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A transitory pool of labile organic carbon hosted in global fjords revealed by thermal pyrolytic decomposition analysis

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The organic carbon cycle, together with silicate and pyrite weathering, plays a fundamental role in regulating global climates. Accordingly, qualitative and quantitative estimations of carbon fluxes among multiple carbon pools are necessary for an accurate understanding of carbon-climate feedback. The global ocean, as the largest active carbon pool on Earth, has been the foci of carbon burial and transformation. Particularly, hotspots of carbon burial and oxidation have attracted disproportional attention over past decades.

Numerous studies have reinforced the notion that fjords are hotspots for carbon burial. With an estimated OC burial of 18 Tg yr^{-1}, fjords may host 11-12% of total OC buried in the global ocean over 10^4-yr time scales. Owing to the unique glacier carving nature of fjords, OC buried in fjords during interglacial periods, once being exposed to atmospheric O_2 during glacial-deglacial remobilization, is prone to decomposition, which overall contributes to glacial-interglacial CO_2 fluctuations. While it has been verified that fjords are sites of tremendous OC burial, little is known about the liability of this OC pool, making the fjords' glacial-interglacial carbon cycle hypothesis unverified.

In this study, we adopted thermal pyrolytic decomposition analysis to assess the thermal reactivity of sedimentary OC in fjords, which is further transformed as the OC lability. Our results demonstrate that OC in fjords shows a wide range of lability, which is possibly attributed to contrasting carbon sources and variable levels of mineral protection. Overall, a substantial proportion of OC buried in fjords is highly labile, which can be easily degraded once being exposed to atmospheric O_2. Our quantitative estimates indicate that fjords play a considerable role in contributing to glacial-interglacial atmospheric CO_2 fluctuations.