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Geochemical and vegetational changes during the postglacial: Sediment record from a glacial cirque lake in the Northern Black Forest (SW Germany)

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To evaluate long-term interactions between soils, vegetation, and anthropogenic land-use changes from a small mountainous catchment (27.2 ha) in SW Germany we used palynological and fractionated chemical analyses of Holocene lake sediment cores.

The dystrophic Lake Herrenwies (1.8 ha; max. depth 9.5 m) lies at 832 m asl and is situated in the Triassic Bunter sandstone (base-poor, quarz-rich). Today, the catchment is totally forested with mostly Norway spruce (Picea abies L.). Soils (Podsol, Histosol, Stagnosol) are highly acidic. A short core (45cm) and a long core (675cm) were taken from the centre of the lake. The longitudinally sliced wet cores were divided in subsamples of 1 cm (short core) and 2 cm (long-core) thickness. 1 cm^3 subsamples were take for pollen analysis and processed as described by RÖSCH (2009).

For chemical analysis the samples were freeze-dried and homogenized. We applied a 3-step extraction modified according to ENGSTROM and WRIGHT (1984). Samples were sequentially extracted/digested with hydrogen peroxide (1-authigenic fraction), sodium hydroxide (2-biogenic silica fraction), and fluoric acid (3-allogenic fraction). In those fractions elements Si, Al, Ca, K, Mg, Fe, Mn, and S were analyzed using inductively coupled plasma atomic emission spectrometry. Furthermore, total concentrations of C and N were analyzed. The cores were dated using 137Cs, 210Pb, and 14C.

The first results show a decrease of recent high C-org concentration of 23% with the depth and strong variability between 400 and 200 cm (Atlantic period).

Concentrations of allogenic Al, Fe, K, and Si show three peaks between 400 and 100 BP. The signals could be interpreted as erosion events following forest grazing, logging activities, and forest road construction. In those recent centuries man-made expansion of Norway spruce took place which is clearly reflected in the pollen profiles.

An increasing productivity of Lake Herrenwies during the Holocene, is reflected by increasing biogenic silica accumulation rates. However, after 1600 AD a decrease in BSi occurs which goes along with higher C-org. concentrations. This might be interpreted as the combined effect of spruce expansion and related soil acidification (podsolization).

This acidification can be detected with several element rations of the allogenic fraction (e.g. Na:Si, Ca:Si; Mg:Si) as indicators. The observed soil acidification (podsolization) resulting from a changed land-use cannot be clearly separated from more modern process of soil acidification resulting from atmospheric deposition.

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References:

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