Coarse-Grained Meander-Belt Reservoirs, Rocky Ridge Field, North Dakota

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Introduction

Fluvial sandstones are among the most extensively studied and documented terrirogenous clastic sequences. Numerous depositional models have been developed to generalize fluvial processes and sedimentary structures, and countless papers describe various aspects of modern fluvial environments. However, few studies have integrated the characteristics of fluvial sandstone reservoirs at all scales, and none have done so for coarse-grained meander-belt systems.

The Rocky Ridge area in North Dakota has been extensively explored and produced. Thus, the area is ideal for documenting reservoir characteristics at all scales (see also Barwis, this volume). This chapter presents an integrated evaluation of the depositional controls and reservoir characteristics of a coarse-grained meander-belt reservoir system from a seismic to a pore scale.

Field Location

Rocky Ridge Field is located in southwestern North Dakota along the southern flank of the intracratonic Williston basin (Fig. 3-1) and produces high-gravity oil from Lower Pennsylvanian sandstones. The field lies within the Rocky Ridge, Medora-Dickinson area, which has yielded about 60 MMBO (9.6 × 10⁸ m³) from the nonmarine and marginal marine Tyler Formation. Total proven recoverable Tyler reserves for the Williston basin are about 170 MMBO (2.7 × 10⁸ m³).

Production History

Rocky Ridge Field (Main Pool) was discovered in 1957 through serendipity when the Northern Pump-Lucy Fritz No. 1 well encountered oil-bearing sandstones in the Tyler Formation (Fig. 3-2). The prospect was a seismically defined structural test for a deeper objective. That objective was tested as water-productive, but the uphole Tyler Formation was tested at an initial potential of 1,224 BOPD (195 m³/D). Subsequent drilling has resulted in nine other producing wells and 19 dry holes.

Another pool (Southeast Pool) a few miles to the southeast was discovered in 1969 when the Shell State No. 41-36 well encountered oil-bearing Tyler sandstones on a seismically defined stratigraphic prospect. Subsequent drilling of this pool resulted in seven other oil wells and 15 dry holes.

Until 1983, Shell Oil Company was the major operator of the field. Other operators included Pan American (Amoco), Northern Pump, and Mule Creek Oil. Apache Corporation is currently the major operator. The field has a conspicuously linear northwest-southeast trend and is 8 miles (13 km) long and 1 mile (1.6 km) wide. Production is from a complex network of coarse-grained meander-belt channel sandstones of the Tyler Formation. Cumulative production is 5.04 MMBO (8.0 × 10⁸ m³).
Fig. 3-1. Index map of the Williston basin showing Rocky Ridge Field and other key areas with Tyler production. The map shows the erosional limit of the Tyler Formation and Big Snowy trough, which connected the basin with the ocean to the west. The large northwest-trending fault is the Cedar Creek fault.

Fig. 3-2. Index map of Rocky Ridge Field, North Dakota. Wells shown are all Tyler Formation penetrations in the area. The map shows field outlines and discovery wells for both pools as well as locations of key cross sections and two seismic lines (120-2 and 120-3). 120-2, F-F', and B-B' are the sections of Figures 3-10, 3-12, and 3-15, respectively.