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Formation evaluation of Gas Hydrate bearing sediments using probabilistic software

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There is a growing interest in natural gas hydrate mainly due to the possibility that it may represent a large energy resource, potentially have an impact on global climate change and a have a role in submarine slope stability failures. It is therefore of great importance to be able to identify the occurrence of in-situ gas hydrates and accurately assess their volume within the host sediments. The evaluation of gas hydrate volumes is dependent on a number of parameters, including the areal extent of the hydrate occurrence, reservoir thickness, porosity of reservoir and degree of hydrate saturation. Normally in hydrocarbon exploration of conventional oil and gas fields the analysis of core samples obtained while drilling are used to evaluate this petrophysical data. However, because hydrate disassociates and loses gas as it is brought up to normal surface temperatures and pressure, it becomes problematical in obtaining meaningful porosity and saturation values from recovered cores. Pressure vessels are being developed to maintain the core samples at their in situ conditions, but the number of samples yet analysed remains small. Therefore downhole well logging techniques are used in order to obtain petrophysical data. These techniques have in the main been adapted from the standard hydrocarbon industry methods of determining porosity and saturations using resistivity and acoustic log data, together with the deterministic relationships such as the Archies (resistivity) and Wyllies (acoustic) time average equations. Deterministic formation evaluation methods follow a step by step approach to arrive at one solution for each depth step. In successive steps, the lithology, porosity, and saturations are determined. Thus the analytical parameters are fixed and the solutions unique. Another approach has been to use probabilistic statistical software such as the Mineral

Solver module within the Interactive Petrophysics™ software package. Probabilistic evaluation, computes a solution from an assigned mineral model and all the available logs simultaneously, using statistical methods. The solution is found by varying fluid and mineral volume fractions until the closest fit between reconstructed logs and logs actually measured in the borehole is obtained. The quality of the fit is reflected in a computed incoherence curve, which is thus regarded as being indicative of the quality of evaluation. The probabilistic method has been applied to the log data acquired from the ODP/IODP (marine) and the Mallik (permafrost) exploration wells.