

Information on the Spearfish Formation

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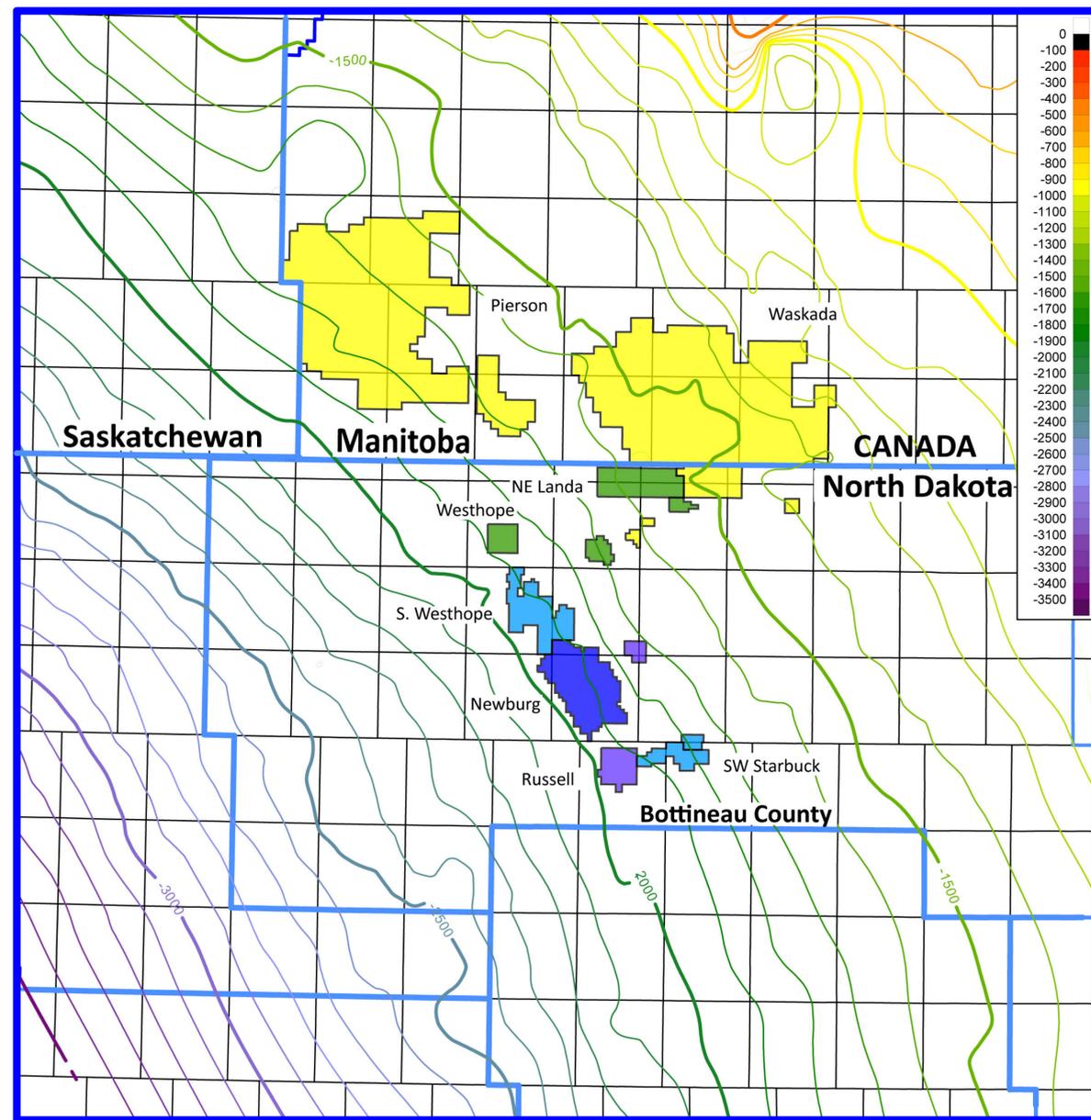
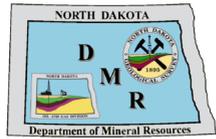


Figure 1. Structure map of the Madison unconformity surface. Spearfish Formation producing oil fields in Bottineau County, North Dakota and Canada are indicated by the colored areas. The field colors are based on the discovery date (modified from LeFever and LeFever, 1991).

	Southwestern Manitoba	North-Central North Dakota
Formation	2,935 TVD	3,000 ft TVD; 5,500 ft MD
Thickness (ft)	78	50
Average porosity	14.5%	14%
API Oil Gravity	35°	36°
Initial IPS	208-337 Bopd	285-305 Bopd
Oil-in-Place/Section	9-15 MMbo	13 MMbo

Table 1. A comparison of the reservoir characteristics of the current Spearfish play (modified from Papa, 2010; Redekop, 2010; NDIC Case #12076). TVD = true vertical depth, Bopd = barrels of oil per day, MMbo = millions of barrels.

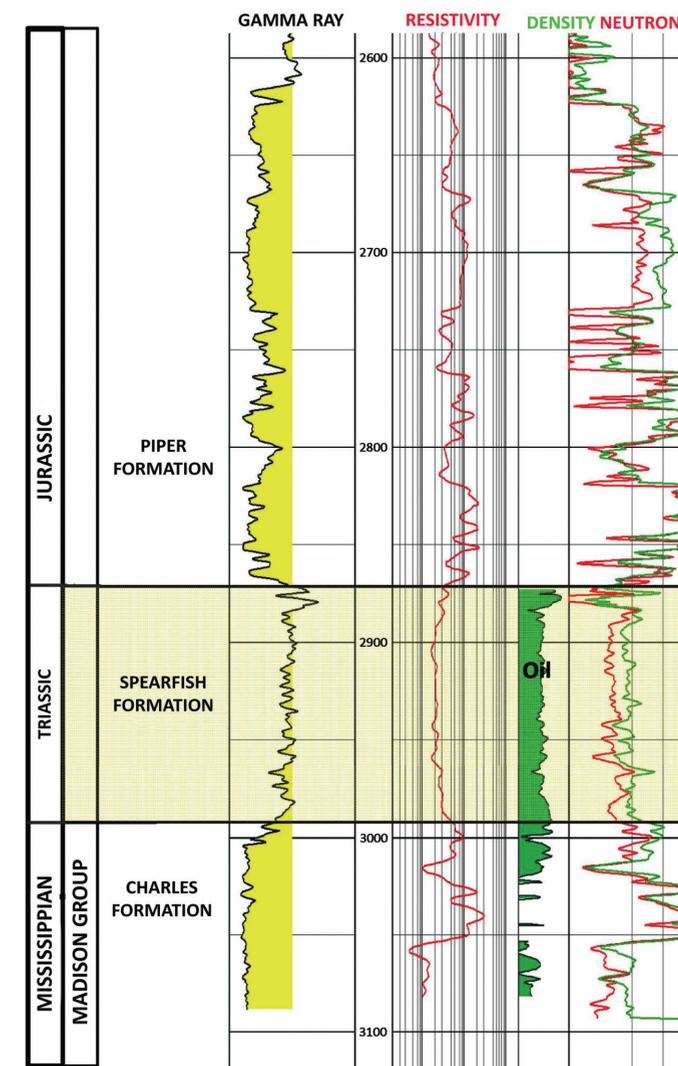


Figure 3. Typical log from the current play in the Spearfish Formation (modified from Papa, 2010).

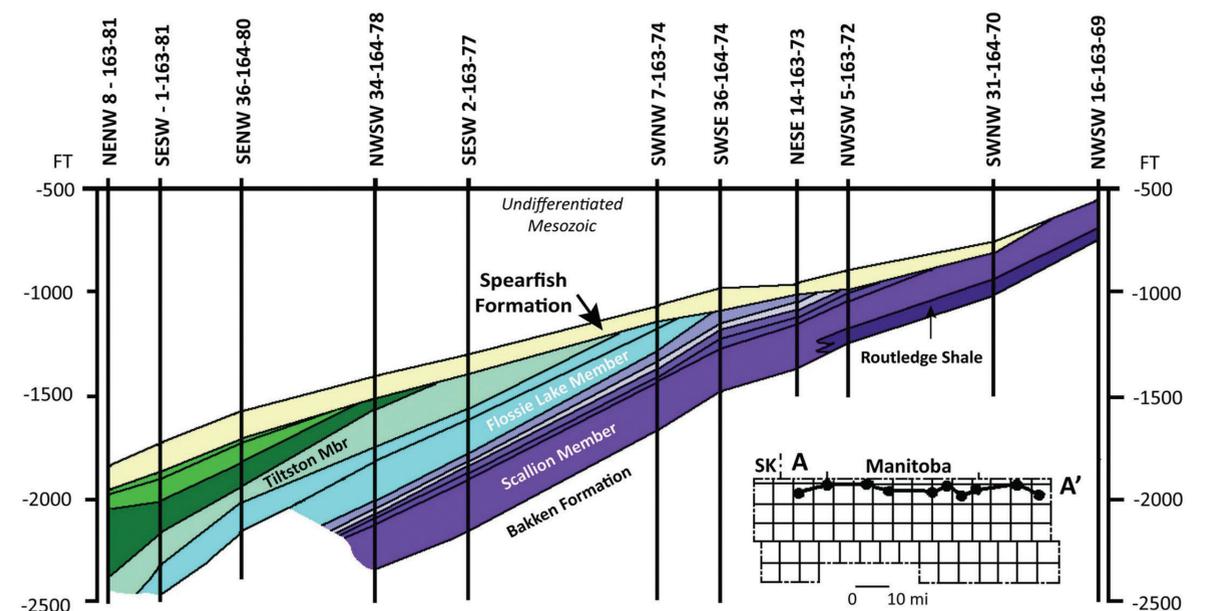


Figure 2. Schematic cross-section showing the onlap of the Spearfish Formation over the Madison unconformity surface in Bottineau County, North Dakota. The shades of green represent the various members within the Mission Canyon Formation (Madison). The shades of blue and purple represent members of the Lodgepole Formation (modified from LeFever and LeFever, 1991).