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The Alberta Bakken: A Potential New, Unconventional Tight Oil Resource Play

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The Alberta Bakken (AB Bakken) is the latest play area being evaluated in the quest to capture early entry, contingent, light tight oil resources. The AB Bakken Petroleum System comprises a 0–50m thick mixed carbonate-clastic interval in northwestern Montana and southwestern Alberta, consisting of Devonian and Mississippian Stettler/Big Valley – Exshaw – Banff Formations (Fig. 1). The AB Bakken is approximately time equivalent to the Bakken Petroleum System of the Williston Basin, and is considered a proven play with production both from the Stettler/Big Valley and DST hydrocarbon recoveries from the Bakken/Exshaw Formations. Evaluation of the available geological, production, drill stem test (DST) and core data indicates that the AB Bakken is characterized by: i) pervasive petroleum saturation; ii) abnormal pressure (high); iii) a lack of down dip water; iv) up dip water saturation; v) low-permeability and low-matrix porosity reservoirs; vi) deliverability is enhanced by fracturing; and vii) plays that are self-sourcing within a mature source rock fairway. The key play elements for the AB Bakken are shown in Figures 2a and b, and the paleogeographic setting of the AB and Williston Basin Bakken are shown in Fig. 3.

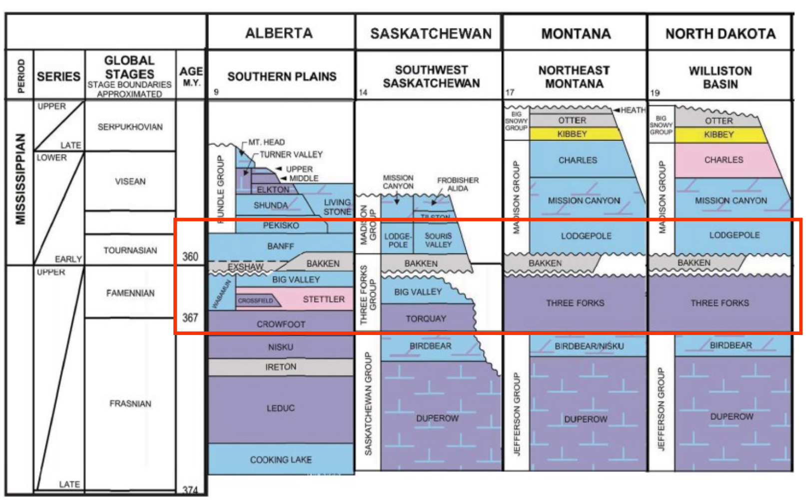

Figure 1: Stratigraphic Column, AB and Williston Basin Bakken
(*Source: Zaitlin et al., BMO Capital Markets, 2010, modified from Core Labs Stratigraphic Chart, 2010*)

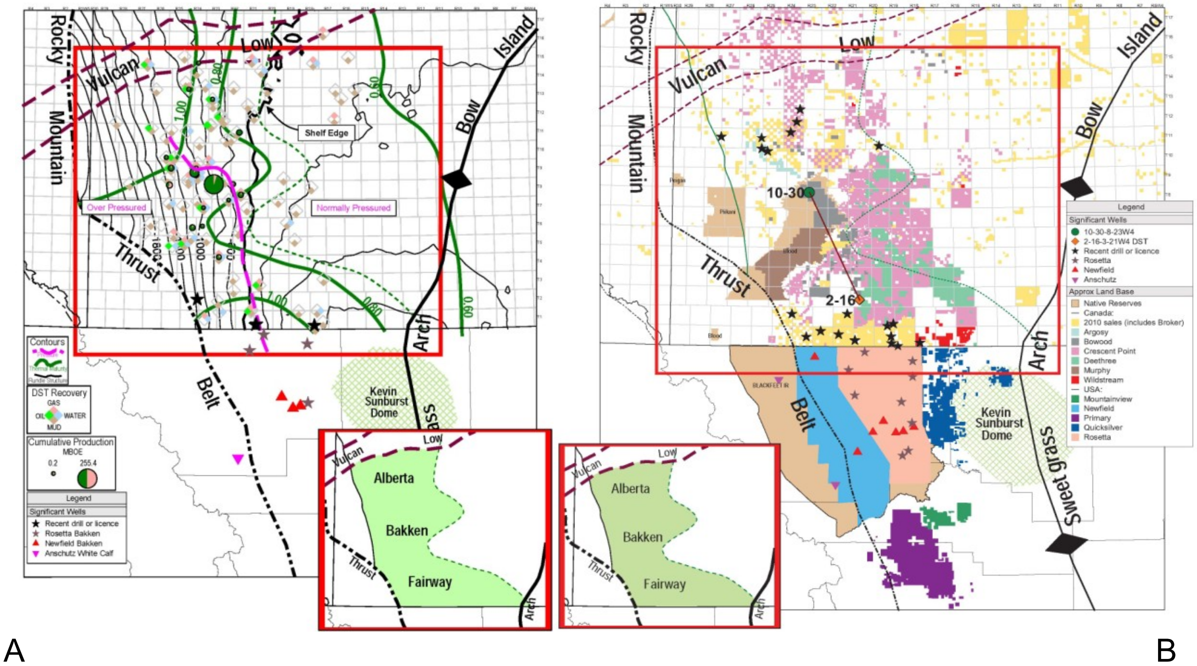

Figure 2: a) Key play elements for the AB Bakken with drilling activity to October 2010; b) drilling and licensing activity to January 2011(*Source: Zaitlin et al., BMO Capital Markets, 2010*).

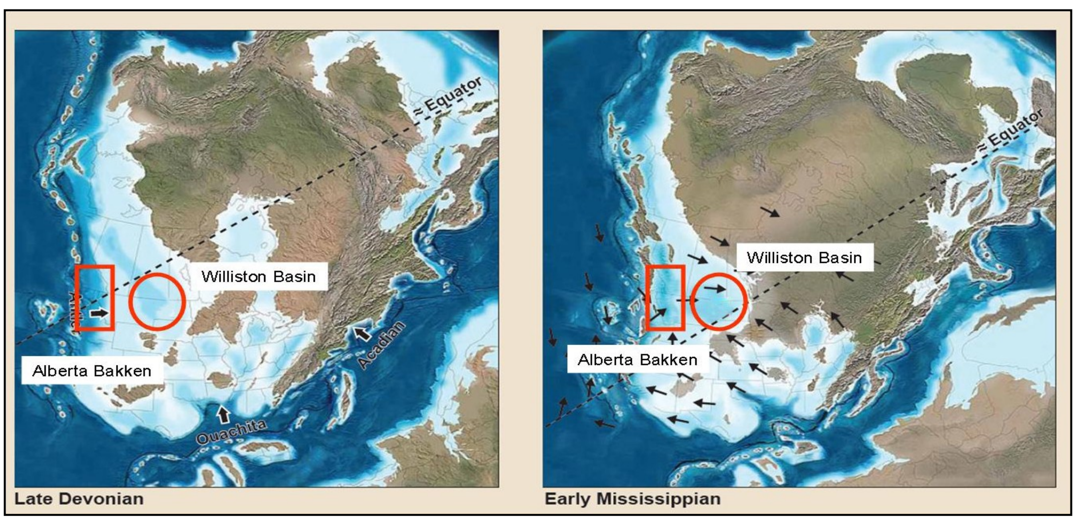

Figure 3: Paleogeographic reconstruction for the AB Bakken and Williston Basin Bakken depicting depositional settings: a semi-restricted intracratonic basin (Williston Basin) versus a westward-facing foreland trough (*Source: http//personal.umich.edu/~sperrin/geology/northamerica.pdf*).

Figure 2 shows the main geological elements of southwestern Alberta and Northern Montana during AB Bakken time. The western boundary of the AB Bakken play is defined by the Rocky Mountain Thrust Belt. AB Bakken reservoirs are influenced by structuring, enhancing inherent low permeability by naturally fracturing dolostones to silty dolostones. The eastern boundary of the AB Bakken is defined by the Sweetgrass Arch/Bow Island Arch and Kevin Sunburst dome. The northern limit of the Alberta Bakken is defined by the Vulcan Aeromagnetic Low. The bolded subsea contours on the Mississippian Rundle

Formation exhibit widely spaced contours to the east and more closely spaced contours to the west, indicating a hinge and change of slope aligned north-south through the study area.

The Exshaw and Bakken shales represent important petroleum source rocks in the Western Canadian Sedimentary Basin. Figure 2a displays the contours of thermal maturity as defined by vitrinite reflectance (Ro) values as taken from GSC Report for the Alberta Bakken area. Oil generation from most organically rich shale units is considered to commence at Ro~0.65, with peak oil generation occurring at Ro~1.00 and the end of oil generation occurring when Ro >~1.3. As is shown in Figure 2a, Ro values associated with the Alberta Bakken range from ~0.6 in the east to >1.00 toward the west and south. This indicates that the Alberta Bakken Petroleum system is an active hydrocarbon system. Important points in support of a locally sourcing area of maturity are: 1) DST recoveries (Fig 2a) indicate that all live oil or gas recoveries occur at or west of the Ro=0.80 line; and 2) a review of production (Fig 2a) indicates that no proven production occurs east of the Ro=0.80 line.

A two-well cross-section (Figs 2b and 4) shows the thinning of the Stettler/Big Valley-Bakken succession eastward (Fig 4). The 10-30 well displays a full AB Bakken succession. The silty dolostone of the Big Valley has approximately 15m of pay at 12% average porosity cutoff, and has produced ~ 243 Mbbl of oil with no water with a pressure gradient calculated at PGrad = 0.65 psi/ft (approximately 50% overpressure). Using a dolomite baseline of 0% and interpreting the Middle Bakken/Exshaw as a silty dolostone, it is possible to calculate 12m of potential pay with an Rt~15 (total pay of 27m). The Big Valley in 2-16 is interpreted as a tight limestone and forms an updip facies trap. The Middle Bakken/Exshaw displays approximately 2m of >6% pay, and recovered ~300 feet of live oil from a straddle DST with an Rt ~35. The low Rt values may be indicative of low resistivity pay due to the mineralogical composition. A hydrodynamic study of the Alberta Bakken shows a potential change from normal pressure in 2-16 well to overpressure in10-30 well.

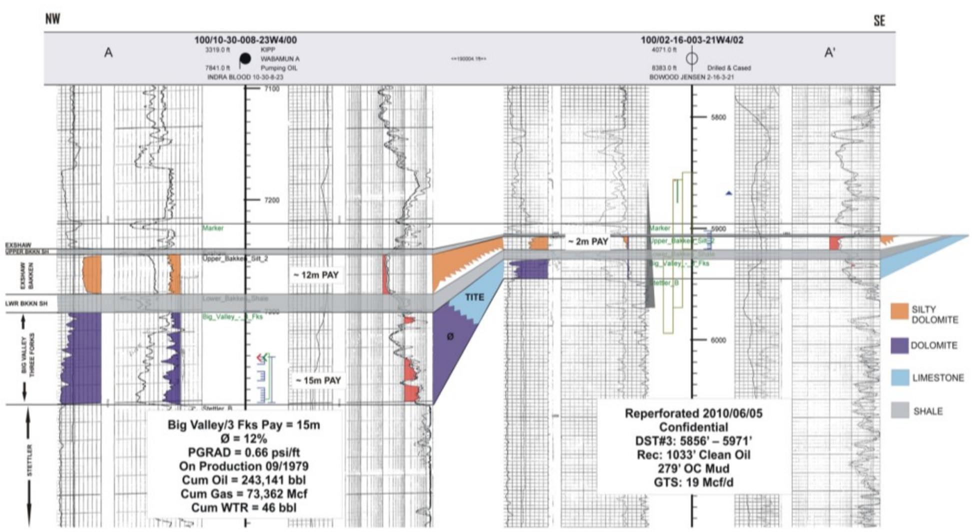

Figure 4: *Two-well cross section in the Alberta Bakken highlighting the rapid thinning of the Three Forks-Exshaw. Note proven production in the Big Valley - Three Forks in 10-30 well and low resistivity pay in the Bakken/Exshaw in 2-16 well confirmed by DST oil recovery.* (*Source: Zaitlin et al., BMO Capital Markets, 2010*).

Integrated structural studies of the fairway suggest that the play fairway is dominated by the presence of several major structural features that represent deep seated basement structures (Fig 5). These structures exhibit the structural style of extensional graben features which were reactivated and inverted by late Laramide compression. These graben features appears to form the focal point of deposition of thick section of Exshaw - Bakken sediments and therefore are likely to become the major “sweet-spots” of this play. Late Laramide inversion and reactivation may lead to further enhancement of the ‘sweet-spot” by local increase in natural fracture densities (Fig. 5).

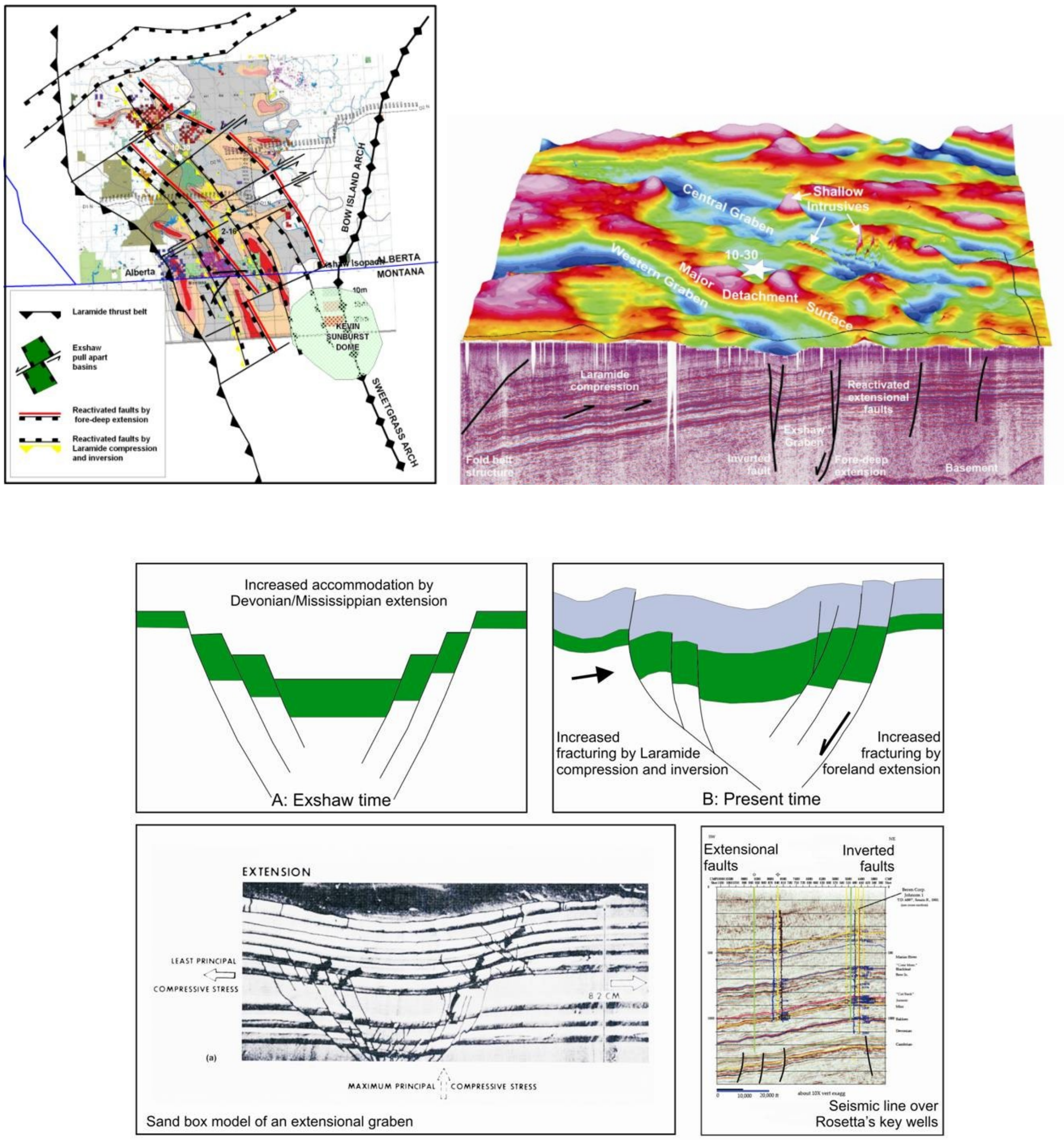

Figure 5: Integrated structural study of the Exshaw Bakken play showing: A) general tectonic map of the play fairway area; B) a three dimensional block diagram of HRAM data and regional seismic; and C) a schematic map illustrating the relationships between structural features and structural timing and the location of “sweet spot” of the Bakken/Exshaw play.
(Source: Exshaw/Bakken isopach map is after Bowood Energy 2010 Corporate presentation).