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Analysis of anomalies in seismic ambient noise above fluid reservoirs

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Anomalies in seismic ambient noise, defined as strong spectral amplification of the vertical components at frequencies of several Hertz, are currently observed on sites located above hydrocarbon reservoirs. If properly understood, these anomalies could have a potential for applications such as geothermal reservoir exploration or underground gas storage monitoring. Under purely elastic modeling, the nature of these anomalies was mainly explained by the geological structure more than the fluid reservoir itself. The main objective of the present work is to explain the exact origin of the anomalies by numerical simulations of the 3D wave propagation using specfem3D code. The simulated spectral anomalies are essentially static and determined by the typical geological reservoir environments. The effect of an anticline structure, which is a common characteristic of hydrocarbon reservoirs, is investigated using different types of sources. Results show that the spectral anomalies caused by the presence of the anticline structure have similarities with the anomalies observed in real data. More work is needed to extract laws linking geometrical characteristics of the anticline to spectral properties. Future works will also include analysis on real gas storage sites, followed by a transposition to the geothermal field applications, for which more complicated parameters appear to participate to the phenomenon.