



Opeche A + B Salt Thickness and Extent

Williston Basin, North Dakota

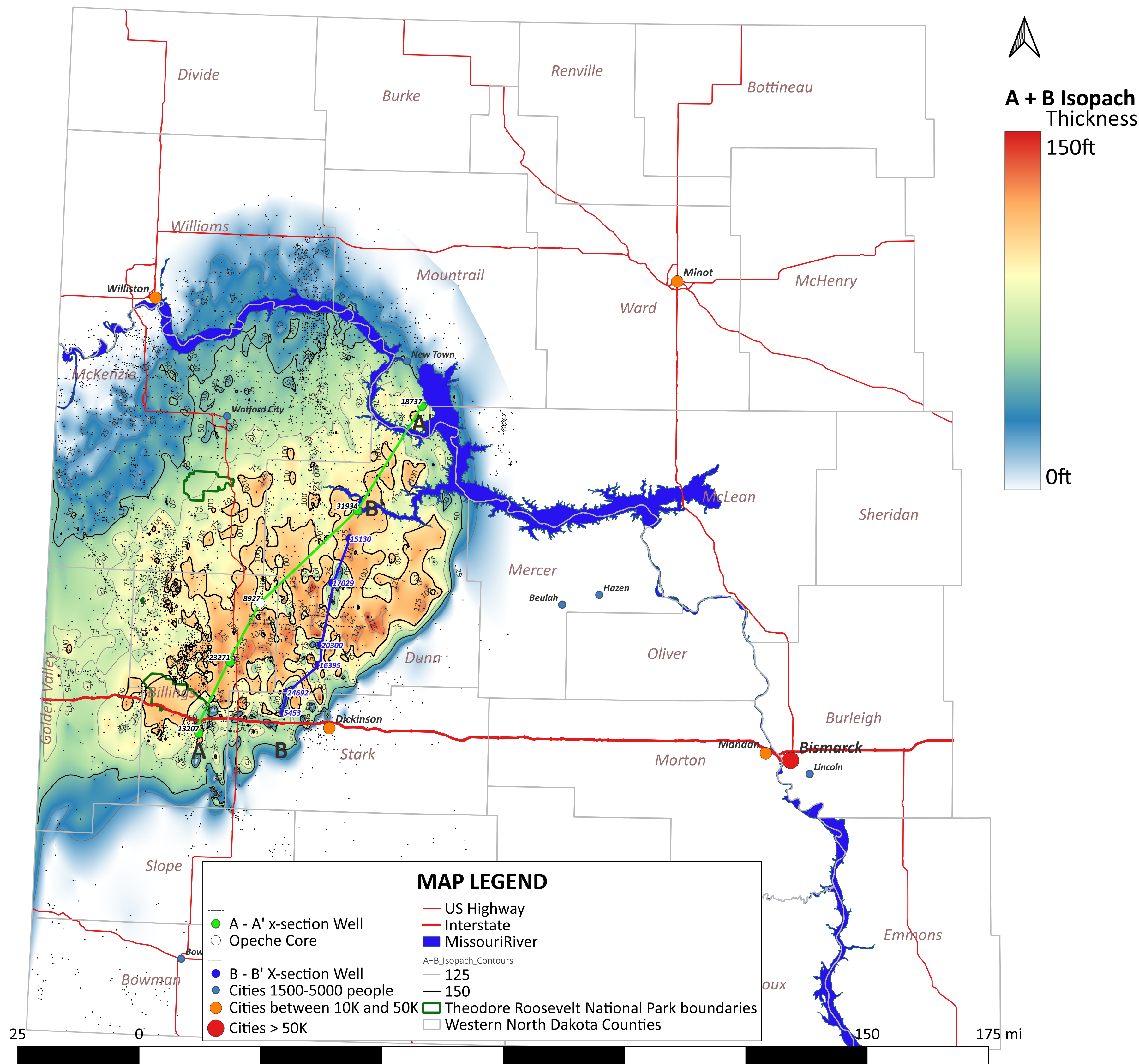


Figure 1

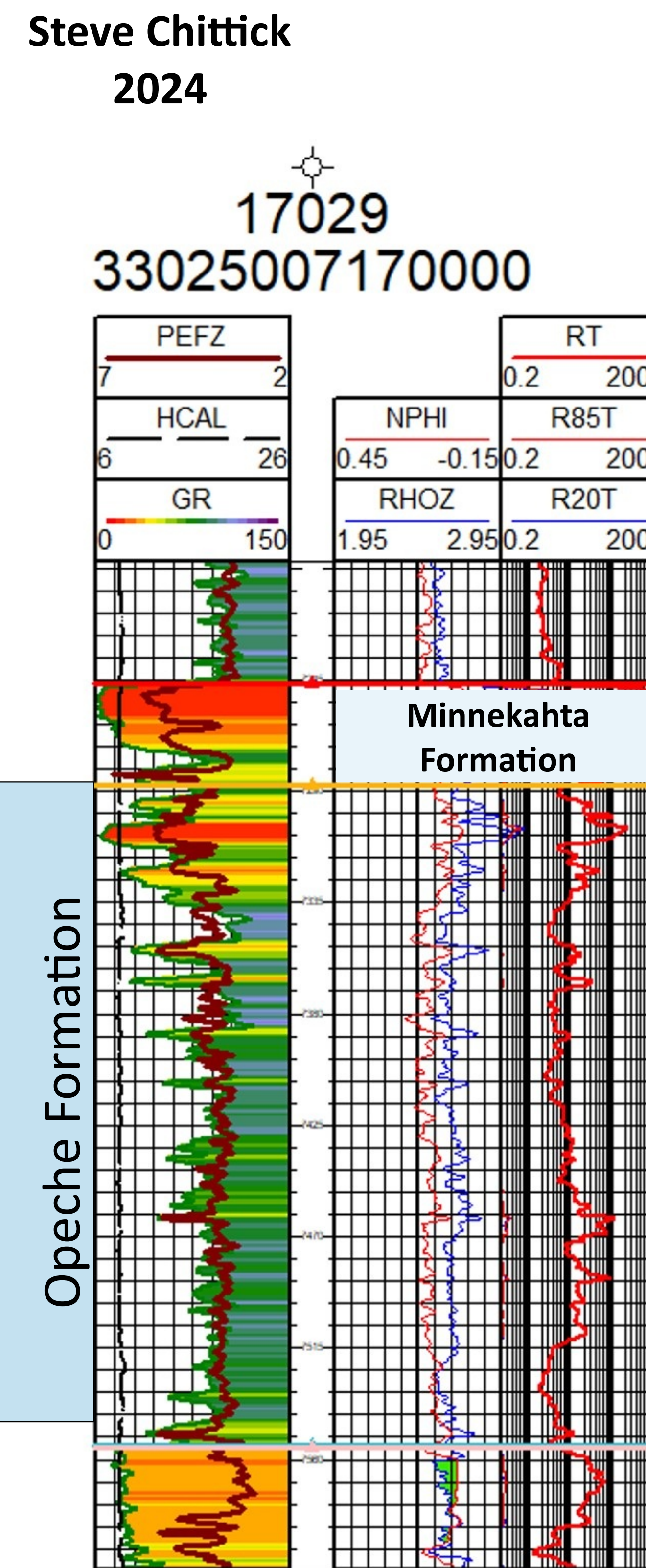


Figure 2

Figure 1: A map of the combination of Opeche A and B salt thicknesses. The dark blue dots connected by a dark blue line is the cross-section line across a linear zone of sinkholes shown in Figure 4. The green dots connected by the light green line represents the locations of the wells in Figure 3, which represents a stable area north of the sinkholes. The white dot in the center of the more northerly cross-section is well NDIC# 8927 with a nearly complete core of the Opeche Formation.

Figure 2: Wireline log through one of the sinkholes in the Opeche. It is also the second well from the right in cross section of Figure 4. In this well both the A and B salts have been dissolved. Note the higher gamma ray (GR) in track 1, recognized by the mostly green shading instead of red or yellow. Track 1: PEFZ=photoelectric factor, HCAL=Caliper, GR=gamma ray, Track 2: NPHI=neutron porosity, RHOZ=bulk density, Track 3: RT=deep resistivity. Figures 3 and 4 have similar track headers. See Geologic Investigation No. 275 for example across salt section.

Figure 3: Cross section north of the line of sinkholes and shows a consistent A salt and variable B salt. The B salt can be missing in this area but the A salt is quite consistent.

Figure 4: Cross section across a line of sinkholes. In the first well from the right, the Opeche has a relatively clean GR throughout, The A salt top is a light blue line and its base is a light green line and has an appreciable thickness. The B salt near the base of the well lies between the two darker green lines. The second well from the left (NDIC# 24692), in contrast, has no A or B salt and goes through one of the sinkholes. The third well from the left (NDIC# 16395), again has a thick A salt and a B salt. The fourth well from the left (NDIC# 20300) has a thinner A salt and no B salt and is on the edge of one of the sinkholes. The fifth well from the left (NDIC# 17029) is the example well of a sinkhole shown in Figure 2. Note the higher GR throughout the section.

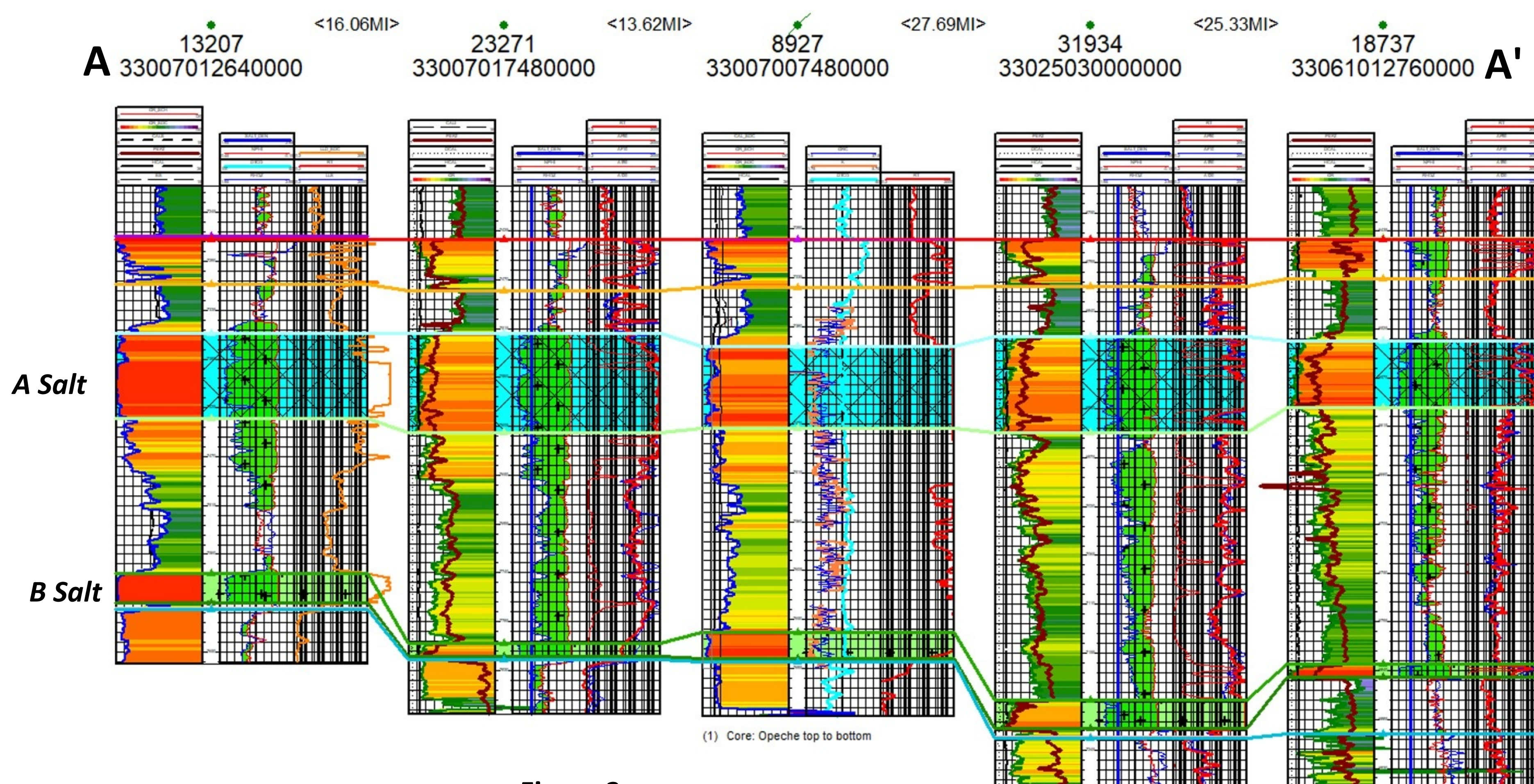


Figure 3

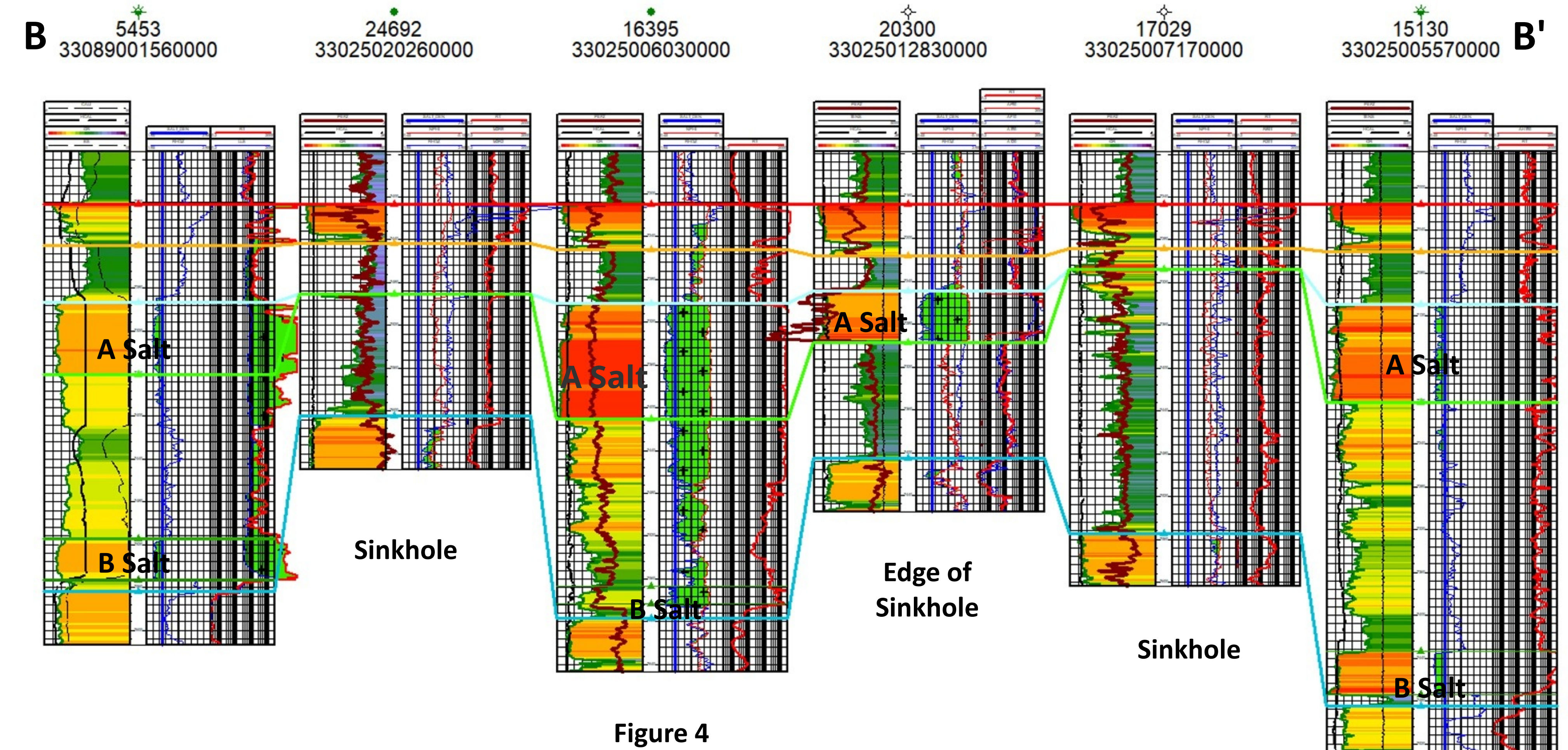


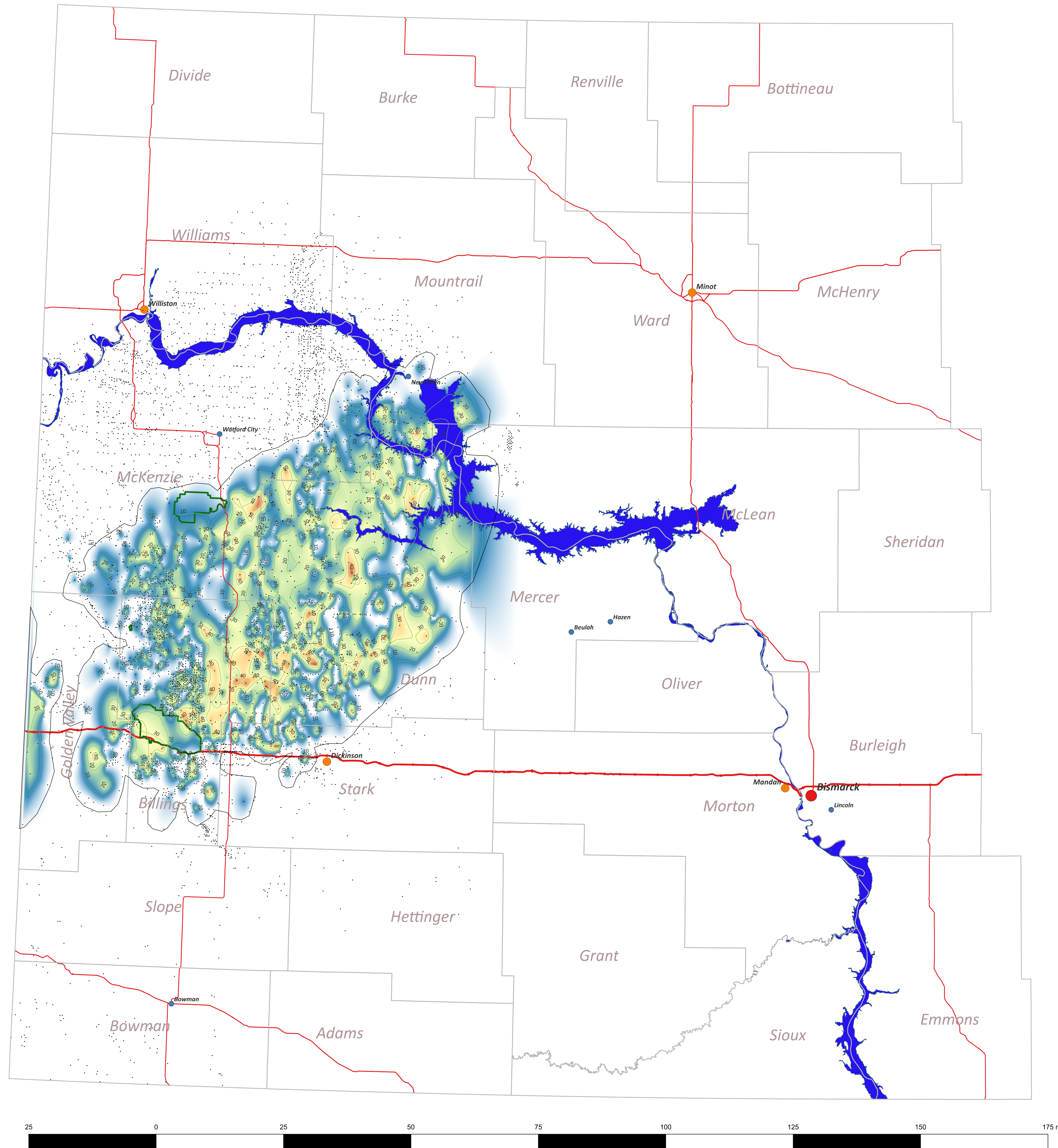
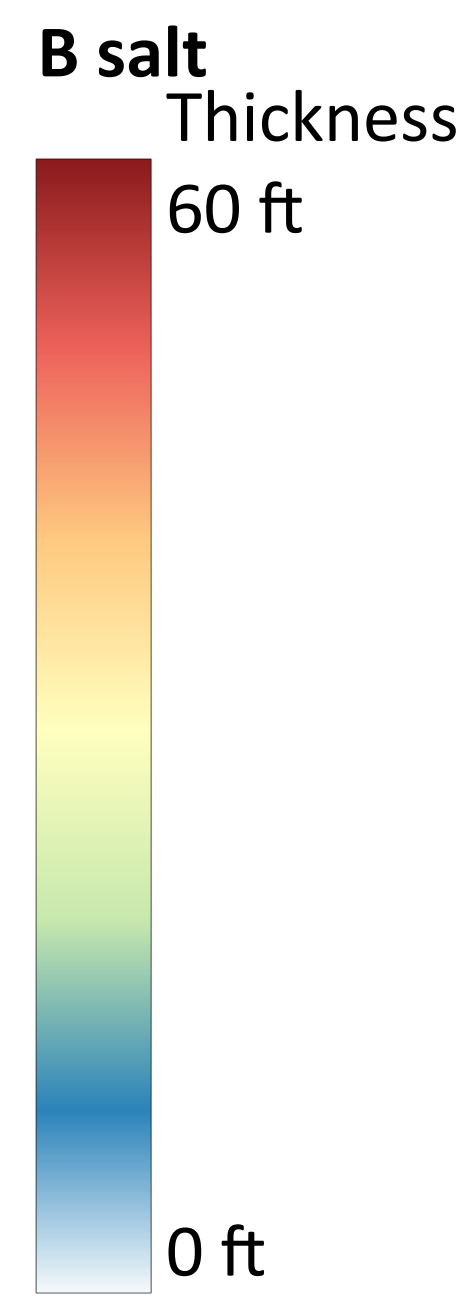
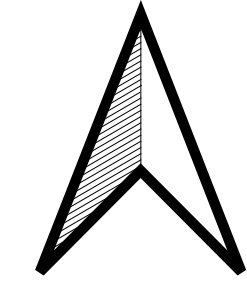
Figure 4



Opeche B Salt Thickness and Extent

Williston Basin, North Dakota

Steve Chittick
2024



Map Legend

- Western North Dakota Counties
- Theodore Roosevelt National Park boundaries
- Cities 1500-5000 people
- Cities between 10K and 50K
- Cities > 50K
- B-Salt Contours (10 ft)
- Missouri River
- Interstate
- US Highway

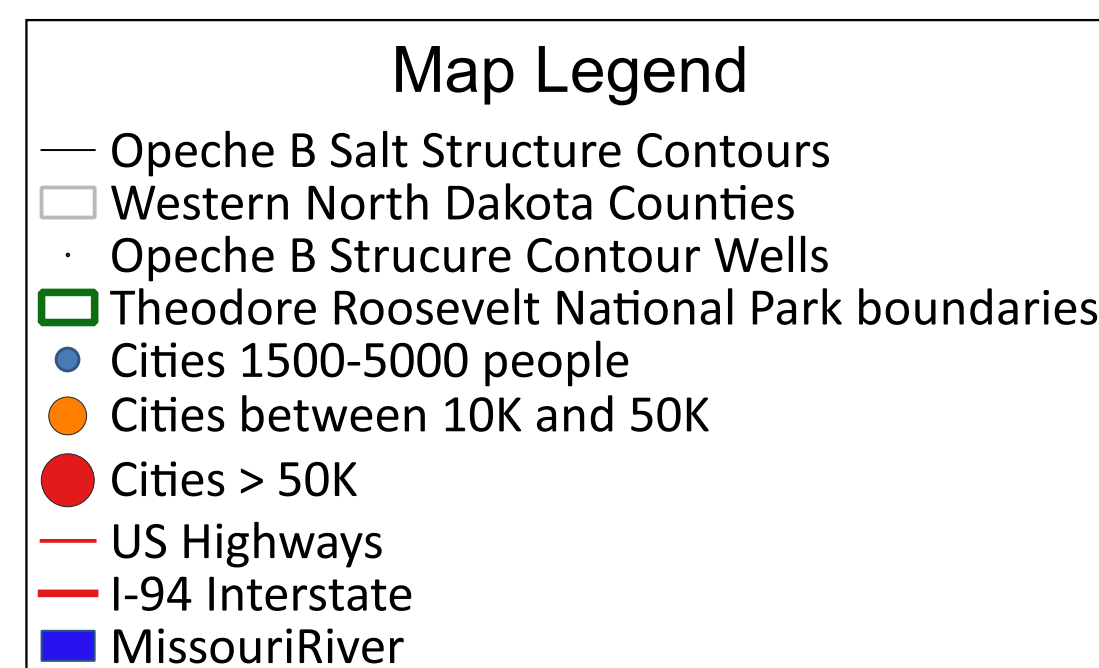
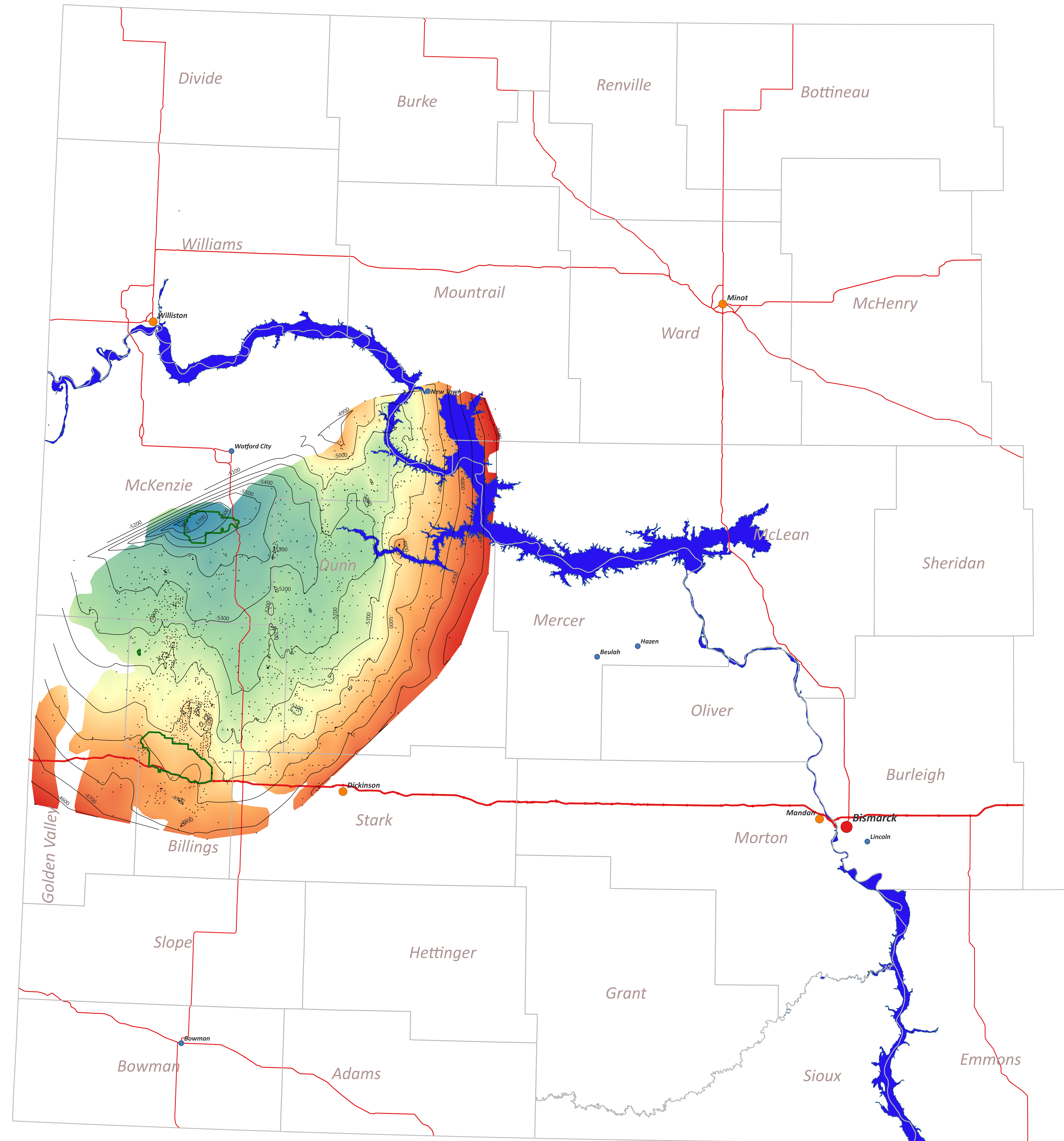
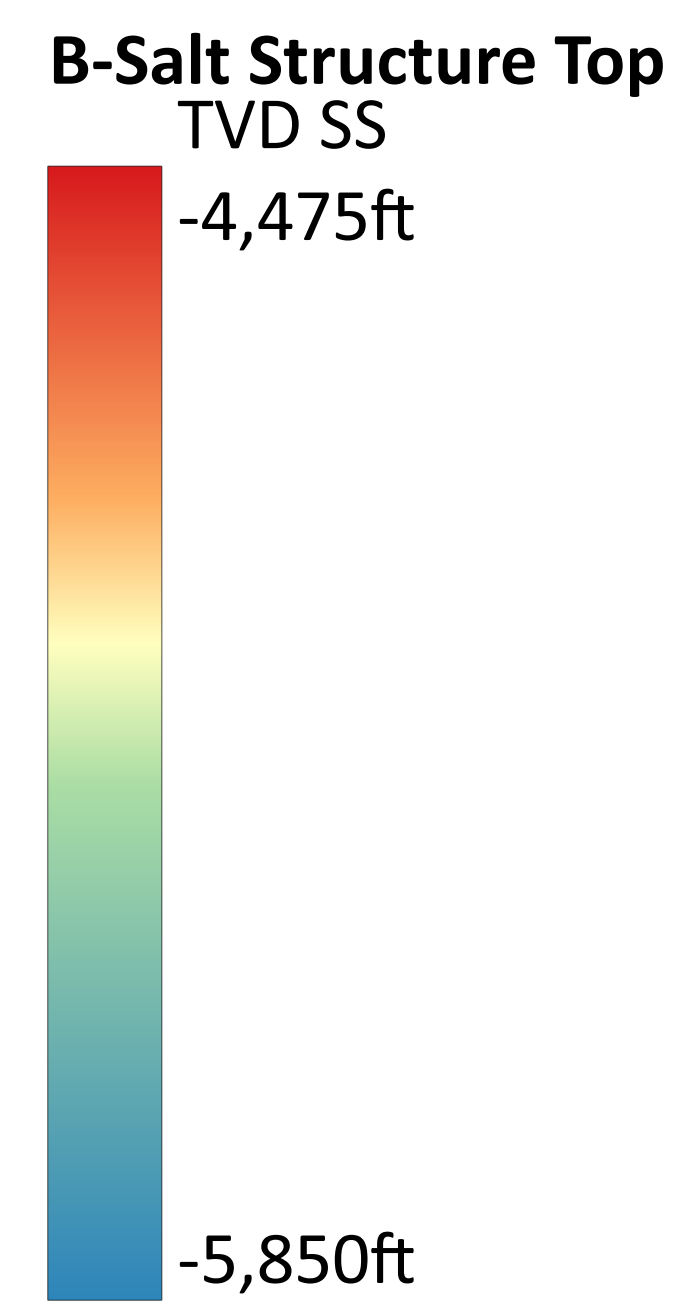
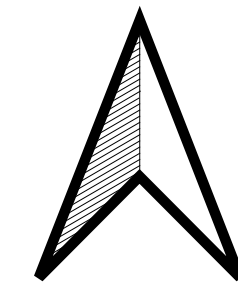
North Dakota State Plane North
Clarke Ellipsoid 1866
North American Datum 1927
Lambert Conformal Conic
Latitude of Origin: 47 degrees north
Central Meridian: 100.5 degrees west
Standard Parallel 1: 47.433333... degrees north
Standard Parallel 2: 48.733333... degrees north
False Easting: 2,000,000 US survey feet
False Northing: 0 US survey feet



Opeche B Salt Structure (SS)

Williston Basin, North Dakota

Steve Chittick
2024



North Dakota State Plane North
Clarke Ellipsoid 1866
North American Datum 1927
Lambert Conformal Conic
Latitude of Origin: 47 degrees north
Central Meridian: 100.5 degrees west
Standard Parallel 1: 47.433333... degrees north
Standard Parallel 2: 48.733333... degrees north
False Easting: 2,000,000 US survey feet
False Northing: 0 US survey feet