Box1: Organic Carbon Burial

Traditionally, burial refers to the transfer of carbon from the fast-cycling surface reservoirs to the slow-cycling geological pool (e.g., ref. [39]). The sediment depths or age horizon at which this transfer is considered complete is usually defined as the point where the vertical gradient in organic carbon (OC) concentration approaches zero (i.e., $\delta OC/\delta z \rightarrow 0$). However, this reference framework is not applied consistently. In the literature, burial fluxes are frequently reported for arbitrary or unspecified reference depths, chosen largely for pragmatic reasons, and ranging from the sediment-water interface to tens of meters below the seafloor. This inconsistency is critical because policy documents often misleadingly equate burial with permanent sequestration or storage. Moreover, in the context of accelerating climate change, ncreasing anthropogenic disturbance, and emerging carbon capture technologies, sediment depth is not necessarily the most relevant reference frame. Scientists and policymakers are often more interested in the fate and storage of carbon over specific timescales rather than depth horizons. Poorly defined burial fluxes reported for arbitrary reference horizons can therefore lead to flawed interpretations, incorrect global carbon budget estimates, and poor policy decisions.

Here, we report total OC burial fluxes, burial flux densities, and OC transfer efficiencies (TE, as defined in ref. [15]) through three global sediment horizons defined by equal burial age (i.e., corresponding to variable sediment depths). We report these estimates both globally and for specific regions. The selected time horizons reflect their relevance to both the global carbon cycle community and policymakers and are: 1) the 100-year horizon, relevant for coastal management because Global Warming Potentials in IPCC reports, and thus carbon offset credit mechanisms, are commonly reported on this timescale; 2) the 1000-year (1 kyr) horizon, relevant for carbon dioxide removal sustainability because it reflects the timescale required to neutralize residual fossil CO_2 emissions under net zero emission scenarios[52]; and 3) the 5-kyr horizon, representing a meaningful timescale for quantifying geological OC burial on continental margins, as it corresponds to the stabilization of global sea level and the establishment of modern continental margin extent.

Inorganic carbon released during the degradation of OC within the sediment layers defined by these time horizons can exchange with the overlying water column on annual (100-year horizon), decadal (1-kyr horizon), or centennial (5-kyr horizon) timescales, depending on the depth of release and local sediment characteristics. It is also important to recognize that the reported burial fluxes integrate both natural (i.e. pre-industrial) fluxes and recent anthropogenic perturbations. Due to sediment mixing by benthic fauna, the temporal resolution of coastal sediment records is generally insufficient to separate these signals. However, anthropogenic impacts on OC burial likely became significant only in recent decades, with both enhancing and reducing effects that may partially offset one another. We therefore consider the fluxes reported here to be broadly representative of natural Holocene conditions.

Additional SI References

52. Brunner, C., Hausfather, Z., & Knutti, R. (2024). Durability of carbon dioxide removal is critical for Paris climate goals. Communications Earth & Environment, 5(1), 645.