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CONSIDERATIONS TOWARDS THE DEVELOPMENT OF AN EPEIRIC SEA CARBON BOX MODEL.

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Introduction: Certain features of the C isotope record of Paleozoic epicontinental limestones are not easily explained in the context of modern ocean-centred C-cycling. These features include facies dependency in the distribution of epeiric sea limestone $\delta^{13}C$, large magnitude $\delta^{13}C$ excursions unparalleled by any C isotope excursions recorded in younger deep ocean sediments, and offsets in the magnitude of correlated C isotope excursions. However, these features might be explained if epeiric sea C-cycling could, at times, be decoupled from ocean C-cycling to various but significant degrees. The degree to which epeiric sea C-cycling can overprint the $\delta^{13}C$ signature of contemporaneous ocean water that penetrates the epicontinental environment can be investigated quantitatively using a box model approach.

A box model of the epeiric sea C-cycle: Using C mass balance and isotope mass balance considerations, the evolution over time of the C isotope composition (δ_e) of the epeiric sea C reservoir (M_e) can be described as follows,

$$M_e \frac{d\delta_e}{dt} = F_{ae}(\delta_s - \delta_e) + F_r(\delta_r - \delta_e) + F_w(\delta_w - \delta_e) + F_{se}(\delta_s - \delta_e) - F_{be}{}^{o}\Delta$$

where fluxes of C are, respectively, atmosphere to epeiric sea (F_{ae}), recycled C (F_r), weathered C (F_w), input of ocean DIC (F_{se}) and burial of organic C ($F_{be}{}^{o}$). Critical differences between the epeiric sea box model described above and the nature of ocean-centred C-cycling are the following:

Epeiric sea C reservoir. M_e is small compared to the C reservoir of the ocean. Consequently, small changes to the relative magnitude of C-fluxes contributing to the epeiric sea C-cycle can have a large effect on δ_e, while barely affecting the isotope balance of C in the oceans.

Ocean. The exchange of seawater between the ocean and the epeiric sea is the principle control over the degree to which C-cycling in epeiric seas can be decoupled from the ocean. We couple changes in the magnitude of this flux to changes in sea level.

Atmosphere. Because the ocean controls the $\delta^{13}C$ of CO_2 in the atmosphere through the ocean-atmosphere CO_2 exchange flux, the atmosphere is an additional pathway by which the ocean C signature can be imparted to the epeiric sea.

Conclusions: We will show with the aid of examples how adjustments in the relative magnitudes of these C-fluxes impact the isotope balance of C in an epeiric sea and can explain some of the peculiar features of the C isotope record of Paleozoic epeiric sea carbonates. We will also show that sea level change is an important driver of C isotope excursions in epeiric sea environments.

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