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Rolling in the Deep: Tectonically-triggered sediment and carbon export to the Hadal zone

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The origin, nature and past variability of sediments accumulating in the abyssal ocean is a topic that has garnered the attention of many geoscientists. Sediment deposits in deep ocean trenches, one important type of hadal environment located in tectonically-active regions, hold great potential for understanding large-scale sediment remobilization and translocation processes triggered by major earthquakes, and for documenting the past history and frequency of such events. Establishing the chronostratigraphic framework for hadal zone sedimentary records constitutes a long-standing issue as they are deposited below the Calcite Compensation Depth (CCD), resulting in an absence of dateable (i.e. carbonate biominerals), thereby confounding traditional ^{14}C dating methods. This is one of the most critical challenges that must be overcome in order to constrain the provenance and frequency of specific event deposits, and to link them to specific earthquakes.

In this study, we present results from detailed radiocarbon-based investigation of the organic matter in a sediment core retrieved from the Japan Trench ($>$ 7.5 km water depth), proximal to the giant Tohoku-oki earthquake and ensuing tsunami of 2011. Construction of a high temporal resolution bulk organic carbon (OC) ^{14}C record reveals that sedimentation in the Japan Trench is interrupted by episodic deposition of sediments characterized by pre-aged OC. These sedimentary layers coincide with intervals that have been attributed to past, historically-recorded earthquakes. Moreover, we describe further ^{14}C measurements on specific thermally-resolved organic matter fractions from ramped pyrolysis-oxidation of a subset of sediment samples that yield new chronological constraints in the context of past earthquake history in the Japan Trench.

Our observations suggest translocation and burial of significant quantities of pre-aged organic carbon in the hadal environment, shedding new light on the nature and dynamics of carbon supply to hadal zone, with important implications for the identification of gravity flow events triggered by non-known tectonic activity in the Japan Trench sediments, and potentially in other hadal zone sedimentary sequences lying below the CCD where lacking abundant microfossils for conventional radiocarbon dating and isotope stratigraphy.