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Compositional classification and sedimentological interpretation of the laminated lacustrine sediments at Baumkrichen (Western Austria) using XRF core scanning data

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The outcrop at Baumkirchen (Austria) encloses part of a unique sequence of laminated lacustrine sediments deposited during the last glacial cycle. A ∼250m long composite sediment record recovered at this location now continuously covers the periods ∼33 to ∼45 ka BP (MIS 3) and ∼59 to ∼73 ka BP (MIS 4), which are separated by a hiatus. The well-laminated (mm-cm scale) and almost entirely clastic sediments reveal alternations of clayey silt and medium silt to very-fine sand layers. Although radiocarbon and optically stimulated luminescence (OSL) dating provide a robust chronology, accurate dating of the sediment laminations appears to be problematic due to very high sedimentation rates (3-8 cm/yr). X-ray fluorescence (XRF) core scanning provided a detailed ∼150m long record of compositional changes of the sediments at Baumkirchen. Changes in the sediments are subtle and classification into different facies based on individual elements is therefore subjective. We applied a statistically robust clustering analysis to provide an objective compositional classification without prior knowledge, based on XRF measurements for 15 analysed elements (all those with an acceptable signal-noise ratio: Zr, Sr, Ca, Mn, Cu, Zn, Rb, Ni, Fe, K, Cr, V, Si, Ba, T). The clustering analysis indicates a distinct compositional change between sediments deposited below and above the stratigraphic hiatus, but also differentiates between individual different laminae. Preliminary results suggest variations in the sequence are largely controlled by the relative occurrence of different kinds of sediment represented by different clusters. Three clusters identify well-laminated sediments, visually similar in appearance, each dominated by an anti-correlation between Ca and one or more of the detrital elements K, Zr, Ti, Si and Fe. Two of these clusters occur throughout the entire sequence, one frequently and the other restricted to short sections, while the third occurs almost exclusively below the hiatus, indicating a geochemically distinct component that possibly represents a specific sediment source. In a similar manner, three other clusters identify event layers with different compositions of which two occur exclusively above the hiatus and one exclusively below. The variations in the occurrence of these clusters revealing distinct event layers suggest variations in dominant sediment source both above and below the hiatus and within the section above it. More detailed comparisons between compositional variations of the individual clusters obtained from biplots and microscopic observations on thin sections, grain-size analyses, and mineralogical analyses are needed to further differentiate between sediment sources and transport mechanisms.