Geophysical Research Abstracts
Vol. 21, EGU2019-8204-1, 2019
EGU General Assembly 2019

BasinVis 2.0, estimation and application of the compaction trend for basin modelling

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Basin analysis aims at understanding the stratigraphic framework of the infilling sedimentary rocks and sediments. Due to thickness reduction by compaction effects during burial, however, the present sedimentary units do not directly represent the initial sedimentation processes and the original thicknesses and geometries. Therefore, thickness restoration, i.e. the decompaction of compacted layers, is crucial to understand sedimentation systems during deposition and the evolution of structural geometries throughout basin history. Due to the high effort of performing the decompaction process, however, thickness restoration has not been actively applied to reconstruct sedimentation systems and basin evolution. Therefore, this study refines the decompaction process for quantitative thickness restoration and its applications to basin analysis. These improved techniques are implemented in a MATLAB-based open source program, BasinVis, upgrading the software to Version 2.0. Thus, BasinVis 2.0 provides new functions which aim mainly at; 1) compaction trend estimation based on porosity variation data with depth, 2) application of the estimated compaction trends to analyze sedimentation profiles and subsidence, and 3) quantitative initial sedimentation setting and visualization, applying the decompaction process. We demonstrate these new and improved functions by using a case study comprising well data from the offshore part of the Perth Basin, Australia. The compaction trend, which is essential to perform decompaction, is estimated in better detail to linear and exponential trending equations, and the quality is examined using porosity data from IODP Site U1459 and Industry well Houtman-1. The estimated trends are applied to decompaction of stratigraphic units arranged from collected IODP and industry well data to demonstrate the new functions. A variety of plots based on compacted and decompacted thicknesses are now added to analyze the sedimentation profile of a selected site. 3D surface models and 2D isopach and sedimentation rate maps of the study area are generated by renewed visualization interfaces. The subsidence analysis is examined by estimated compaction trends to investigate the influence of the applied compaction trend quantitatively. The results of BasinVis 2.0 provide useful and more detailed information to understand overall sedimentation settings during basin formation as well as subsidence, and changes during burial. This study also discusses some degree of uncertainty introduced by low data density in conjunction with 3D interpolation and applied compaction trend types, to help users to choose the best method based on characteristics of their study area and research goals.