Characterizing the physical properties of seafloor sediments in the Santos Basin and their applications in geophysics and geomechanics models.

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In 2006, Petrobras made a historic announcement, revealing the discovery of a vast oil province known as the pre-salt, located in the Santos Basin. These reserves are located over 300 kilometers off the Brazilian coast and are deposited at depths greater than 7,000 meters below sea level. The pre-salt reservoirs consist of heterogeneous carbonate rocks and are typically found beneath a thick salt layer. Additionally, the Santos Basin's seafloor is characterized by a complex topography and variations in sediment composition. Accurate characterization of these deposits is important to multiple disciplines related to oil exploration and production, encompassing geophysics, geomechanics, installation of drilling and production platforms, placement of subsea pipelines, and development of anchoring systems. In this study, dozens of geotechnical boreholes located in various regions of the Santos Basin were used to characterize the properties of sediments present in the seafloor. These wells have an average depth of 20 meters and acquired profiles of compressional velocity, density, and gamma-ray measurements. Statistical analyses of petroacoustic properties (velocity and density) were applied to determine minimum, average, maximum, standard deviation, P10 (10th percentile), and P90 (90th percentile) values. The sediments identified on the seafloor consist predominantly of carbonate mud with a limited presence of siliciclastic component. These materials are unconsolidated, which can impact the readings of the borehole's tools and introduce a higher level of uncertainty in the measured values, thus requiring a careful approach in the interpretation of the acquired information. The average velocity of these sediments (1490 m/s) is lower than the expected velocity for seawater (1524 m/s - a value commonly used in velocity modeling during seismic processing). However, the density of these materials (1.49 g/cm³) is higher compared to saltwater (1.03 g/cm³), yet significantly lower than the values empirically utilized in geomechanical studies. The conducted study has significantly enhanced our understanding of the physical characteristics of the sediments present in the seafloor of the Santos Basin. These results hold great importance for the construction of accurate velocity models, which are utilized in seismic data migration and time-depth conversion. Furthermore, the obtained information is essential for estimating dynamic mechanical properties, such as Young's modulus, Poisson's ratio, and bulk and shear moduli, which are inputs used in geomechanical modeling, as well as field stresses that can directly impact well injection pressures and, consequently, influence pressure maintenance and production of the fields.