Sedimentary Process and Depositional Model for the Badami Reservoir, Canning Formation, North Slope, Alaska

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Abstract

The 1990 discovery of the Badami field by Conoco Inc.'s Badami No. 1 led to a major exploration effort by BP Exploration Alaska, Inc. between 1992 and 1995, where three wells were drilled and cored (Badami No. 2, 4, and 5). Subsequent production began in 1998 with a total of 13 development wells. Original reserves were estimated at 120 MMBO. However, after 21 years, the cumulative production is only 7.9 MMBO. Initial production rates quickly reached up to 7,450 BOPD a month after field start-up but rapidly declined. Today, the Badami oil pool produces an average of 506 BOPD with eight wells. Previous work recognized only four general facies: "amalgamated pay", "bedded pay", "thin-bedded pay", and "non-pay." This study provides insight into the troubled production history of the Badami reservoir in order to better develop similar fields by presenting a revised, higher-resolution depositional model that delineates a wider range of sedimentary processes and facies based on analysis of Badami No. 2, 4, and 5 cores. This study delineated 20 facies and recognized a broader suite of sedimentary processes ranging from sustained-flow turbidity currents to contour currents. Facies interpretations indicate that Badami largely consists of unconfined channel-lobe deposits dominated by sustained-flow turbidites fed directly by a shelf-edge delta. Channel-lobe deposits are locally reworked by contour currents, thereby improving reservoir quality in facies that were otherwise considered non-reservoir. Moreover, channels are highly compartmentalized with little connectivity, and lobe sands are very thin but may have better connectivity because they are locally reworked. Core-derived porosity and permeabilities indicate the channel

facies have an average porosity of 20% and an average permeability of 130 mD, while the overbank/lobe deposits average 17% porosity and 75 mD permeability. Contourite deposits have not been previously recognized in any AK deepwater deposits, but average 10.5% porosity and a surprising 11 mD permeability, attributed to better sorting by contour currents. Development of this higher resolution depositional model and placement of the Badami in a source-to-sink context provides insight into development strategies that could unlock areas of the reservoir that were not considered in the original development plan. Additionally, such case studies can be used to guide future exploration and development efforts for deepwater reservoirs on the North Slope.