Geophysical Research Abstracts, Vol. 9, 03812, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03812

Numerical modelling of tides in the Late Pennsylvanian epicontinental seaway of North America

M.R. Wells, P.A. Allison, G.J. Hampson, M.D. Piggott, G.J. Gorman, C.C. Pain and F. Fang

Department of Earth Science and Engineering, Imperial College London, SW7 2AZ, UK (martin.wells@imperial.ac.uk / Phone: +44 20 759 41363)

A novel numerical model (the Imperial College Ocean Model, ICOM) is used to simulate tidal circulation in shallow epicontinental seas connected to large, open oceans. ICOM is validated using the present-day North Sea and applied to predict tidal range in the Late Pennsylvanian Midcontinent Seaway (LPMS) of North America. The model simulates the effect of the principal tidal constituents (astronomical tides) as well as the tide propagating from the adjacent open ocean (co-oscillating tide).

Two 'base-case' Pennsylvanian palaeogeographies were tested; (1) maximum sea-level highstand and (2) early stages of a transgression. Sensitivity tests determined the importance of palaeo- water depth and coastline uncertainty on tidal range prediction. During the highstand, tidal ranges in the craton interior (Midcontinent Shelf, Illinois and Appalachian basins) are consistently predicted as micro-tidal ($<$2 m tidal range). Such low tidal ranges would have inhibited water-body mixing in the LPMS, promoting stratification. Predicted bed shear stress is also low and thus mud deposition is expected. This, with other factors, such as influx of oxygen-poor water from the Permian Basin to the west and high organic input from tropical rivers may have contributed to the deposition of 'core' black shales in LPMS cyclothems. Conversely, a meso- to macro-tidal, diurnal (once daily tide) regime is predicted for the early transgression in a large-scale embayment in eastern Kansas due to resonant amplification of diurnal tidal constituents. Elevated bed shear stresses here indicate sand transport may have been possible. Pennsylvanian strata here have been ascribed to a meso- to macro-tidal setting and include cyclic rhythmites that suggest a strongly diurnal system, as predicted by ICOM.