Sedimentology of Permian Upper Part of the Minnelusa Formation, Eastern Powder River Basin, Wyoming, and a Comparison to the Subsurface

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ABSTRACT

Outcrops of the Permian upper part of the Minnelusa Formation near Beulah, Wyoming consist of dolomite, gypsum, and sandstone units deposited in transgressive-regressive cycles. Three depositional cycles are partly exposed in the Simons Ranch anticline near Beulah, and provide an opportunity to view facies of the upper Minnelusa Formation in three dimensions. The cycles observed in outcrop were informally labelled cycle 1, cycle 2, and cycle 3 in ascending stratigraphic order. Cycle 2 contains a basal, laterally extensive sabkha sandstone and an overlying, laterally restricted sandstone that represents a preserved eolian-dune complex. The eolian-dune sandstone of cycle 2 was partially reworked during the marine transgression that initiated cycle 3. The eolian-dune deposit grades laterally into an apron of contorted and massive-bedded sandstones that formed as water-saturated sands liquified and slumped from the margins of the eolian dune. The partially reworked eolian-dune topography was covered by gypsum beds of cycle 3. The sandstone of cycle 3 is interpreted as a laterally continuous sabkha sandstone.

West Mellott field (secs. 8, 9, T52N, R68W) represents a subsurface example of the facies and facies relationships observed in outcrop. The eolian-dune sandstone of the C cycle, which was partially reworked by the transgression of the B cycle, produces oil at West Mellott. The draping of dolomite and anhydrite of the B cycle on the eolian-dune sandstone of the C cycle is analogous to the draping of gypsum on dune sand in cycle 2 in outcrop.

INTRODUCTION

Sandstones of the Permian upper part of the Minnelusa Formation in the Powder River basin, Wyoming, were deposited in marine, marginal-marine, and eolian environments (Achauer, 1982; George, 1984; Fryberger, 1984). Eolian-dune sandstones are the principal upper Minnelusa petroleum reservoir rocks. The sedimentology of sandstones of the Minnelusa is known primarily from subsurface data. Core descriptions and borehole-log cross sections typically provide the basis for interpretations of sandstone internal structure and reservoir geometry (Fryberger, 1984; Shier, 1986; Schmoker and Schenk, 1988).

This paper describes and illustrates the geometry and sedimentology of sandstones and related facies of the upper Minnelusa Formation that crop out near Beulah, Wyoming (Fig. 1). In contrast to subsurface studies, outcrop continuity allows sandstones to be examined in three dimensions, thus providing sedimentologic information useful not only for interpretations of facies, but also for defining lateral facies changes. In this paper, following a discussion of the facies observed in outcrop, interpretations of upper Minnelusa sandstone reservoir and related facies at West Mellott field (T52N, R68W) are used to illustrate the usefulness of outcrop data in refining sedimentologic interpretations of sandstones of the upper Minnelusa in the subsurface.

LOCATION AND DESCRIPTION OF STUDY AREA

The upper Minnelusa outcrops are located along South Redwater Creek, which flows eastward across the Simons Ranch...