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ScienTissiME: A software package combining gamma spectrum analysis and age dating (e.g., 210-Pb, 137-Cs, 241-Am) of recent sediments

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Age dating of recent (~ ≤200 yrs.) sedimentary deposits is of general interest for reconstructions of e.g., past environmental changes. Lead-210 (^{210}Pb, $t_{1/2}$ = 22.3 yrs) combined with independent time markers (e.g., Cs-137, Am-241) has proven to be a powerful technique, requiring analyses of multiple sediment samples via gamma spectrometry followed by applications of a variety of different ^{210}Pb age-dating models. This entire analysis procedure is, however, time consuming and error prone, unless an efficient processing software is available.

Here, we present the software solution ScienTissiME to this data processing task. It is entirely based on graphical user interfaces and employs a tool-flow control panel, which allows the user to interactively build entire data analysis projects as execution sequences of individual tools (Fig.1). These tool sequences compromise calculations of sediment physical properties, evaluation of gamma spectra, identification and quantification of isotopes, as well as down-core activity profiles (Fig.2). Alternative sequences can be built for the purpose of detector efficiency calibration and background evaluation. All tool sequences can then be run interactively, step-by-step, or fully automated, and all tool outputs, in graphical or tabular form, are stored in a variety of file formats (e.g., pdf, png, csv, xlsx).

The DATE tool (shown at the end of the workflow control panel in Fig.1) offers simultaneous evaluation of up to four different dating models (CFCS, CRS, CIC, time marker peaks) with optional overlay of results in both viewgraphs and tables for easy comparison (e.g., chronologies, sedimentation rates, model fit results, 210-Pb inventories and fluxes). There are various user-selectable options for fine-tuning these dating models (e.g., initial and supported concentrations, equilibrium depth, Binford's rule, inventory tail fitting, multiple reference points).

The capability of ScienTissiME is demonstrated with a full analysis sequence and final chronology results for sediment core AL2114 3-2, retrieved from Kiel Fjord from the Southwest Baltic Sea in Northern Germany. We will specifically show in detail the various parameterization and output options of the tools depicted in Fig.1 for this dataset. Further software development will also implement a tool that deals with sediment mixing effects.

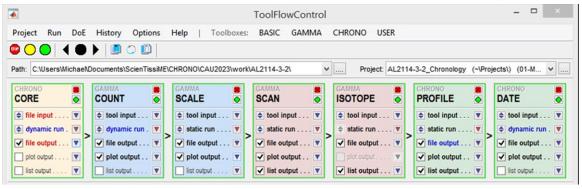

Fig.1: ScienTissiME's Tool-Flow Control panel featuring a sequence of tools optimized for the end-to-end analysis of multiple samples from a sediment core.

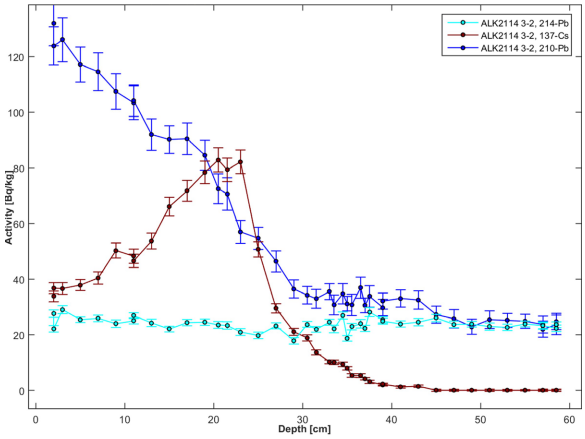

Fig.2: Isotope activity down-core profiles (210-Pb, 214-Pb, 137-Cs) for sediment core AL2114 3-2, retrieved from Kiel Fjord from the Southwest Baltic Sea in Northern Germany.