Geophysical Research Abstracts
Vol. 20, EGU2018-5820-1, 2018
EGU General Assembly 2018

Acoustic impedance inversion of seismic data from the New Jersey shelf for delineating porosity distribution of an offshore groundwater reservoir

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Understanding offshore groundwater flow plays a key role in improving our knowledge on the global hydrological cycle. Through the Integrated Ocean Drilling Program (IODP) Expedition 313, we have an opportunity to develop our understanding of the offshore groundwater flow at the scale of a continental margin. One significant finding of this expedition is the presence of offshore groundwater with remarkably lower salinity compared to seawater. This observation raises many questions on the governing aspects behind this phenomenon, and therefore triggers further investigations. A fundamental way to understand the key factors in this offshore fresh groundwater phenomenon is through numerical simulations using a realistic three-dimensional (3D) hydrogeological model of the New Jersey shelf. For that we have performed acoustic impedance inversion of several two-dimensional (2D) seismic profiles acquired along the shelf. The results provided a new interpretation on the subsurface porosity distribution in that area and has contributed to guide facies delineation in the hydrogeological model which is currently built. The results of the acoustic impedance inversion also allows to evaluate and refine the initial seismic horizon picks which are essential to improve the reliability of the model geometry. The quantitative interpretation of the porosity distribution might as well open new geologic insights of the area, which has been so far only interpreted in more conventional and less deterministic ways. Additionally, the work presented here also serves as an assessment to perform more advanced rock physics methods for the groundwater reservoir characterization at the New Jersey shelf within follow-up projects.