TEMPORAL AND ELEVATIONAL PATTERNS IN $\delta^{34}S$ VALUES OF DIFFERENT TYPES OF ATMOSPHERIC DEPOSITION IN THE JEZEŘÍ CATCHMENT, CZECH REPUBLIC

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In 1994 and 1995 stable isotope composition of bulk and throughfall sulphur was measured at 17 locations within the forested catchment Jezeří, Northern Czech Republic (50° 33' N, 13° 30' E, 2.61 km^2, 475–925 m a. s. l.). The catchment is situated on a steep south-eastern slope of the Krušné hory Mts., close to open pit coal mines and sources of sulphur emission. The catchment was characterized by a high sulphur load (up to 126 kg ha^{-1} $year^{-1}$ in spruce stands) and a 309 mm annual precipitation gradient over an elevation span of 446 m.

Isotopic composition of S sources is characterized by values of about +2 ‰ for local dry-deposited SO_2, +5 to +6 ‰ for SO_2 of external sources and up to +9 ‰ for long-range transport sulphates, respectively.

Samples of bulk precipitation, deciduous throughfall and spruce throughfall were collected monthly at several different altitudes and the $\delta^{34}S$ isotope ratio was measured on composite, volume weighted samples for every two consecutive months at each altitude.

The mean annual values of $\delta^{34}S$ were +5.6 ‰ for bulk precipitation, +5.2 ‰ for deciduous (mostly beech) throughfall and +4.2 ‰ for spruce throughfall. This reflects a larger amount of low-$\delta^{34}S$ dry-deposited SO_2 intercepted in spruce canopy throughfall than in beech canopy throughfall, due to smaller leaf surface area of deciduous trees compared to spruce needles. During the whole year $\delta^{34}S$ decreased in the order: $\delta^{34}S_{bulk} > \delta^{34}S_{deciduous\ throughfall} > \delta^{34}S_{spruce\ throughfall}$, with the only exception in early summer, when this order was reversed. No distinct elevational pattern in S isotopic composition was observed for bulk precipitation samples. Deciduous throughfall samples exhibited a rather constant S isotopic composition (ca. +5 ‰) along the elevational gradient. Spruce throughfall $\delta^{34}S$ values exhibited a complex elevational pattern, which however remained stable throughout the sampling period, with the exception of June and July. Spruce throughfall $\delta^{34}S$ decreased with increasing altitude with an exception of the elevation of 832 m (young vigorous spruce stand) where $\delta^{34}S$ were as high as 5.8 ‰.

Differences in S isotopic composition between bulk precipitation and throughfall were intensively studied in 1994 at the sampling site Červená jama inside the Jezeří catchment as part of a long-term $\delta^{34}S$ monitoring. This sampling site is situated in the upper part of the catchment, where the forest is heavily damaged. In 1994 the mean $\delta^{34}S$ here were significantly higher for both bulk and throughfall samples than in 1995. $\delta^{34}S$ were + 7.6 ‰ and +5.6 ‰ for the bulk deposition, + 7.1 ‰ and +5.2 ‰ for deciduous throughfall + 5.4 ‰ and +4.2 and for spruce throughfall in 1994 and 1995, respectively. Both in 1994 and 1995 the values of S isotopic ratio decreased in the order: $\delta^{34}S_{bulk} > \delta^{34}S_{deciduous\ throughfall} > \delta^{34}S_{spruce\ throughfall}$. The between-year negative shift by about 2 ‰ observed in bulk precipitation was mirrored in a shift of the same magnitude in the deciduous throughfall. For spruce throughfall a negative shift by only 1.2 ‰ was observed, which might be caused by a smaller amount of dry-deposited SO_2 washed out in the year 1995 relative to 1994.

For all three types of deposition at Červená jama the seasonal trends in S isotopic composition were similar in 1994 and 1995. The $\delta^{34}S$ of bulk deposition were lower in spring and summer months compared to the rest of the year. An opposite trend with lower $\delta^{34}S$ values in autumn and winter months compared to the rest of the year was observed in both types of throughfall precipitation. This might have been caused by an increased ratio of local to external SO_2 in autumn and winter.

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