

Bakken Formation Middle Member Lithofacies 3



Julie A. LeFever

LITHOFACIES 3

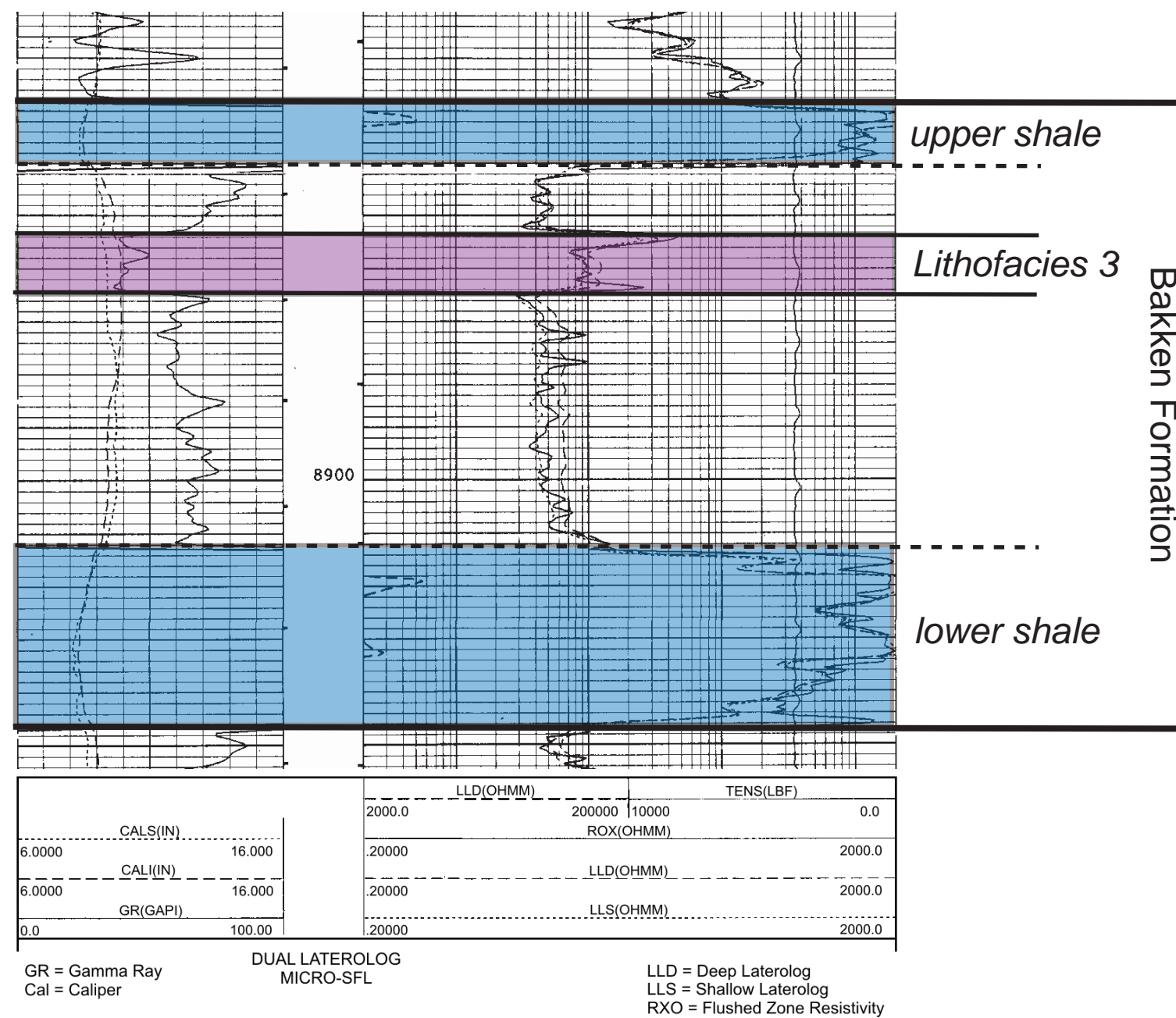
Lithofacies 3 varies from a medium grey to dark grey to greyish-tan, very fine- to fine-grained sandstone to a medium grey limestone. Localized accumulations of coarser material exist in the northeastern portion of the map (Burke County). Limestone forms a series of bands along the southwestern extent of the Bakken. Towards the basin margin the limestone changes from a sand-algal packstone, to a sand-oid packstone, ooid packstone, to an ooid-crinoid packstone-grainstone.

The facies is predominantly sandstone and is moderately well-sorted to well-sorted and may be poorly-sorted locally. Clasts consist predominantly of quartz with some feldspar and heavy minerals. The grains are rounded to well-rounded; the finer grained material is sub- rounded to sub-angular. Cement is generally calcite, and in some cases pyrite. Pyrite is disseminated throughout the interval. The lower portion of the interval is locally reverse graded. The middle portion of the section consists of an alternating sequence of massive to cross-bedded to thinly laminated beds. These beds are generally coarser grained than the under and overlying lithologies. Overlying these beds is a series of multiple fining upward sequences. Other structures that have been noted in the core are rip-up clasts, load or channel structures, usually into the finer grained material, and calcite-filled fractures. Locally, soft-sediment deformation destroys the entire fabric. Oil staining may be present in the very fine-grained, laminated, predominantly quartz sandstone portion of the core. It appears that as the grain size increases in this lithofacies so does its ability to undergo cementation.

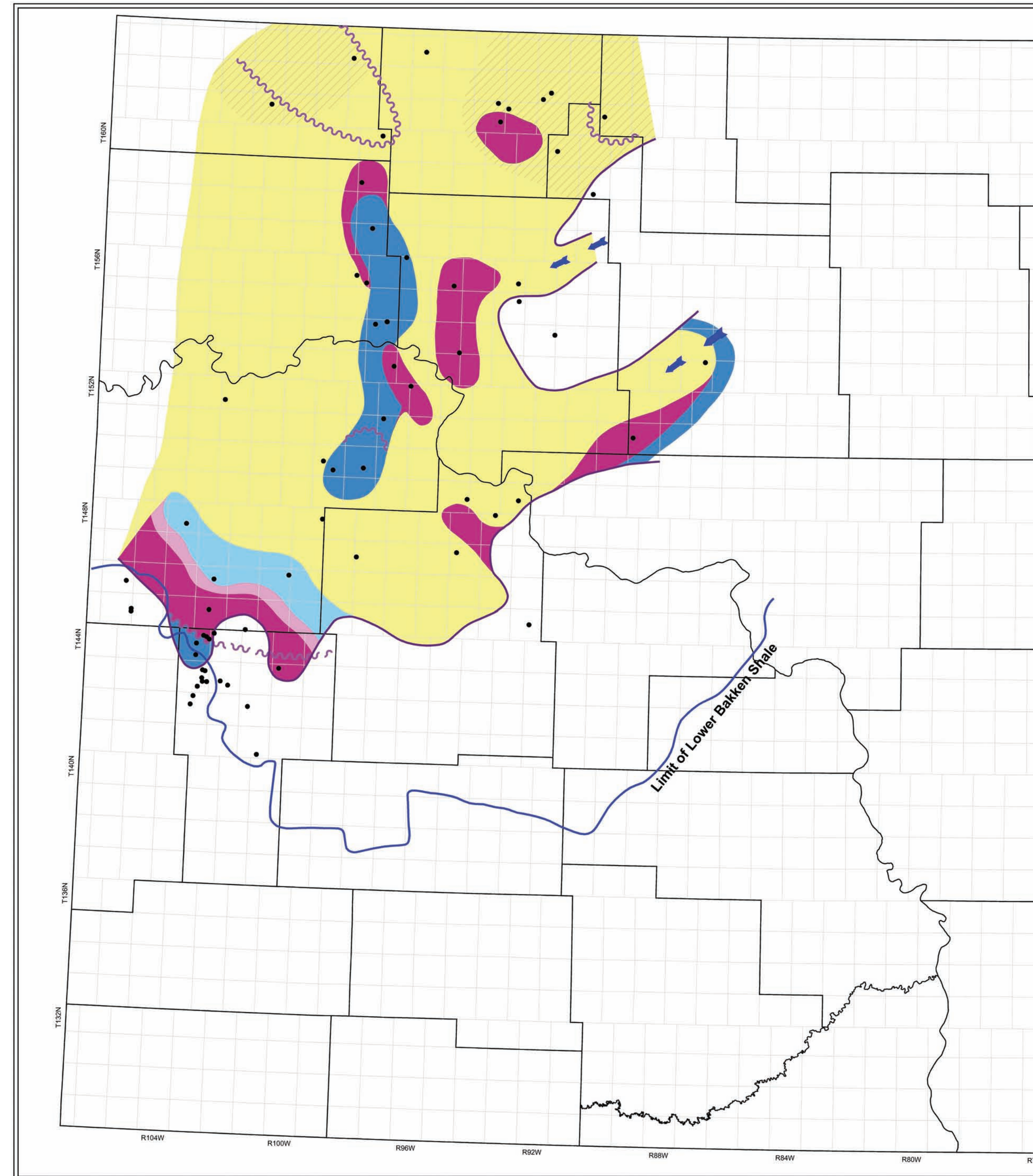
The thickness of Lithofacies 3 reaches a maximum of 17.5 ft, averaging 8 ft in the North Dakota portion of the Williston basin. This lithofacies is generally limited to the northern half of the state and thickens in a northward direction. Distribution of this facies from wireline logs is difficult to determine as the edge is approached. It has a prominent, consistent, and easily mappable gamma-ray log response over the majority of its extent (see wireline log). However, as its depositional edge is approached, it is difficult to determine its log characteristic with any certainty. At least one well appears to have penetrated a channel sand.

The sediments of Lithofacies 3 represent middle to lower shoreface environments of deposition. Contacts are conformable, but unconformities occur in localized areas along the Nesson anticline, along the southwestern margin, and along the Canadian border. The presence of an unconformity surface, soft-sediment deformation and the increase thickness in the area of Divide County suggests dissolution activity in the underlying Devonian Prairie salt by extending the Hummingbird trough into North Dakota. Available cores indicate that the northern and southern portion of the Nesson anticline was a positive feature throughout the deposition of this unit with a probable bypass channel through the lower central portion of the anticline. The structure is probably responsible for the distribution of clastics in this interval. Sand, sourced from the north, was routed around the eastern side of the Nesson anticline leading to the development of carbonates along the southwestern edge. It also starved the western side of the state of coarse clastics, producing a finer-grained facies.

SENW Sec. 11, T.160N., R.95W
 Conoco, Inc.
 #17 Watterud "A"



NDIC File No: 13318

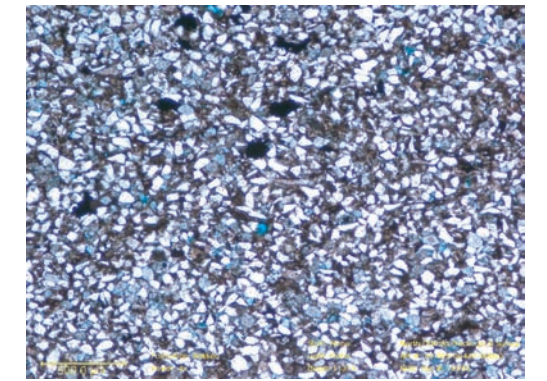


NENW Sec. 19, T.147N., R.96W.
 Maxus Exploration Co.
 #21-19 Carus Fee
 KB = 2547

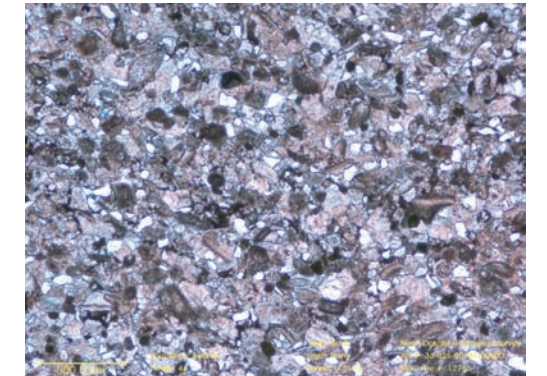


1 inch

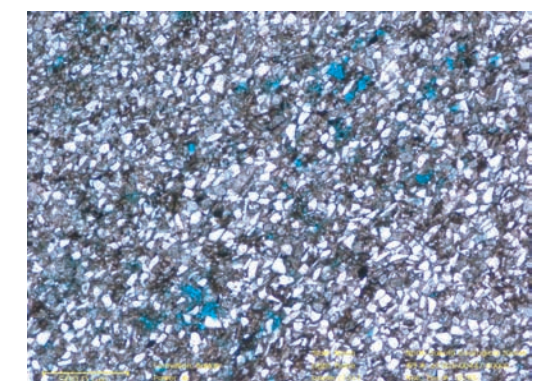
11314.0 ft



Very fine-grained sandstone to siltstone with well developed interparticle porosity. Microfractures are also present.



Silty limestone with bioclastic material. Porosity is minimal to non-existent.



Calcareous siltstone to very fine-grained sandstone with abundant interparticle porosity.

Lithofacies 3

- Limit of Lithofacies 3
- Unconformity - L3 - Underlying Unit
- Limit of Lower Bakken Shale
- Limestone - Ooids & Crinoids
- Limestone - Ooids
- Limestone - Ooids & Sand
- Algal Mats with Ooids & Sand
- Fine-Grained Sandstone
- Fine- to Coarse-Grained Sandstone
- Channel Direction
- Bakken Core Locations