# Associaton of large oxidation events and carbon isotope excursions – Increased $CO_2$ drawdown and deep recycling of organic carbon

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The geologic record shows that large oxidation events are often associated with large, positive C isotope excursions, with two of the most notable examples occurring at the beginning and end of the Proterozoic. One way to explain the assocation of $O_2$ accumulation and positive C isotope excursions is an increase in $f_{org}$. However, studies have suggested that the Great Oxidation event may have preceded its associated carbon isotope excursion ( Lomagundi event) by tens of millions of years [1], making it difficult to explain both events by increased $f_{org}$. For this reason, some researchers have proposed mechanisms which decrease oxygen sinks as the ultimate driver of $O_2$ accumulation in Earth's atmosphere [2], but it is unclear how decreased oxygen sinks would also results positive $\delta^{13}C$ excursion.

Here we present a carbon-oxygen box model which demonstrates that increased $CO_2$ drawdown into carbonates and organic C coupled with preferential release of subducted carbonates at arc volcanoes and deep recyling of graphitized organic carbon to intraplate ocean island basalt mantle source can explain both the magnitude and timing of large oxidation events and their associated $\delta^{13}C$ excursions. This model does not rely on any changes to $f_{org}$ to change $\delta^{13}C_{carb.}$ The model's initial response to increased C subduction fluxes is increased $CO_2$ emissions at arcs (carbonate-enriched, high $\delta^{13}C$), shifting $\delta^{13}C$ of atmospheric volcanic $CO_2$ inputs to higher values. $\delta^{13}C_{carb}$ continues to increase until the increased flux of subducted organic C is released at intraplate ocean islands, returning global $CO_2$ emissions at different volcanic settings to their steady-state ratios, ending the $\delta^{13}C$ excursion. Increased $CO_2$ drawdown in the model can be caused by major tectonic transitions such as contintal emergence[3], which increase the weathering of continental rocks leading to increased delivery of cations and bio-essential elements to the oceans. This contribution provides a link between Earth's evolving tectonics, atmospheric evolution, and the C isotope record.

[1]Bekker, A., et al. (2006). *Prec. Res.* [2] Lee, C.T., et al. (2016). *Nat. Geo*. [3] Bindeman, I., et al. (2018). *Nature.*