The Weissensee – A natural carbonate mineral factory

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Freshwater lake settings can be used to follow the effects of climate change, like the increasing atmospheric temperature and CO_2 concentration. For instance, acidification of freshwater is challenging for many aquatic organisms and thus crucial for intact ecosystems. In order to evaluate the climate impact on a well-defined Austrian alpine region, the Weissensee freshwater lake in Carinthia (929 m a.s.l.) was selected for a site investigation and time series analysis to record and asses (i) seasonal hydrological and hydrochemical variations, (ii) potential long-term trends, (iii) mineralogical, chemical composition, and microstructures of modern sediments and (iv) seasonal distribution of stable hydrogen and oxygen isotopes of the water. The data set of the lake water indicates seasonal and site-specific effects whereas the long-term data reveal a significant trend of increasing surface water temperature in autumn and winter as well as rising concentrations of Na^+, Mg^{2+}, and Ca^{2+} ions within the last three decades. In contrast, no evidence regarding freshwater acidification due to elevated atmospheric CO_2 concentrations could be found. The modern Weissensee sediment mainly consists of the minerals calcite (low Mg-calcite) and dolomite with spatial differences from 1 to 96 wt.-%, which is caused by variable input of locally precipitated calcite and suspended dolomite from the catchment area. The authigenic lacustrine calcite is of particular interest, as constituting an important CO_2 sink. The nano- to microcrystalline calcite crystals in the Weissensee sediment are surrounded by extracellular polymeric substances, thus classified as lacustrine microbialites with substantial organomineralization. In some cases, a low percentage of aragonite, as a third carbonate mineral, hints towards its precipitation from the water column in early summer.