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Target-oriented time-lapse monitoring of mature oil fields

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Introduction

Time lapse monitoring of mature oil fields implies acquiring seismic data in obstructed areas. The effort to make a survey happen is proportional to the size of the towed streamers. Nevertheless, when data is processed, one of the critical steps to achieve the final image is the muting of the stretched migrated traces, which is done in the easiest way by an angle mute. If we overlay the calculated angle to the common midpoint gather of seismic traces, we can easily conclude that at reservoir level some number of traces with higher offsets are discarded. Our purpose is to take this into account at the time of the seismic acquisition design to improve the efficiency of the acquisition in obstructed areas.

Method and/or Theory

In this work we deal with towed streamer seismic acquisition for time-lapse purposes, so to say, we already have enough data to build a reliable velocity model. This data can be a legacy streamer or OBN data, and our target horizons (top and bottom of the reservoir) are well stablished, in the way that the data is used only for time-lapse purposes. Most of the tools used in seismic processing use the equation described by A. T. Walden (1991), where the incidence angle is related to the interval velocity, rms velocity, offset, and time. We inverted this relation to calculate the maximum offset at a specific angle mute like 40 or 45 degrees and then create a map of maximum offset for this angle.

Results and Conclusions

In our case we had an acquisition survey in two steps, the first one with a single vessel towing a 6 km streamer, and after a cable reconfiguration, a second step using two vessels, one only for shooting and the other towing a 3.2 km streamer used in one pass to shoot and register, and other only to register. So, three bunches of data were to be acquired, the full, the near and far offset shots. This methodology allowed us to modify the processing flow to bring the result earlier as the acquisition was running, just after the full and near shots were acquired, dispensing the far shots and undershooting sequences. On the other hand, another result came out: is it necessary to acquire these far offset shots? The answer depends on the field to be monitored, and the requirements already posted. But, even in the case we need these shots, we set up an acquisition survey that uses this information to deal with the simultaneous operations in the field and acquire more relevant data to better image and monitor the field without avoidable delays.