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Abnormal Abundance of Wood Fragments in Sandstone Reservoirs Linked to Volcanic Activity (?): Managing Induced Biases in Log Response and Quantitative Interpretation - Illustration from the Plover Formation of the Ichthys Field (NW Shelf of Australia)

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ABSTRACT

The Ichthys field is a major gas-condensate accumulation that is located in the Browse Basin of the Northwest Shelf of Australia and which is currently under development by INPEX and its joint venture participants. The resources are distributed between two very distinct formations: Below the Lower Cretaceous Brewster massive turbidite sandstone reservoir unit lies the more complex Middle Jurassic Plover reservoir interval, which corresponds to a large deltaic system with several volcanic levels of both effusive and intrusive origin.

The best developed sandstone reservoirs of the Plover Formation correspond to large fluvial to estuarine distributary deposits within a matrix of mixed fluvial-tidal-dominated delta plain that contains several coal beds. The examination of the cores has allowed characterizing a few peculiar intervals of sandstones showing dense and chaotic scattering of coal clasts that corresponded initially to large pieces of wood. Although wood debris are commonly found -and near diagnostic- in deltaic settings, they seem to be much more abundant in the Plover of Ichthys than in other analog case studies of mixed fluvial-tidal deltaic series with recurrent coal seams, such as the Neogene of the Mahakam delta in Southeastern Borneo (Indonesia), the Cretaceous Tanopchin Formation of Western Siberia or the Pennsylvanian Breathit Group of Eastern Kentucky (USA), among others. A possible interpretation for this difference is that the volcanic activity at Plover times has induced recurrent mass killings of vegetation, due to wildfires and/or heavy ash falls in association to lava flows and eruptions, which should have resulted in abnormal fluxes of dead trees in the delta plain and the delta front. Alternative explanations are possible, in particular a climatic control, with destruction induced by tropical hurricanes for example.

In any case, this particular facies of “wood rich” sandstone creates a bias in wireline log response and in quantitative interpretation of lithology and fluid content in the delineation wells: First, the coal fraction creates a “porous response” on porosity-dependent tools such as neutron, density and sonic. In addition, coal is highly resistive. Therefore, the main characteristics of these “coaly sandstones” are: low gamma ray (both sandstone and coal), high porosity and high resistivity. The combination of these characteristics can be easily interpreted as the response of very porous hydrocarbon-bearing sandstone, especially from routine quantitative analysis procedures, whereas on the contrary these coal-rich units are most often cemented by silica, with poorer reservoir quality than the regular clean deltaic sandstones.

Thanks to core calibration of this abnormal facies, a methodology of automated characterization of such intervals from the combination of several wireline logs was constructed, so that these could be detected in uncored sections. This methodology aims at refining the quantitative

evaluation at each well by filtering out these local overestimates of porosity, which in the end may be the consequence of an old volcanic history.