Using Ocean Bottom Seismic Data and Ultrasensitive Hydrocarbon Mapping Simultaneously to Optimize Production in Offshore Fields

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Abstract

Current offshore hydrocarbon detection methods typically employ vessels to collect cores along transects over structures derived from 2D or 3D seismic surveys. These samples are then analyzed by standard geochemical laboratories. Due to the cost of core collection, the sample density over these structures is insufficient to map hydrocarbon accumulation boundaries. Thus, current methods primarily answer three basic questions: 1.) is there an active petroleum system, 2.) how do the hydrocarbons relate to regional petroleum systems, and 3.) what is the phase of those hydrocarbons. However, the capability to attach ultrasensitive passive modules to Ocean Bottom Seismic (OBS) nodes provides a new option to the industry. High resolution seismic data can be captured simultaneously with high resolution hydrocarbon data. Attaching ultrasensitive passive modules to OBS nodes allows modules to be deployed in dense grid patterns that provide extensive coverage over structures to: • map hydrocarbon charge • identify & map reservoir sweet spots (i.e. areas of better porosity, pressure, & net pay thickness) • infer sealing faults • map hydrocarbon depletion affects over time • map subsalt hydrocarbon charge through thick salt sequences • predict dry & noneconomic wells with an 87% accuracy. Field trials were performed in offshore Ghana. The module testing coincided with testing of a new version of an OBS node. As such, the trial was not intended to duplicate normal field operations, but rather provide a limited trial to determine if the ultrasensitive passive modules could function properly under real

world conditions. The ultrasensitive passive modules were attached to the bottom of the OBS nodes. When lowered to the seabed floor, the weight of the OBNs pressed the AGI module into the seafloor sediment. The samples were only deployed for a few days. Normal deployment is 2 - 4 weeks. Typical spacing for field development surveys ranges from 100 - 500 meters, while spacing for frontier surveys ranges from 1,000 - 3,000 meters. The water depth for the survey ranged from 1500 - 1700 meters. Positive thermogenic signatures were detected in the majority of the samples. Additionally, a baseline or dry signature was also detected. The baseline signature demonstrated that the positive signatures were thermogenic in nature and not from shipboard contamination. Thus, the field trial validated that ultrasensitive passive modules could be deployed on OBS nodes to detect ultralow levels of reservoir hydrocarbons. Furthermore, the normal deployment time of 2 - 4 weeks would further enhance the hydrocarbon intensity on the modules. In conclusion, this new symbiotic capability between OBS nodes & ultrasensitive passive modules can provide high resolution structural data and high resolution hydrocarbon data simultaneously, a capability not previously available in the industry.