Gradients in Sediment Geochemistry as a Constraint on Modeling Epeiric Sea Circulation

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Ancient epeiric sea deposits commonly exhibit lateral gradients in chemistry that are a reflection of spatial variation in environmental conditions. Such gradients place constraints on paleocirculation patterns and may be used to define regions of chemically distinct water masses termed “aquafacies” in which the residence time of a proxy is less than the oceanic mixing time[1]. Tracers such as Nd isotopes[2] and clay-mineral assemblages[3] provide evidence of spatial variation in the provenance of the detrital fraction. Oxygen isotopes can provide information concerning spatial variation in watermass $\delta^{18}O$ (e.g., as a function of salinity variation) or temperature[4-5]. Carbon isotopes, although subject to more numerous controls, can provide information about spatial variation in marine primary productivity and carbon cycling[6-8]. Various proxies including DOP, trace metals, and Fe_T/Al have been used to discern spatial gradients in paleoredox conditions[9-10]. All of these proxies provide indirect clues to paleocirculation patterns, although such information has rarely been integrated in a systematic manner, even for those few ancient epeiric seas that have been extensively studied to date, such as the Late Ordovician Mohawkian Sea[1-2,4,6-8]. We are in the early stages of an integrated data-model study of the North American "Midcontinent Sea" (Middle-Late Pennsylvanian) that will investigate spatial gradients in the proxies above for the purpose of evaluating the robustness of model simulations of paleocirculation patterns. This sea provides a useful case study for internal circulation in ancient epeiric seas owing to its large area (~2.1×10^6 km^2 at highstands), relatively uniform seafloor bathymetry, and pronounced lateral gradients in sediment geochemistry[3,9-10]. [1]Holmden, C., et al., 1998. Geology 26, 567. [2]Fanton, K.C., et al., 2002. Geoch. Cosmoch. Acta 66, 241. [3]Algeo, T.J., Heckel, P.H., 2008. Palaeogeogr. Palaeoclimatol. Palaeoecol. 268, 205. [4]Hermann, A.D., et al., 2005. GSA Abstr. Progr. 37, xx. [5]Joachimski, M.M., et al., 2006. Geology 34, 277. [6]Panchuk, K.M., et al., 2005. J. Sed. Res. 76, 200. [7]Fanton, K.C., Holmden, C., 2007. Canad. J. Earth Sci. 44, 807. [8]Immenhauser, A., et al., 2008. In: Dynamics of Epeiric Seas, Holmden & Pratt (eds.), Geol. Assoc. Canada Spec. Publ. 48, pp. 137-174. [9]Algeo, T.J., et al., 2004. Chem. Geol. 206, 259. [10]Cruse, A.M., Lyons, T.W., 2004. Chem. Geol. 206, 319.