Identification and Evaluation of Buried Slope Channels by 3D Seismic; An Example of A Gas Field in East Kalimantan, Indonesia

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The Mahakam Delta is located at the mouth of the Mahakam River in East Kalimantan, Indonesia. This delta has remained basically in the same location for the last 20 million years. The current size of the delta is 200 kilometers in width and a few tens of kilometers in thickness. Since the discoveries of giant oil and gas fields in late 1960s and early 70s, this area has been one of the most significant oil and gas producing areas in Indonesia. INPEX Corporation has been engaged in the oil and gas exploration, development and production operations in this area with French and American operators since the first discovery. In addition to the legacy giant oil and gas fields in Mahakam Delta on the continental shelf (shelf, hereafter) at water depth shallower than 200 meters, middle-size fields have been discovered since mid 1990s on the continental slope (slope, hereafter) and the basin floor, at water depth exceeding 200 meters (deepwater). Their oil and gas bearing sandstones were also deposited in deepwater. In contrast to the deltaic depositional environment in which the coarse sediments are abundant, the sandstones are rare and unevenly distributed in deepwater. Therefore, accurate prediction of sandstone distribution is important for the technical and economical evaluation of the deepwater fields. In this presentation, we will talk about how we identified and evaluated the gas bearing sandstone reservoir by showing a case study of gas field X that is located on the current slope at water depths ranging from 400 to 1,000 meters.

A series of strong seismic amplitude packages that exhibit river-like geometry were identified at the potential target sections of the gas field X. They are interpreted as buried slope channel sandstones. A slope channel is an underwater conduit that carries sand from the shelf to the basin floor. Because oil and gas accumulations were predicted from seismic data, several exploratory wells were drilled into the potential slope channels. The results were as expected. After successful exploratory drilling, a sedimentological model for gas bearing slope channel sandstones was created for the gas volume assessment. A study on the younger and shallower sediments with better seismic image resolution (Saller A. H., et. al., 2004) #1 was used as an analogue. In this study, slope channels are visualized vividly.

Strong and weak amplitudes in the main target zone correspond to gas and water bearing sandstone beds, respectively. A quantitative correlation between the amplitude strengths and gas bed thicknesses was established. However, strong amplitudes above the main target zone correspond to water-bearing sandstone beds. Therefore, gas bearing sandstone beds can generate the strong amplitudes, but strong amplitudes do not guarantee the presence of gas. This is because variations in factors other than fluid content, such as the bed thickness, lithology and porosity can cause a change in the amplitude strength. For example, though bearing water, a thick and porous sandstone bed with abundant plant fossils may generate strong amplitude similar to gas-bearing sand. Because a seismic section contains several different types of information in variable degrees, it is recommended to examine as many related data sets, test as many different seismic attributes, and refer to as many analogue studies, as available, before making conclusions.

#1 Saller, A. H., J. T. Noah, A. P. Ruzuar, and R. Schneider, 2004, Linked lowstand delta to basin-floor fan deposition, offshore Indonesia: An analog for deep-water reservoir system: AAPG Bulletin, v.88, p.21-46.