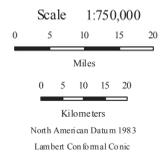
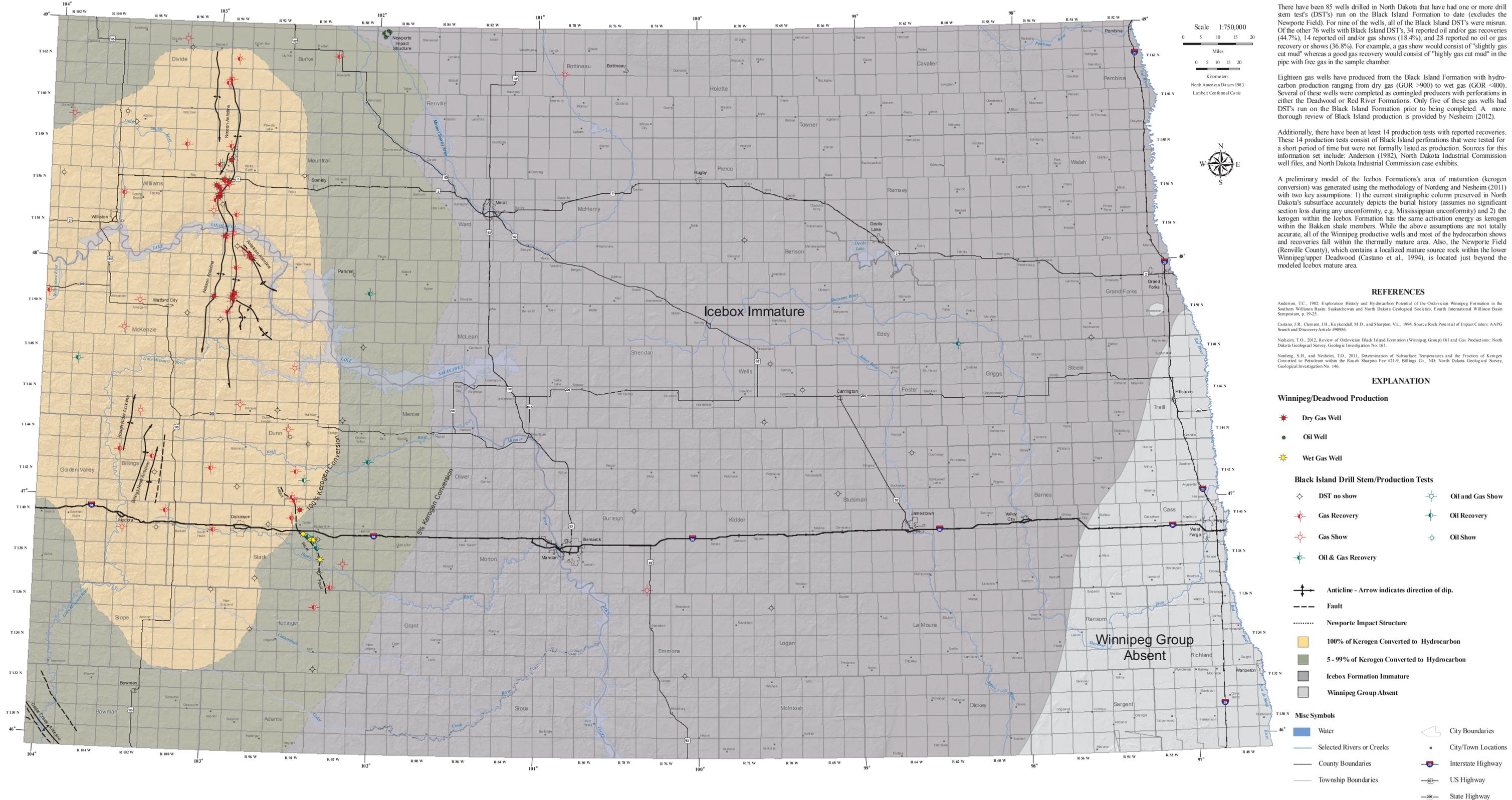


Production and Hydrocarbon Shows from the Black Island Formation, Winnipeg Group (Ordovician)

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There have been 85 wells drilled in North Dakota that have had one or more drill stem tests (DST's) run on the Black Island Formation to date (excludes the Newporte Field). For nine of the wells, all of the Black Island DST's were misrun. Of the other 76 wells with Black Island DST's, 34 reported oil and/or gas recoveries (44.7%), 14 reported oil and/or gas shows (18.4%), and 28 reported no oil or gas recovery or shows (36.8%). For example, a gas show would consist of "slightly gas cut mud" whereas a good gas recovery would consist of "highly gas cut mud" in the pipe with free gas in the sample chamber.

Eighteen gas wells have produced from the Black Island Formation with hydrocarbon production ranging from dry gas (GOR >900) to wet gas (GOR <400). Several of these wells were completed as coning producers with perforations in either the Deadwood or Red River Formations. Only five of these gas wells had DST's run on the Black Island Formation prior to being completed. A more thorough review of Black Island production is provided by Nesheim (2012).

Additionally, there have been at least 14 production tests with reported recoveries. These 14 production tests consist of Black Island perforations that were tested for a short period of time but were not formally listed as production. Sources for this information set include: Anderson (1982), North Dakota Industrial Commission well files, and North Dakota Industrial Commission case exhibits.

A preliminary model of the Icebox Formations's area of maturation (kerogen conversion) was generated using the methodology of Nordeng and Nesheim (2011) with two key assumptions: 1) the current stratigraphic column preserved in North Dakota's subsurface accurately depicts the burial history (assumes no significant section loss during any unconformity, e.g. Mississippian unconformity) and 2) the kerogen within the Icebox Formation has the same activation energy as kerogen within the Bakken shale members. While the above assumptions are not totally accurate, all of the Winnipeg productive wells and most of the hydrocarbon shows and recoveries fall within the thermally mature area. Also, the Newporte Field (Renville County), which contains a localized mature source rock within the lower Winnipeg/upper Deadwood (Castano et al., 1994), is located just beyond the modeled Icebox mature area.

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EXPLANATION

- Winnipeg/Deadwood Production**
- ★ Dry Gas Well
 - Oil Well
 - ☀ Wet Gas Well
- Black Island Drill Stem/Production Tests**
- ◇ DST no show
 - ◇ Gas Recovery
 - ◇ Gas Show
 - ◇ Oil & Gas Recovery
 - ◇ Oil and Gas Show
 - ◇ Oil Recovery
 - ◇ Oil Show
- Geological Features**
- ↗ Anticline - Arrow indicates direction of dip.
 - Fault
 - Newporte Impact Structure
 - 100% of Kerogen Converted to Hydrocarbon
 - 5-99% of Kerogen Converted to Hydrocarbon
 - Icebox Formation Immature
 - Winnipeg Group Absent
- Misc Symbols**
- Water
 - Selected Rivers or Creeks
 - County Boundaries
 - Township Boundaries
 - City Boundaries
 - City/Town Locations
 - Interstate Highway
 - US Highway
 - State Highway