FACIES AND RESERVOIR CHARACTERIZATION OF AN UPPER SMACKOVER INTERVAL, EAST BARNETT FIELD, CONECUH COUNTY, ALABAMA

Gail R. Bergan[1] and James H. Hearne[2]

ABSTRACT

Excellent production from an upper Smackover (Jurassic) ooid grainstone was established in April 1988, by Coastal Oil and Gas Corporation with the discovery of the East Barnett Field in Conecuh County, Alabama. The discovery well, the Grisset 36-16 No. 1 in Section 36, of Township 4 North, Range 7 East, had initial production of 1,020 BOPD and 1,762 MCFGPD on a 15/64 inch choke with a flowing tubing pressure of 2,200 psi. A structure map on the top of the Smackover Formation with an outline of the producing facies (Figure 1) shows that the production at the field has both structural and stratigraphic components.

Two diamond cores were cut from 13,580 to 13,701 feet, beginning approximately 20 feet below the top of the Smackover. This interval has been extensively dolomitized and contains several of the better reservoir quality facies common to the Smackover.

Two shallowing-upward sequences are identified in the cores. The first sequence starts at the base of the cored interval and is characterized by thick, subtidal algal boundstones (Figures 6 and 7) capped by a collapse breccia facies (Figures 4 and 5). This entire sequence was deposited in the shallow subtidal to lower intertidal zone. Subsequent lowering of sea level exposed the top of the boundstones to meteoric or mixing zone waters, creating the diagenetic, collapse breccia facies. The anhydrite associated with the breccia suggests probable subaerial exposure. The second sequence begins with algal boundstones which sharply overlie the collapse breccia facies. These boundstones grade upward into high-energy, cross-bedded ooid beach (?) (Figure 3) and oncoidal, peloidal beach shoreface deposits (Figure 2). Proximity of the overlying Buckner anhydrite, representing a probable sabkha system, favors a beach or a very nearshore shoal interpretation for the ooid grainstones.

The ooid grainstone (beach) facies, which is the primary producing interval, has measured porosity values ranging from 5.3% to 17.8% and averaging 11.0%. Measured permeability values range from 0.04 md. to 701 md. and average 161.6 md. These high porosity and permeability values result from abundant primary intergranular pore space, as well as secondary pore space created by dolomitization and dissolution of framework grains.

The algal boundstone facies has heterogeneous reservoir quality, with porosity values ranging from 1.0% to 21.9% and averaging 6.0%. Permeability ranges from less than 0.01 md. to 3731 md. and averages 64.6 md. The highest porosity and permeability values occur in zones where localized dissolution of trapped allochemical grains or solution-enhancement of preexisting fenestral pores has created additional porosity. Most of the primary pore space is tightly cemented by baroque dolomite or anhydrite. The remaining facies in the core have local porous and permeable streaks, created by secondary dissolution, that are volumetrically insignificant in the total rock volume.

Depositional and diagenetic studies such as these add to our regional knowledge of the Smackover Formation and help us better understand (and we hope predict!) the rapid facies changes that occur in the upper Smackover in southern Alabama.

[1] Reservoirs, Inc., Houston, Texas
[2] Coastal Oil and Gas Corporation, Jackson, Mississippi

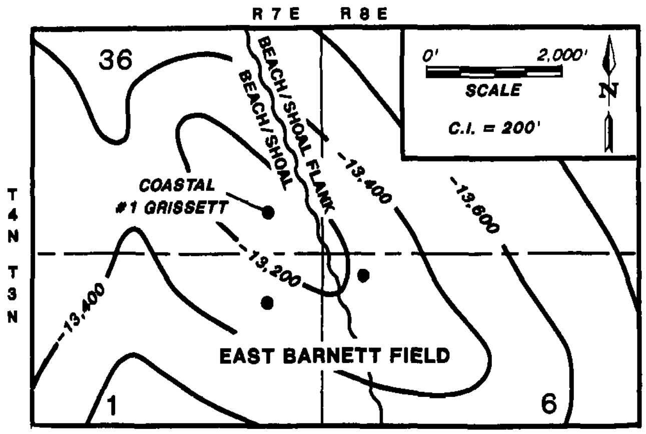


Figure 1. Structure map on the top of the Smackover Formation with the depositional environment of the reservoir indicated (wavy line).

Figures 2-7: Photographs of conventional core from the Grisset 36-16 No. 1. Figure 2. Bedded oncoidal, peloidal packstone-grainstones from the beach shoreface/flank deposit. The bedding is disrupted by burrows near the base of the sample. Most of the large oncoids are dissolved out and occur as isolated, secondary moldic pores. 13,583 feet.

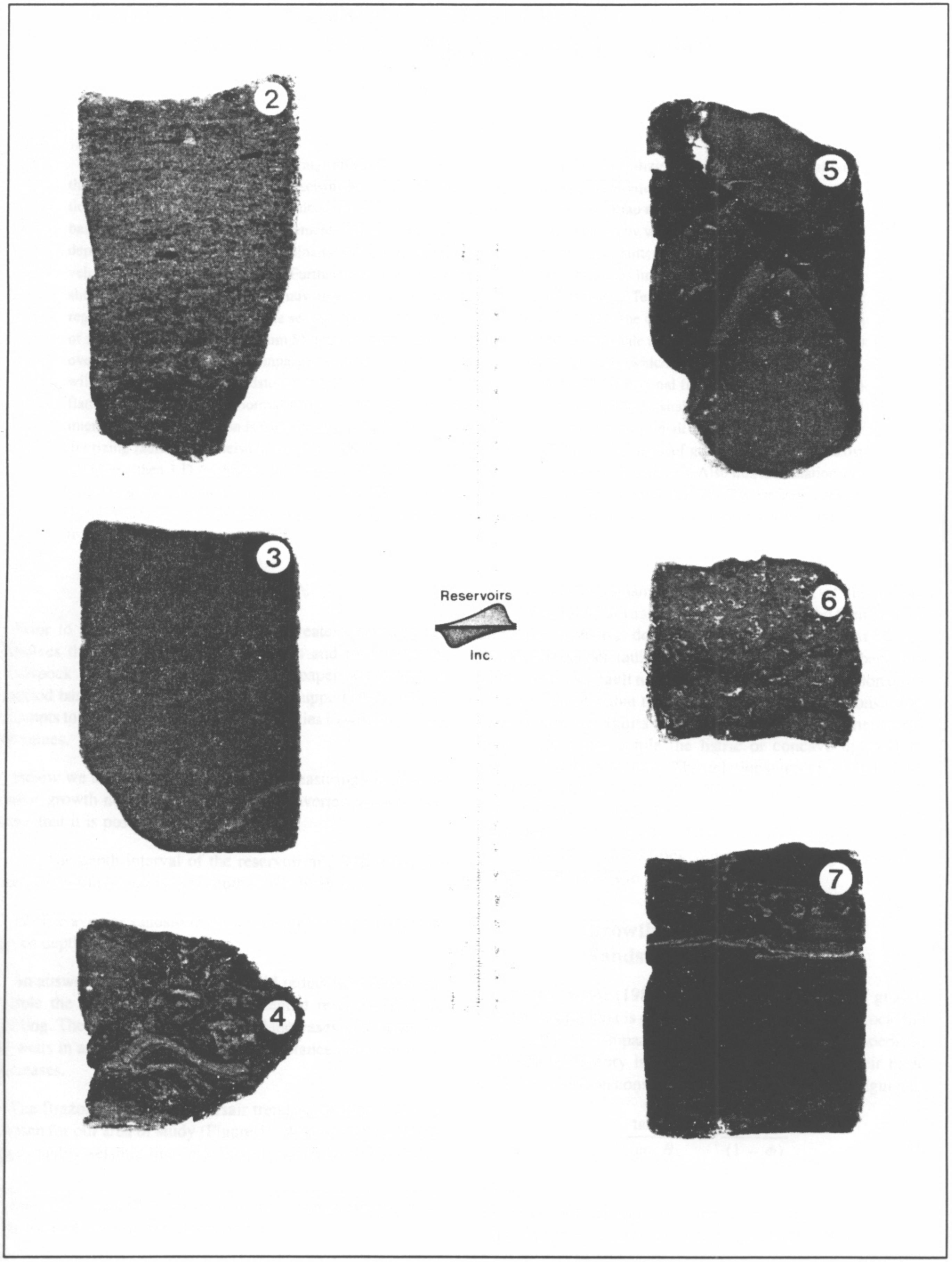
Figure 3. This slab shows a uniform, well-sorted ooid grainstone from the ooid beach/shoal environment. Extensive dolomitization has obscured most of the sedimentary structures, and the unit appears massive. Faint cross-bedding was seen in other parts of the core. 13,590 feet.

Figure 4. Angular clasts surrounded by a highly distorted, chaotic matrix from the dolomitized, collapse breccia facies. Most of the clasts have darkened weathering rinds and prominent solution pits on their outer surface. Several of the contorted layers are fractured. This sample was taken from just below a prominent sedimentation break or discontinuity surface in the core. 13,625.5 feet.

Figure 5. This sample is also from the collapse breccia facies and shows large boundstone clasts lithified by a mud matrix. These clasts are quite angular and do not appear to have undergone significant transport. Several internal fractures are filled with anhydrite, which appears white. 13,633 feet.

Figure 6. The algal boundstone facies consists of grainy, finely laminated sediment alternating with mud-dominated sediment characterized by abundant fenestral pores. This sample shows large fenestral pores lined with anhydrite or dolomitized rim cements. Solution-enhancement of this fenestral pore system can create significant vuggy porosity in this facies. 13,686 feet.

Figure 7. Fine crenulated laminae characterize this portion of the boundstone facies, which contains abundant trapped peloids, oncoids, and other subtidal allochems. The probable desiccation cracks seen near the top of the sample are filled with dolomite and anhydrite. 13,695 feet.


2
3
4
5
6
7
Reservoirs
Inc.