AVO analyzes as a tool to infer sand-to-shale ratio.

Amin Murad, Rafaela Reis Lima, Elita Selmara de Abreu, Petrobras S.A.

Abstract

To help geological risk analysis in well planning, we have used AVO analyses to detect possible influx zones, HC presence and sandstone bodies along the well path interval. The AVO analysis is based on Fatti's approximation, where the A and D attribute volumes are integrated and used to obtain the gradient (B=A+D). The analyses are done interval by interval. A crossplot of gradient (B) versus intercept (A) for each studied interval is performed and the background trend and the standard deviation are calculated. As a criterion, we limit our analyses only to the anomalies which the standard deviation is greater than 3.0 and the intercept is negative. In this present work, we show a case study on offshore, Santos Basin. Our AVO analyses showed that the angular coefficient of the background trend per interval changes considerably with depth. In shallow intervals the values of the trend's inclination vary from -0.91 to -0.76, going to 0, returning to -2.21 in deeper intervals. According to the theory, the inclination of the trend should increase with depth because of the increase in the consolidation of the sediments due to the overburden. We correlate these variations in the background trend inclination with geological events and data processing issues, as it follows. In the interval from Sea Bottom (+100 m) to Middle Miocene the trend inclination is -0.41. Although this number could be explained by the great presence of unconsolidated sediments resulting in a V_P/V_S ratio increase, acquisition marks are observed as well and could also be an explanation for this value. The interval from Middle Miocene to Eocene has a trend inclination of -0.76. AVO anomalies (class III and IV) were detected in this interval, indicating the presence of sediments of lower consolidation, with possible risk of influx. A trend line inclination of 0 was found in the interval from Eocene to Paleocene, where consolidated sediments are expected. However, a class III anomaly with regional aspect is found in this interval revealing possible presence of sandstones with good porosity. The interval from Paleocene to Cretaceous shows a trend line inclination of 0, analogous of the former interval, but sandier. Structural attributes were used to help the interpretation showing that the anomalies found in the intervals with trend inclination of 0, display a channel like shape, confirming our hypotheses that the decrease in the trend inclination was related to sand rich intervals. Finally, the interval from Cretaceous to Top of the Salt (-100 m) has a trend line inclination of -2.21, where sediments with extreme consolidation and mild V_P/V_S ratio are dominant and fault structures due to halokinesis are detectable. The study showed that it is very important to segment the AVO analyses by stratigraphic zones to achieve a better detection and interpretation the anomalies. Our interpretation of the results, considering not just the AVO anomalies, but also the background trend inclination and structural attributes, allowed us for a better understanding of the causes for the anomalies and provided us insights on the sand-to-shale ratio relationship with the inclination of the trend.