North Dakota Geological Survey

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Study Reveals . . .

WHERE NORTH DAKOTA'S BEST NEWCASTLE SAND TRENDS ARE LOCATED

Change from porous, permeable sandstone to shale updip is mapped in six-county area

By

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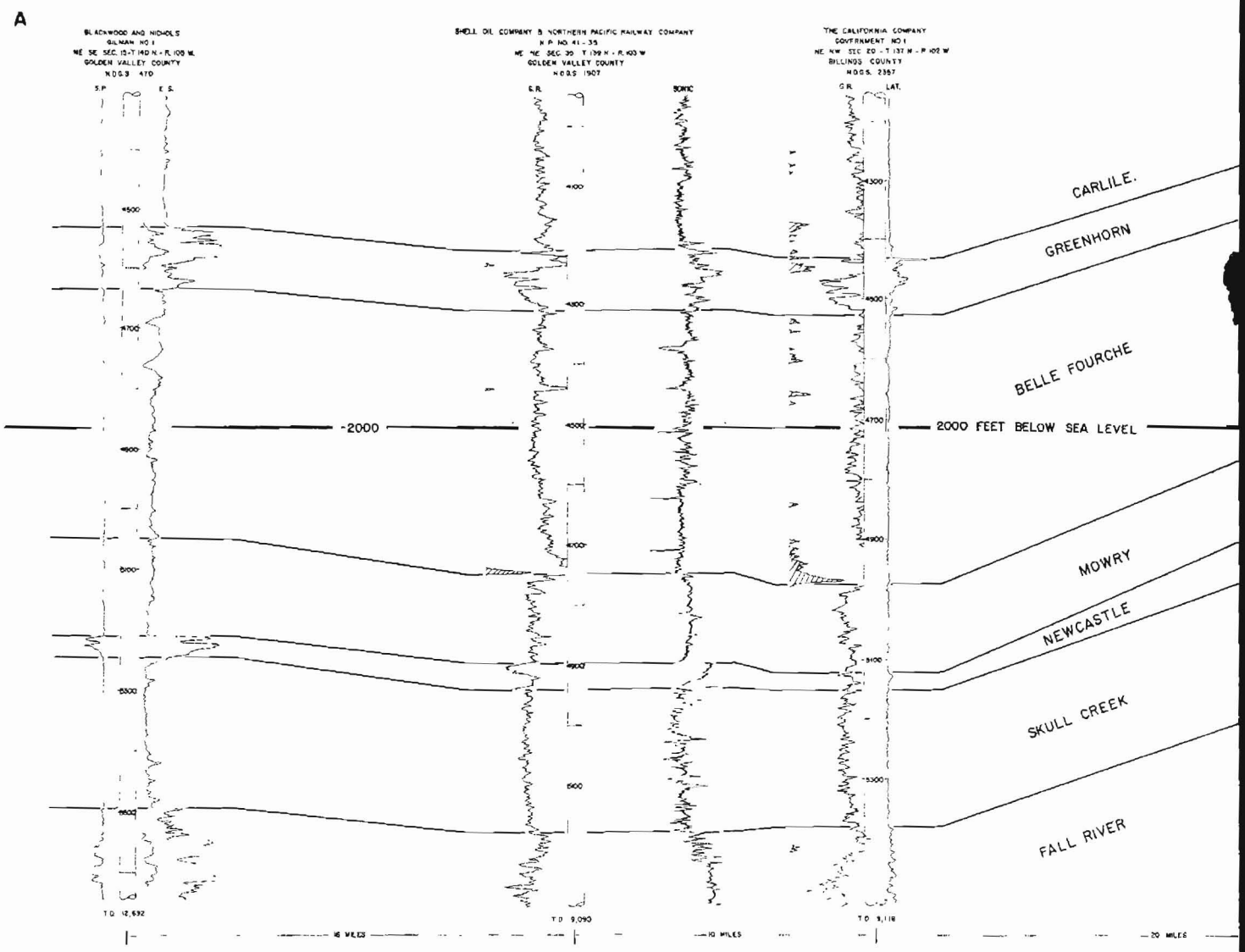

Fig. 1—Northwest (left) to southeast (right) cross-section A-B. Line of section is shown in Figs. 2 and 3. Combined length of segments is 74 miles.

Where North Dakota's best Newcastle

Change from porous, permeable sandstone to shale updip is mapped in six-county area

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15-second summary

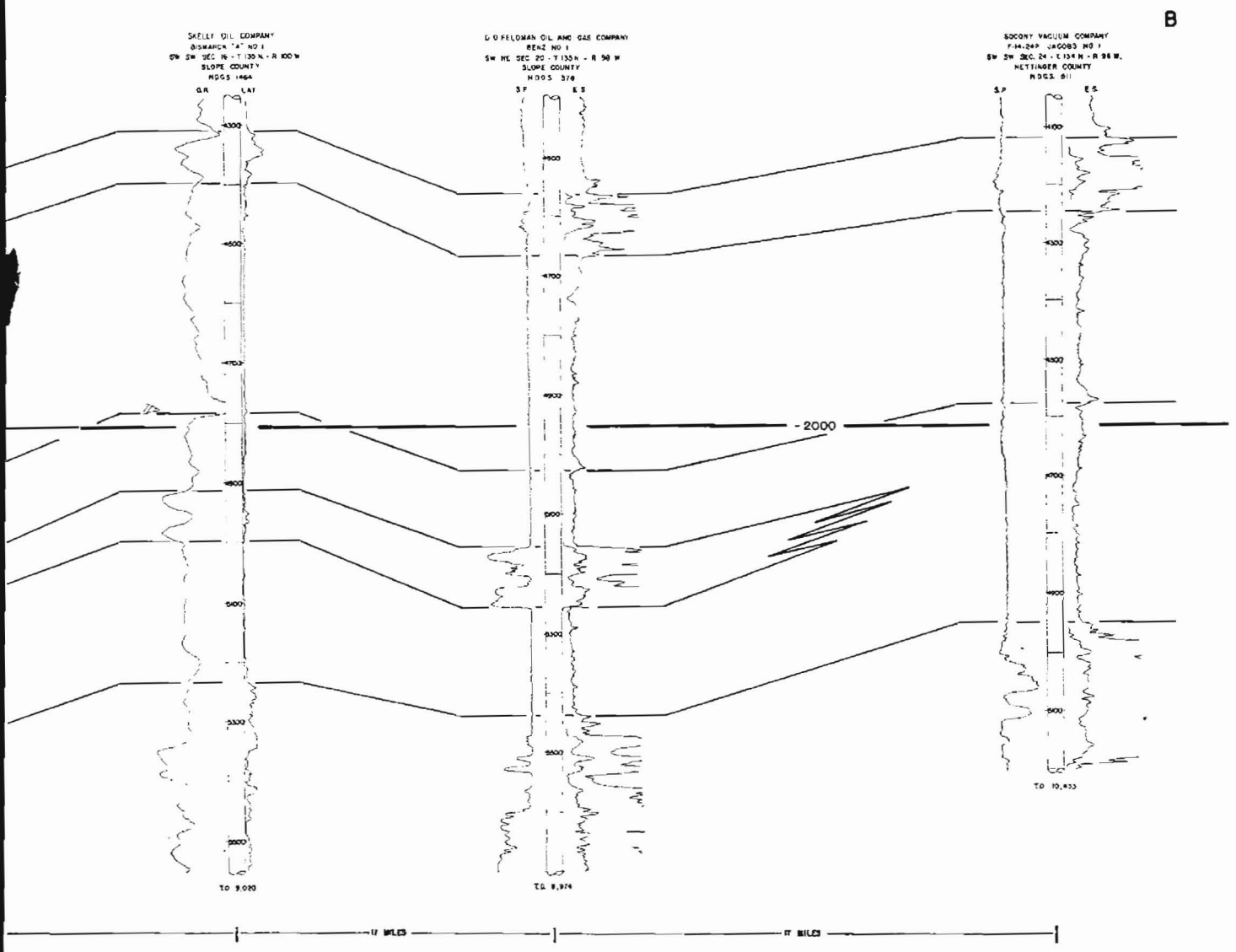
The Lower Cretaceous Newcastle Sandstone apparently has excellent stratigraphic trap potential in Golden Valley, Billings, Stark, Slope and Hettinger counties and in the south half of Dunn County, N. D. Good reservoir conditions are evident. Shallower rocks, mostly shale, are easily drilled, and depth to the Newcastle Sand is only about 5,000 feet. Emphasis on deeper formations and on structural traps has resulted in failure to evaluate the Cretaceous section in some wells drilled in this area and to make a comprehensive, specific search for Cretaceous gas and oil fields there.

RECENT DISCOVERIES in the Ordovician Red River Formation have caused renewed interest in southwestern North Dakota. The area is also of interest both in development and wildcat drilling for Mississippian Madison and Pennsylvanian Tyler (Heath) objectives. But little interest has been shown yet in North Dakota's Cretaceous rocks.

Purpose of this article is to describe gas and oil potential of a portion of this much-overlooked part of the geologic column—specifically the Lower Cretaceous sandstone section, generally termed the Newcastle or Muddy Formation, and called Dynneson by Wulf.[1, 2]

In the current article the interval is referred to as the Newcastle Formation because this term is in more general use in this area.

At present the only production from Cretaceous beds in North Dakota is the gas produced from the Eagle Sandstone on the Cedar Creek anti-



Sand trends are located

cline in the extreme southwestern part of the state.

The area studied includes Townships 129 to 144 north, and Ranges 91 to 107 west.

ILLUSTRATIONS

Fig. 1. Cross-section A-B extends in a southeasterly direction from 140-n, 104-w to 134-n, 96-w. Line of section is shown on Figs. 2 and 3.

Two Newcastle depositional anomalies appear on Fig. 1. The first is apparent in California Co.'s Government 1, located in NE NW 20, 137-n, 102-w, where the sandstone almost thins out entirely. The second appears in the Socony-Vacuum Jacobs 1, located in SW SW 24, 134-n, 96-w where the Newcastle Sandstone is completely replaced by shale.

The part of Fig. 1 from D. D. Feldman Oil and Gas Benz 1, located in SW NE 20, 135-n, 98-w and the Socony-Vacuum Jacobs well is typical of the facies change that occurs along the eastern margin of the Newcastle Formation. Here the Newcastle Sandstone changes to shale updip, presenting almost a textbook example of a stratigraphic trap.

The isopachous map of the Newcastle Formation (Fig. 2) indicates a considerable range in thickness of the Newcastle in the study area. An area of extreme thinning extends from the western edge of the map in Townships 132 to 135 north, northward through Fryburg field. Areas of extreme thickness are in the northwest corner of the study area, and in a

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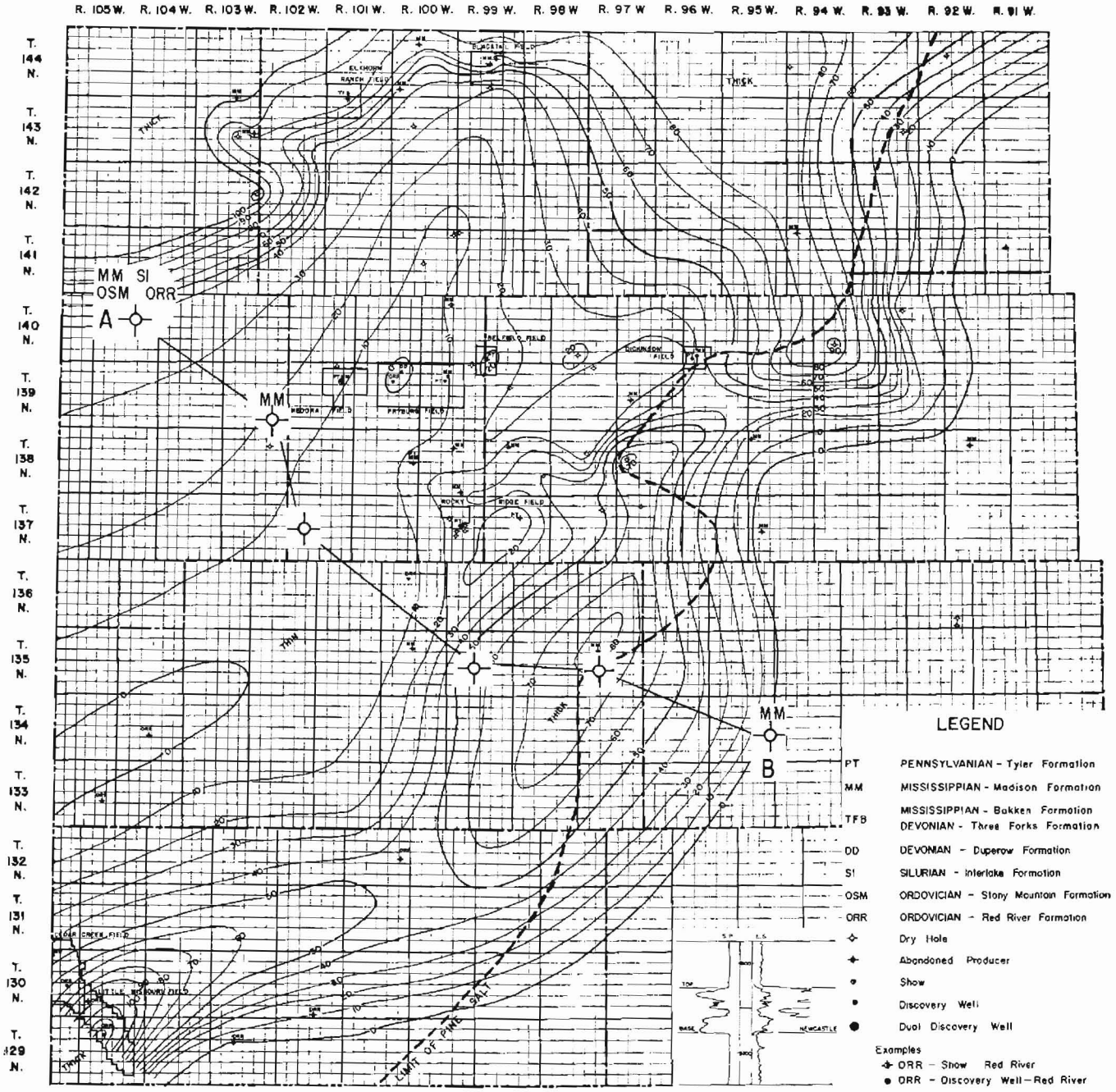

Fig. 2—Isopachous map of Newcastle Formation. Contour interval is 10 feet.

band near and roughly parallel to the eastern limits of the sandstone.

Gross thickness of the Newcastle interval was used in preparing this map. In parts of the study area, two separate sandstone units are present which have not been delineated.

A structure map on the top of the Newcastle Formation (Fig. 3) indicates that the Newcastle dips gently toward the north-central part of the area except where the dip is interrupted by structural anomalies. One of these anomalies is an anticlinal nose originating in Township 136 north Range 101 west and continuing northward to the edge of the map area. A second anomaly is a structural low in Townships 136, 138 and 139 north, Ranges 96, 97 and 98 west.

This low was apparently caused by solution of the Permian Pine Salt after deposition of the Mowry Formation.[3] Structural and/or stratigraphic traps may also be present along the margins of this salt solution area.

STRATIGRAPHY

The Newcastle Formation is underlain by Cretaceous Skull Creek Formation shales and is overlain by shales of the Cretaceous Mowry Formation.

The Newcastle is composed largely of fine-grained (with some medium-grained) quartz sandstone. The sandstone is subrounded to subangular, well sorted, calcareously cemented and friable. It also appears to have good porosity and permeability, and should be an excellent reservoir rock.

PETROLEUM POSSIBILITIES

To date there has been no drilling in this part of the state with the Newcastle Formation as an objective. On many wells a geologist has not been present until the wells were below this section. It is possible that shows which may have occurred in the

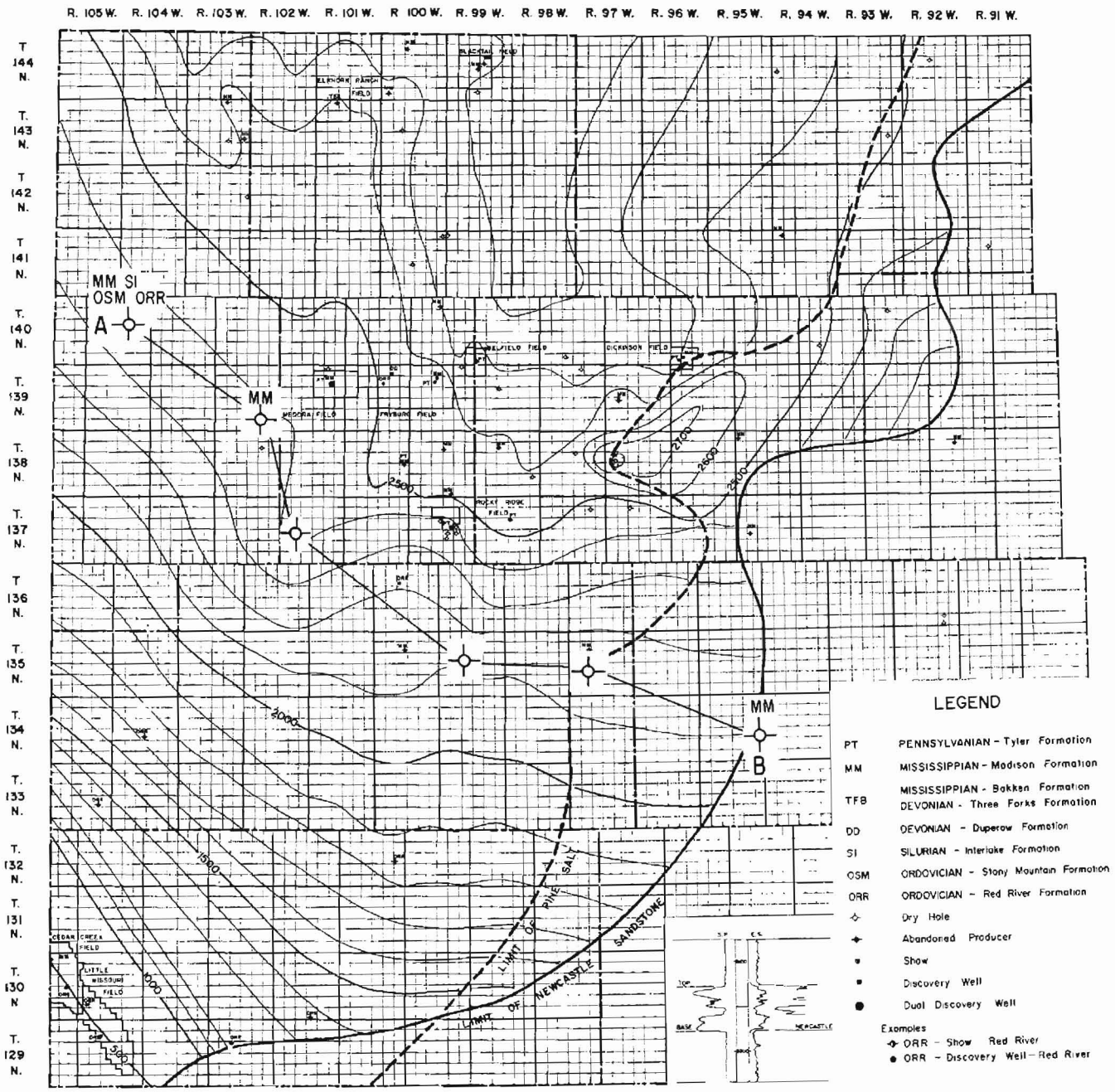

Fig. 3—Structure map drawn on Newcastle datum. Contour interval is 100 feet.

Newcastle were not observed. These aspects have been noted previously by Wulf.[2]

All factors necessary for accumulation of hydrocarbons appear to be present in the Newcastle Sandstone in southwestern North Dakota. In this area as in northeastern Wyoming where the Newcastle is productive, the formation is underlain by the dark, organically rich shales of the Skull Creek Formation and overlain by similar Mowry Formation shales.

Shales of the Skull Creek and Mowry Formations are generally thought to be source rocks for Newcastle oil in northeastern Wyoming.

The same shales, deposited under similar conditions, should logically be excellent source rocks for generation of hydrocarbons in southwestern North Dakota. It seems improbable that in the relatively short distance from production in northeastern Wyoming, such a sandstone as the Newcastle, sandwiched between these shales, should be devoid of gas and oil accumulations in southwestern North Dakota.

Assuming that hydrocarbons have been generated, numerous traps are likely, particularly along the eastern limits of the Newcastle interval where sandstone is replaced updip by shale.

ACKNOWLEDGMENTS

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[3] Anderson, S. B., A Look at the Petroleum Potential of Southwestern North Dakota, North Dakota Geological Survey, Report of Investigations 42 (1966).