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Influence of different porosity-depth trend types on subsidence analysis

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In subsidence analysis of a sedimentary basin, it is necessary to use an appropriate porosity-depth curve, because understanding the relationship between porosity and burial depth is crucial for decompaction and backstripping techniques to calculate the original thickness of a sediment unit. The relationship is controlled by a variety of factors including primary lithology, depositional facies, composition of framework grains, temperature and time. All of these factors are combined and govern the rate of porosity change. Borehole data such as sonic log, neutron log, density log and core samples are commonly used to evaluate porosity, and several methods can assist in providing porosity information from undrilled geological and geophysical data. Previous publications on subsidence analysis use porosity-depth relations from specific lithologies, stratigraphic units and well sites. Although porosity data show usually exponential decrease with depth, the quantified porosity-depth trend is varying based on data arrangement; lilthology, geologic age and site. In many studies, it has not been considered that the different type of porosity-depth trend can influence on subsidence analysis. To confirm the influence and understand quantitatively, this study applies several porosity-depth trend sets to basement subsidence analysis for a synthetic well. The porosity data used in this study were derived from discrete samples, applying the Moisture and Density (MAD) technique and were conducted during the IODP Expedition 356 along the northwest shelf of Australia. The data are arranged mainly in three sets; site-based (linear, exponential, double exponential), lithology-based (mudstone, wackestone, packstone, grainstone, dolomite) and age-based (Pleistocene, Pliocene, Miocene). The analyzed subsidence curves are overall similar. In detail, however, the subsidence curve using double exponential site-based trend reflects the porosity data better, when each layer is placed in shallow depth. The curve using lithology-based trend shows a little different subsidence pattern and rate, which is mainly due to porosity-depth trend of dolomite layer. In the curve using the age-based trend set, past thicknesses of relatively older layers are underestimated by lower initial porosity and higher coefficient of porosity-depth trends which is caused possibly by cementation effect.