NORTH DAKOTA

STRATIGRAPHIC COLUMI							
F YEARS RESENT	HEM	SYSTEM		NCE	I	ROCK UNI	T
AGE MILLIONS OF YEARS BEFORE PRESENT	ERATHEN			SEQUENCE	GROUP	FORMATION	MEMBER
-0.01-	H		Holocene			ОАНЕ	RIVERDALE PICK CITY AGGIE BROWN MALLARD ISLAND
0.01		QUATERNARY			COLEHARBOR	WEST CENTRAL EAST	RED RIVER VAL SHERACK POPLAR RIVER BRENNA FALCONER HU
		QUAT	Pleistocene	AS		SNOW SCHOOL DAHLEN GARDAR HORSESHOE VALLEY CHWICH MEDICINE HILL CAMPO G	S FERRY AAFTON MARCOUX
-2.6 —			Pliocene Miocene	TEJAS		(Unnamed Unit)	, and ook
- 5.3 — 23.0 —		Odix	Miocene Oligocene			ARIKAREE BRULE	
33.9 –	OIC	ARY	Eocene	~~	WHITE RIVER	CHADRON	SOUTH HEART CHALKY BUTTES
55.8-	CENOZOIC				FORT UNION	GOLDEN VALLEY	CAMELS BUTTE BEAR DEN
	0	TERTIARY	PALEOGENE			SENTINEL BUTTE	
			Paleocene			BULLION CREEK	
						SLOPE	
65.5—						LUDLOW	
					MONTANA	HELL CREEK	BREIEN COLGATE ≥ LINTO
						FOX HILLS	BULLHEAD TIMBER LAKE TRAIL CITY
						PIERRE	ODANAH
							DEGREY
		ľ	Upper	ZUNI			GREGORY
		CRETACEOUS		Z			PEMBINA
	MESOZOIC	CRE			COLORADO	NIOBRARA	GAMMON
						CARLILE	
						GREENHORN BELLE FOURCHE	
.6-	ME				DAKOTA	MOWRY	
			Lower			NEWCASTLE SKULL CREEK	
5.5-						INYAN KARA	
		JURASSIC				SWIFT	
						RIERDON	BOWES FIREMOON
						PIPER	TAMPICO KLINE PICARD
1.6-							POE DUNHAM SAUDE
61.0-			TRIASSIC			SPEARFISH	PINE BELFIELD
		PERMIAN		ABSAROKA		MINNEKAHTA OPECHE	
			2 233,132			BROOM CREEK	
9.0-					MINNELUSA	AMSDEN	
			PENNSYLVANIAN			TYLER	ALASKA BENCH
18-					BIG SNOWY	OTTER KIBBEY	
		sno				CHARLES	
		CARBONIFEROUS			MADISON	OllArdies	
		CAI	MISSISSIPPIAN			MISSION CANYON	
				KASKASKIA		LODGEPOLE	
59 —	OIC			KAÈ		BAKKEN THREE FORKS	
	PALEOZOIC	DEVONIAN			JEFFERSON	BIRDBEAR	
	PAL.					DUPEROW SOURIS RIVER	
					MANITOBA	DAWSON BAY	Works
						PRAIRIE	MOUNTRAIL BELLE PLAINE ESTERHAZY
					ELK POINT	WINNIPEGOSIS	
6-				 		ASHERN	
		SILURIAN				INTERLAKE	
14 —				OE		STONEWALL	
		ORDOVICIAN		TIPPECANOE	DIG WOTE	STONY MOUNTAIN	GUNTON STOUGHTON
				TIP	BIG HORN	RED RIVER	
					WINNIPEG	ROUGHLOCK ICEBOX	
				 ~~		BLACK ISLAND	
38-				SAUK		DEADWOOD	
12-			CAMBRIAN	<u>ـــ</u>	S	TRUCTURAL PROVIN	CES
PRECAMBRIAN WYOMING TRANS-HUDSON SUPERIOR PROVINCE OROGEN PROVINCE							
l							



BAKKEN PETROLEUM SYSTEM SUMMARY

DRILL STEM TESTS AND PRODUCTION MAPPING

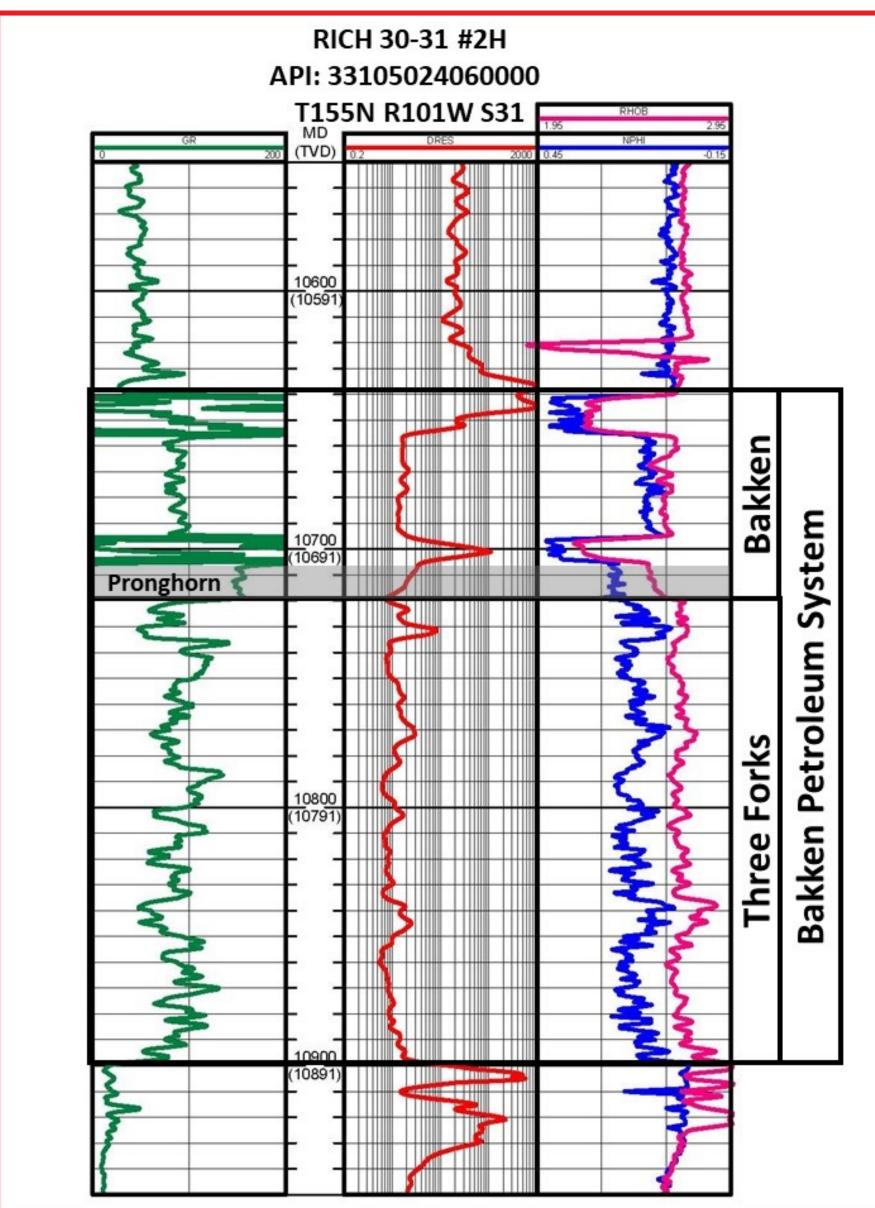
Prepared by **Travis Stolldorf**

In order to better facilitate petroleum exploration and development in the Williston Basin, the North Dakota Geological Survey (NDGS) has published a series of production-related maps and corresponding data sets. These maps sets include production and drill stem test (DST) results with an accompanying spreadsheet for easy data extraction. The primary goal of this project is to create a database showing the distribution of hydrocarbons within each productive unit.

Prior to this project, over 55% of the DST results in the state did not have an associated geologic interval. The NDGS utilized a series of filters in Petra and Excel to unite formation tops with DST results. Now over 95% of DST results are associated with a geologic interval. After removing failed (misrun) DSTs, the remaining DST results were then separated into three groups. The first group (Positive DSTa) contains wells that have recovered oil or gas (in either the drill pipe or the sampler), or those that list oil or gas as the primary component of the fluid/gas mixture (e.g. 10' mud cut oil) in the description. Secondly, Positive DSTb wells display results for oil or gas as the secondary component of the fluid/gas mixture (e.g. 50' gas cut mud). Although Positive DSTb wells do show signs of hydrocarbons, the hydrocarbon signal is considered weaker than those in the Positive DSTa group. Lastly, the Negative DST results have no indication of hydrocarbons. Detailed information for each DST (time-pressure data, interval depths, fluid and gas recovery information) can be accessed through the well file database maintained by the North Dakota Industrial Commission (NDIC) Oil and Gas Division.

Production for each well was determined using the NDIC's Production Pools and associated monthly production totals. The production pools utilized are shown on the Production Map for each interval. Cumulative production for each well was calculated through September 2019.

This project is a summary of the Bakken Petroleum System's production and drill stem test results. Map sets include a production map, cumulative production map and DST results in North Dakota's portion of the Williston Basin. The Bakken Petroleum System is highlighted by the red box on the North Dakota Stratigraphic Column on the left. A representative log of the Bakken Petroleum System is shown below along with a map showing the well's approximate location.



The Bakken Petroleum System is comprised of the Bakken and Three Forks Formations as well as the lowermost portion of the Lodgepole Formation where hydrocarbon charged from the underlying Bakken Formation. This study deals with data exclusively from the Bakken and Three Forks Formations. All Lodgepole Formation data are available within the Madison Group products.

References

Murphy, E.C., Nordeng, S.H., Juenker, B.J., and Hoganson, J.W., 2009, North Dakota Stratigraphic Column, North Dakota Geological Survey, MS-91, 1p.

North Dakota Industrial Commission, Department of Mineral Resources, Oil and Gas Statistics, retrieved October 2019, https://www.dmr.nd.gov/oilgas/

NORTH DAKOTA LOCATION MAP

