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Using terrestrial carbon-isotope stratigraphy in understanding climates and environments

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Many studies have used the carbon-isotope ratios of both organic and inorganic materials to demonstrate that rapid perturbations occurred in the oceanic carbon reservoir in the geological past. Our attention to the Earth's response to these rapid, short-lived carbon events on the global environment has been dominantly confined to the oceanic realm with leaps of faith to the effect these events had on the terrestrial environment. Our lack of understanding and ignorance of the geologic terrestrial record has, in part, been exacerbated by our inability to directly relate the oceanic carbon reservoir with that of the terrestrial environment. Over the past decade the application of terrestrial carbon-isotope stratigraphy using plant matter and/or bulk terrestrial organic matter has successfully been used to infer changes to the paleo- carbon cycle. The first principle of terrestrial carbon-isotope stratigraphy is that the dominant control, on geological timescales, is through changes in the isotopic composition of atmospheric carbon dioxide. As a result, terrestrial carbon-isotope stratigraphy has been applied to many stratigraphic time periods in the Mesozoic and successfully shown to provide direct comparisons between the terrestrial and marine carbon cycle. However, like many newly developed methods, it has been enthusiastically applied with little reservation about the complications associated with the paleo-proxy itself. An urgent aspect to such a scientific approach is through increasing our understanding of the complexities of terrestrial carbon-isotope stratigraphy, such as preferential preservation of plant components, the effect of the environment, species variation, fire and subsequent diagenesis on the carbon-isotope ratio of plant organic matter. Such research is critical if we are to apply with confidence the carbon-isotope record of the terrestrial environment ultimately to understand the global carbon cycle and its climatic and environmental role in the Earth system.