**Dating deep-sea sediments with **\(^{230}\text{Th}\)-excess**

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We present a dating method for deep-sea sediments that is independent from the presence of microfossils, carbonates or ash layers. In analogy to the constant-rate-of-supply (CRS) model for excess \(^{210}\text{Pb}\), we use the natural radionuclide \(^{230}\text{Th}\) (half-life 75,380 years) as an absolute age marker. Using a sediment core from the Western Indian Sector of the Southern Ocean (PS63/146-2), we evaluate how a set of values of \(^{230}\text{Th}\), \(^{232}\text{Th}\) and U isotopes concentrations can be used to derive age information for the last ~450,000 years for a continuously deposited sediment if the precision, resolution and depth/age coverage of the analytical data is sufficient.

We also assess the age uncertainties resulting from analytical errors using a Monte-Carlo approach as well as an analytical solution for error propagation. These methods show good agreement. In addition, we evaluate deviations due to a violation of model assumptions, e.g. by variable focusing of deep-sea sediments, using a simulated core. The results show that the sensitivity of dates to these effects is quantifiable, and smallest in the central part of the record. The obtained ages also allow calculating \(^{230}\text{Th}\)-normalized preserved vertical rain rates of various sedimentary compounds.

Our example for a \(^{230}\text{Th}\) CRS dated record of lithogenic fluxes in the Southern Ocean agrees exceptionally well with the timing of the completely independent global oxygen isotope record of foraminifera in marine sediments. \(^{230}\text{Th}\)-ex-CRS-dating therefore adds an important tool for dating marine records irrespective of their composition, and for quantifying elemental fluxes in a broad range of deep-sea sediments.