

Regional geology and reservoir potential of the Schrader Bluff, Prince Creek, and Sagwon Member of the Sagavanirktok Formation (Late Cretaceous to Early Tertiary), Sagavanirktok Quadrangle, North Slope, Alaska

Peter P. Flaig,^{1a} Richard Garrard,² and Dolores A. van der Kolk¹

^a Corresponding author fsppf1@uaf.edu

¹ Dept. of Geology & Geophysics, University of Alaska-Fairbanks, Fairbanks, Alaska

² FEX-Talisman Energy, Anchorage, Alaska

During the summer of 2008 University of Alaska-Fairbanks graduate students and FEX-Talisman Energy set out on a collaborative project to investigate surface exposures of the Schrader Bluff (SB), Prince Creek (PC), and Sagavanirktok (SAG) formations along the Toolik, Ivishak and Sagavanirktok rivers in the Sagavanirktok Quadrangle. The goals of the project were to (i) better define the reservoir quality and regional distribution of Late Cretaceous to Early Tertiary Brookian sandstones, (ii) identify sandbody and floodplain geometries, and (iii) assess the hydrocarbon potential of the frontal foothills for this part of the Brooks Range.

Field reconnaissance during the Division of Geological & Geophysical Surveys' 2007 summer field season located a number of significant exposures assigned to the SB, PC, and SAG along the Toolik, Ivishak, and Sagavanirktok Rivers. Additional investigations during 2008 sponsored by FEX-Talisman indicate that portions of the SB along the Toolik and Ivishak Rivers consist of repeated, shallow-marine coarsening-upward successions with a marine mudstone at the base and hummocky or swaley cross-stratified sandstone at the top. Our outcrop samples suggest that present day porosity and permeability of the SB are reduced by compaction and cementation, and may be inadequate for effective oil reservoirs in this area. Excellent porosities and permeabilities are however preserved elsewhere in the subsurface, especially along the eastern flank of the Colville High where the SB is productive in the West Sak, Milne Point, Orion, and Polaris Fields.

The non-marine PC along the Ivishak River south of the Echooka #1 well is structurally complex but generally fines-upward from a basal sandy conglomerate containing abundant wood and logs to interbedded fine-to medium-grained sandstone, siltstone, carbonaceous shale, and coal at the top of the formation. The PC is unconformably overlain by conglomerates and sandstones of the Sagwon Member of the SAG along the Ivishak River.

Exposures of the PC at Sagwon Bluffs along the Sagavanirktok River and along the east side of the Toolik River are remarkably similar, although more of the conglomerate near the local base of the PC is exposed along the Toolik River. The PC at Sagwon Bluffs is composed of coarse-to fine-grained sandstone, along with abundant

organic siltstone, organic mudstone, carbonaceous shale, and coal. The alluvial architecture at Sagwon Bluffs includes laterally extensive, meandering sheet sandstones at least 3 meters thick and hundreds of meters wide as well as ribbon-form sandbodies up to 15 meters thick and hundreds of meters wide. Ribbon-form sandbodies typically interdigitate with or are encased in organic floodplain facies. Sandbodies are isolated from each other by floodplain deposits and display a low degree of channel interconnectedness throughout the succession. The reservoir characteristics of the PC sandstones are excellent with porosities in the 18% to 30% range and permeabilities locally in excess of 1 darcy.

A probable sequence-bounding unconformity separates the Sagwon Member of the SAG from the PC at Sagwon Bluffs. The PC and SAG at Sagwon Bluffs record the transition from a wet, deltaic environment dominated by meandering rivers, crevasse splays, lakes, swamps, and mires during PC time to that of an extensive braidplain during SAG time. The Sagwon Member of the SAG contains medium-to coarse-grained sandbodies encased in pebble-to-boulder conglomerate along with infrequently exposed finer-grained floodplain deposits. Because of the friable and conglomeratic nature of the Sagwon Member, representative core plugs were difficult to acquire in the field. Based upon visual inspection and analysis of petrographic thin sections the Sagwon Member of the SAG is believed to be an excellent reservoir. Reservoirs of approximately equivalent age are known to be oil-bearing at the Ugnu accumulation on the Colville High.

Several of the sandstone outcrops at Sagwon Bluffs are extensively oil stained. Geochemical evaluation of these occurrences is ongoing. Initial results suggest that the oils are light, slightly-to-moderately biodegraded, and derived mainly from Upper Cretaceous source rocks. Key source rock candidates include the Hue Shale and distal portions of the interfingered Seabee Formation. The combination of a pervasive light oil charge and at least three different reservoir intervals suggest that this lightly-drilled area may warrant future hydrocarbon exploration.