Geophysical Research Abstracts
Vol. 18, EGU2016-1835-1, 2016
EGU General Assembly 2016

Empirical Mode Decomposition of Geophysical Well-log Data of Bombay Offshore Basin, Mumbai, India

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Geophysical well-log data manifest the nonlinear behaviour of their respective physical properties of the heterogeneous subsurface layers as a function of depth. Therefore, nonlinear data analysis techniques must be implemented, to quantify the degree of heterogeneity in the subsurface lithologies. One such nonlinear data adaptive technique is empirical mode decomposition (EMD) technique, which facilitates to decompose the data into oscillatory signals of different wavelengths called intrinsic mode functions (IMF). In the present study EMD has been applied to gamma-ray log and neutron porosity log of two different wells: Well B and Well C located in the western offshore basin of India to perform heterogeneity analysis and compare the results with those obtained by multifractal studies of the same data sets. By establishing a relationship between the IMF number (m) and the mean wavelength associated with each IMF (I_m), a heterogeneity index (ρ) associated with subsurface layers can be determined using the relation, I_m=$k\rho^m$, where 'k' is a constant. The ρ values bear an inverse relation with the heterogeneity of the subsurface: smaller ρ values designate higher heterogeneity and vice-versa. The ρ values estimated for different limestone payzones identified in the wells clearly show that Well C has higher degree of heterogeneity than Well B. This correlates well with the estimated V_{shale} values for the limestone reservoir zone showing higher shale content in Well C than Well B. The ρ values determined for different payzones of both wells will be used to quantify the degree of heterogeneity in different wells. The multifractal behaviour of each IMF of both the logs of both the wells will be compared with one another and discussed on the lines of their heterogeneity indices.