New High-Resolution Geodynamic and Landscape Evolution Models for Africa from the Permian to the Present Day

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Abstract

African geodynamic models have been reconstructed for the 59 stages from the Permian to the Present Day. Maps were compiled at a scale of 1:5,000,000 and comprise three main layers: a maximum transgressive depositional layer, a maximum regressive depositional system layer, and a tectonophysiographic layer. These maps are invaluable tools as they provide history on sediment source and sinks over time. Additionally, understanding the interactions between tectonics and sea level variations for each stage allows a good overall understanding of the geological evolution of a region. This gives insights vital for future hydrocarbon exploration.

Prior to this work, we mapped gross depositional environments and tectonophysiographic terranes at a lower compilation scale (1:20,000,000) and as one layer. This gave information on base-level changes and interactions between actively eroding and depositional areas. The new maps have been compiled on a newer plate model which has incorporated feedback from previous work; thus, it is our most robust plate model to date. A more detailed legend has been used to enable more geological information to be integrated onto the maps. As with our previous work, the drainage network for each stage has been represented on the map; however, newer databases have been incorporated to make the results more robust.

The DEM aspect of the project has seen the application of new methods. The enhanced information of the maps has let us better represent offshore features within the context of geometries. Additionally, we now automate the DEM to remove human subjectivity. Furthermore, modelling of DEMs is typically based on Present Day tectonics and the elevations they produce. Landscape elevations, however, are the sum of recent and past tectonics; we therefore use the comprehensive tectonic history gained during the first phase of mapping to understand which cumulative tectonic processes have occurred to produce particular elevations. These results help to identify source to sink relationships and become particularly powerful tools when combined with further evaluation from our climate, ocean, tide, and lithofacies prediction models, the boundary conditions for which are obtained from our maps.

Along with key geological times, maps that include the northern margins of Africa will be shown to highlight the depositional differences between maximum and minimum transgression.