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A new method for linking independently dated sediment archives based on proxy records

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Robust chronologies are essential when studying sediment records for reconstructing past environmental conditions. The reliability of inter-record correlations and identification of leads and lags with distant climate archives depends heavily on achieving accurate age depth models with minimal uncertainties. An obvious way to achieve such chronologies is to increase the amount of dated samples, but this is often a very costly approach. In this study we present a new method for combining independently dated sediment records from the same area that overlap in age range based on high resolution proxy data such as XRF core scans using a Monte-Carlo algorithm. With a multi-proxy approach and taking into account differences in sedimentation rates we cross correlate sediment cores from the same locality into one master core. From the master core we construct one age model containing chronological information from all correlated cores. Our novel approach is here applied to marine sediment cores from a bay in southern Newfoundland. Gravity cores AI07-10G, 12G and 14G are each approximately 5 m long and were all taken from within 50 km from each other in Placentia Bay between 200 and 300 m water depth. Each of the three cores was independently dated using radiocarbon measurements on molluscs and foraminifera. The individual chronologies indicate that all three cores span different age intervals ranging from the late glacial up to present day, but also overlap with each other for a couple of thousand years. Elemental compositions of calcium, strontium and bromine from XRF analyses as well as RGB values derived from high quality photographs served as the basis for the correlation algorithm. With only minimal input of prior information such as reasonable limits for the age offset between cores and stretching coefficients, reproducible results were obtained that link all three cores together on a common depth scale. The new master record combines chronological information from all three original age depth models which leads to reduced uncertainties in the final age model and allows representation of the measured proxies on a single age scale encompassing the last 13,000 years.