

## ATMOSPHERIC POLLUTION BY BISMUTH, ANTIMONY AND LEAD SINCE THE BRONZE AGE IN CENTRAL EUROPEAN LAKE CORES DATED BY $^{210}\text{Pb}$ AND $^{14}\text{C}$

J. VESELÝ

*Czech Geological Survey, Geologická 6, 152 00 Prague 5, Czech Republic*

Sediment cores (0.8–1.3 m) from four Bohemian lakes, Bohemian Forest Mts., SW Czech Republic and the Popradské Lake, High Tatra Mts., Slovakia were analyzed for trace elements by FAAS and HGAAS. The  $^{210}\text{Pb}$  and  $^{14}\text{C}$  datings produced a reliable chronology of the cores. Stratigraphic profiles of Zn, Cd, Cu, Sn, Hg and in some cores also Ag, Co, Be and V showed increases by pollution for at least the last 100 years but usually for several centuries BP. No pollution by these elements was detected in deeper segments of the cores (Bronze Age, Roman times); in the case of Sn and Ag this could be caused by insufficient resolution of the analytical method.

In contrast, concentrations of Pb in the Bohemian lakes remained generally above natural concentrations since 3,000 BP onwards (Fig. 1). Stratigraphic profiles of Pb, Bi, Sb and As are characterized by several maxima and minima (especially during the last 500 years) and are unlike any previously reported profiles. These concentration maxima resulted from regional pollution by metal smelting in the wider surroundings of the lakes. Lead accumulation rate in sediments of the Plešné Lake was double the background value in the Roman times (Fig. 1), about 6 times higher than the natural background in the 16th century AD, and peaked ( $\sim 8 \text{ mg m}^{-2}\text{yr}^{-1}$  Pb; i.e., about 20 times higher than the background) at the beginning of the 20th century, at the time of the highest Pb and Ag production in the Příbram mining district.

The Popradské Lake is situated about 500 km east of the Bohemian lakes and concentrations of Pb, Bi and Sb in the sediments increased exponentially during the last millenium. Surprisingly, in older core segments, another long-term pollution by Bi, Sb, and Pb was observed in the Popradské Lake sediments, in the case of Bi with rates comparable with those in modern times (Fig. 2). This, again, must be a result of metal smelting since metals exhaled by volcanos should be detected simultaneously in all lakes in the area. This oldest known pollution by Bi and Sb, and possibly the oldest known atmospheric pollution world-wide, began in the Bronze Age.

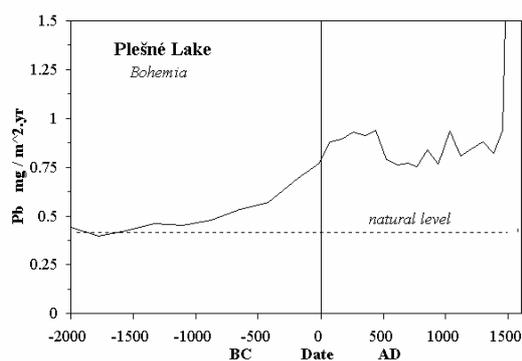


Fig. 1: Accumulation rate of Pb in sediments of the Plešné Lake between 2000 BC and 1600 AD

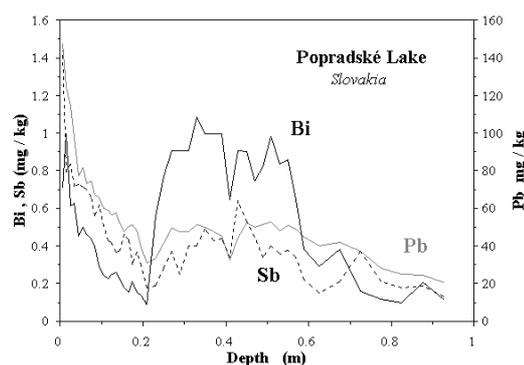


Fig. 2: Changes of Bi, Sb and Pb concentrations in sediments of the Popradské Lake