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Detection of possible errors in varve counting and ^{14}C ages by use of the FENNOSTACK Holocene palaeomagnetic secular variation master curve

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Chronologies based on annual increments, such as tree-rings, varves and annual layers in ice cores, require validation using independent methods. In the absence of annual layers, radiocarbon dating is most often used to date lake sediments that are expected to be older than a few hundred years. In this presentation, we use a palaeomagnetic secular variation master (PSV) curve based on six independent varve chronologies, tephrochronology and radiocarbon dating of terrestrial macrofossils to detect potential errors in varve counts and bulk sediment derived ^{14}C ages from Holocene lake sediments in west central Sweden (lake Kälksjön). The varved sediments in Kälksjön contain a stable single component natural remanent magnetisation, which was measured on discrete samples taken from multiple fixed-piston cores. We transferred the ages from the PSV master curve (FENNOSTACK - Snowball et al. 2007) to recognisable inclination and declination features in the Kälksjön palaeomagnetic record. The comparison with ages derived from FENNOSTACK shows that there is no significant difference between the number of varves counted in Kälksjön and the number of years between PSV features dated to between 2500 and 8000 cal years BP in FENNOSTACK. This agreement implies that the significant errors in varve counting are in sediments lying outside this range. We conclude that approximately 400 years are missing from the younger part ($<$2500 cal BP) of the Kälksjön varve chronology and those laminations older than about 8000 years consist of multiple layers per year, which probably caused an overestimation in the number of varves in the early Holocene. A similar comparison between the PSV determined ages and calibrated bulk radiocarbon

ages suggests that the sediments of mid-Holocene age contain substantial amounts of old carbon, probably of soil origin. This older carbon causes calibrated ^{14}C ages to be about 500 years older than the PSV derived ages, and up to 1000 years older than the original varve count. This study highlights the application of a palaeomagnetic secular variation master curve and the importance of testing incremental chronologies with more than one independent method.