Imaging Conductor Pipes in the Gulf of Mexico Using 3-D High-Resolution Seismic Data: Containing the Largest Oil Spill in US History

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ABSTRACT: Mississippi Canyon Block 20 (MC-20) was Taylor Energy's oil platform in the Gulf of Mexico, located approximately 12 miles (19km) from the mouth of the Mississippi River (Figure 1a). In 2004, Hurricane Ivan generated an underwater mudslide that overturned the production platform and displaced it approximately 500ft (152m) downslope, leading to a significant oil spill. During the mudslide, the conductor pipes were disturbed and buried in sediment up to 187ft (57m) over the top of the wellhead. Since then, this oil spill has reportedly become the longest running in the history of the United States and one of the largest to date, with conservative estimates indicating that millions of gallons of oil were released. To assist with remediation efforts, precise detection and visualization of the buried conductor pipes was required. In May 2022, Kraken Robotic Systems (formerly PanGeo Subsea, a subsidiary of Kraken Robotic Systems) was contracted by Couvillion Group to conduct a sub-bottom/below mudline (BML) survey of the MC-20 site using their specialized, high-resolution Acoustic Corer™ (AC) technology. The AC comprises collocated transmitters, low and high-frequency chirps, and a parametric source that cover a frequency range of 1.5kHz to 15kHz using a fixed landed survey platform. The acoustics are designed to penetrate the sub-seabed to obtain a 46ft (14m) diameter volumetric "acoustic core" down to 197ft (60m) below the seafloor. To determine the extent, orientation, and associated characteristics of the conductor pipes within the MC-20 site, sixty-three (63) AC surveys were acquired throughout the 673ft (205m) x 197ft (60m) survey area (Figure 1b). The AC data processing followed standard seismic procedures using ZoomSpace™ in-house software. Rather than mosaicking the individual acoustic cores, the pre-processed data sets were merged and migrated into a single unified volume which was statically corrected to the same reference datum. This resulted in enhanced resolution and coherency for accurately identifying and representing the conductor pipes. After processing and interpreting the acquired data, the full extent of the conductor pipes were identified and the locations of all structural and geological features were digitized within the sub-seabed. The results revealed chaotic mud slide clay blocks within the upper sub-seabed, interspersed within a depositional distribution of weak unconsolidated sediments. A more densely consolidated basement was identified at approximately 136ft to 165ft (41m to 50m) below the seabed, in which the conductor pipes were observed to be reposing onto. Specifically, 18 smooth and continuous linear conductor pipes were identified, presenting as a collective bundle, constricting at its center and splaying outward as they continue from the collector dome towards the well bay (Figure 2). A region of acoustic blanking was observed within the survey region northwest of Row 11 (Figure 1b), near the well bay. The continuity of the conductor pipes from the collector dome to the well bay suggested that the pipes were not fractured. To investigate and understand the nature of the conductors within this blanking region, a magnetics survey has been proposed for the Summer of 2023. Preliminary magnetic modelling has suggested that this method will prove successful at further delineating the nature of the conductor pipes within this region. This will hopefully provide Couvillion Group with additional insight to further assist with the successful remediation of this oil spill.

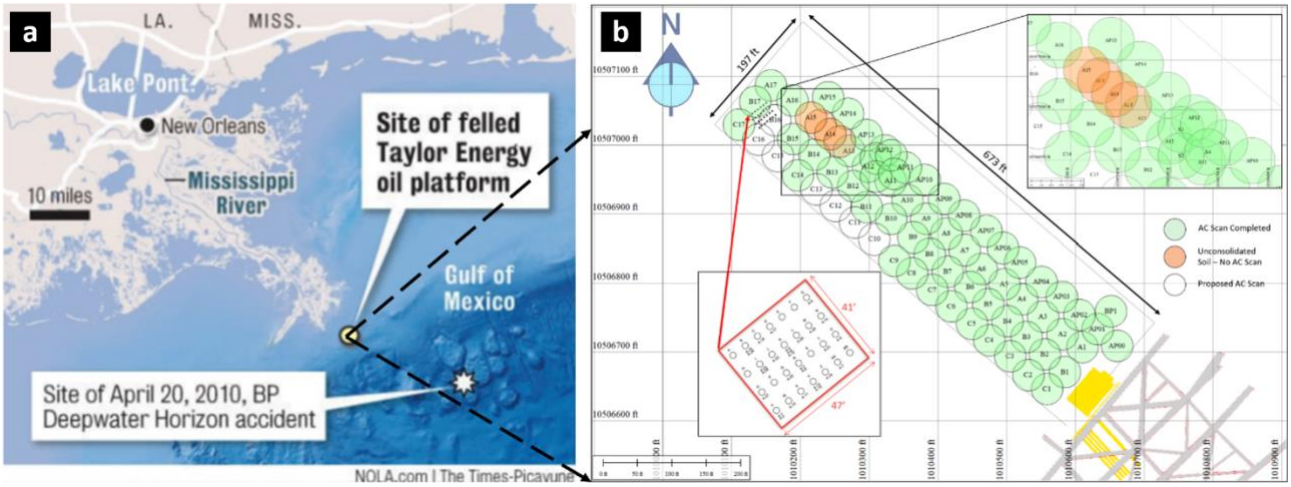

Figure 2 - (a) MC-20 site about the nearest land and Deepwater Horizon accident. (b) MC-20 2021 AC survey area

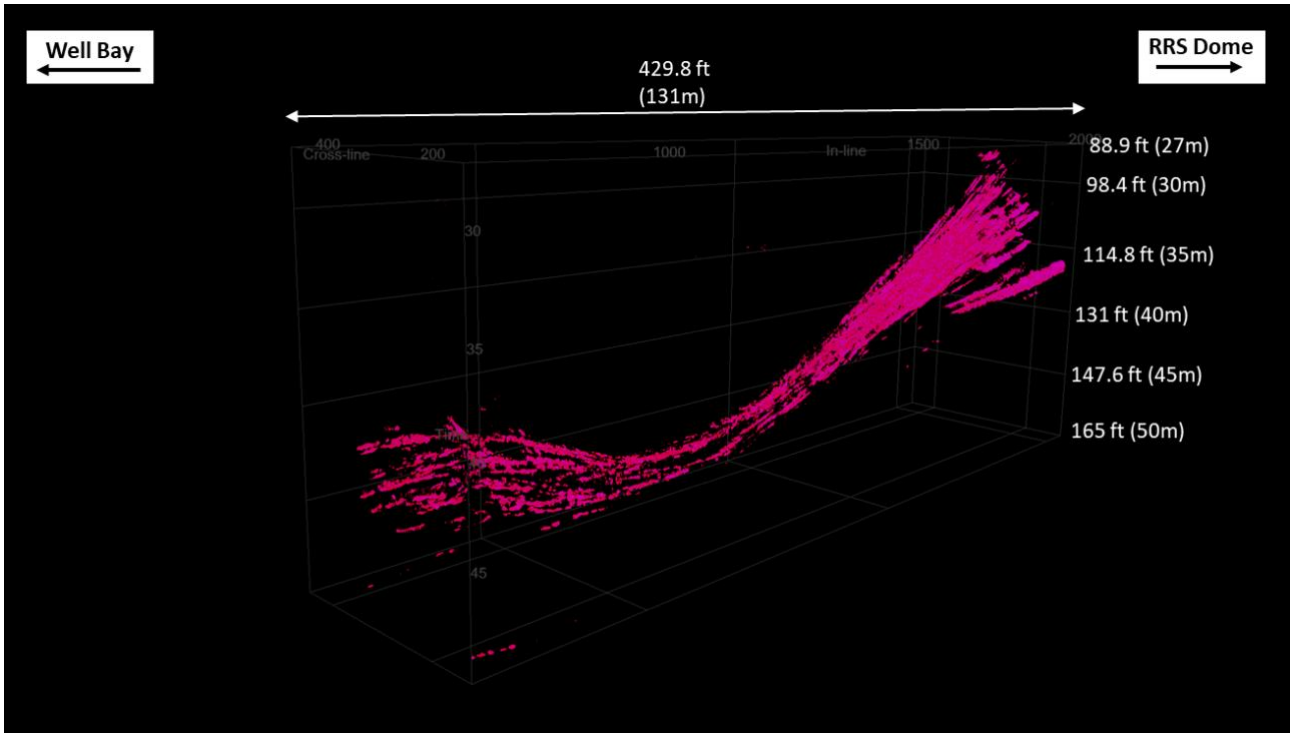

Figure 1 - A bundle of 18 conductors identified within the unified migrated volume. The bundle is observed to constrict at its center and splay outward near the well bay (left) and collector dome (right).