Modeling the Middle-Late Pennsylvanian North American Midcontinent Sea

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One of the goals of our study is to deepen understanding of the Middle-Late Pennsylvanian North American Midcontinent Sea, an area that repeatedly flooded when Gondwanan ice sheets melted. Most of today's knowledge about past climates is gained through pre-Jurassic stratigraphic records from epicontinental seas. This knowledge is complemented by atmospheric general circulation models (AGCMs) with attached "slab oceans mixed layer models". These models describe the ocean in a simplified way through diffusion rather than in a fully dynamic way. The attached slab ocean also referred to as "swamp ocean" is needed for energy balance between radiative, latent, and sensible heat fluxes. One limitation of these AGCMs coupled to “swamp” oceans is that they are unable to produce a three-dimensional circulation pattern based on the overlaying atmospheric forcing on solid-earth and solid-earth age specific boundary conditions. These include the distributions of the continents and their surface types, the presence of ocean gateways, and bathymetry. As of yet, there has been no application of a realistic numerical climate model to simulate the three-dimensional paleo-ocean circulation pattern for the Late Paleozoic Midcontinent Sea (LPMS) for both glacio-eustatic "lowstands and highstands" of the Late Paleozoic Ice Age. In our study, we trade the "swamp" ocean for a three-dimensional ocean general circulation model. We will show first steps from our case study using a global climate model coupled to a high-resolution regional three-dimensional ocean model used to reconstruct water mass conditions such as temperature, salinity, and redox status. The purpose of the study is to test different spatial-temporal variations in water mass properties reconstructed for this large epeiric sea (~2.1 x 106 km^2 at sea level highstand) from a suite of geochemical, sedimentologic, and paleobiotic proxies. We will show what proxies are required to force our models and which ones are used to evaluate our model results, i.e., those proxies that do not determine the circulation but can be simulated in a climate/ocean model.