic Diagram.