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Lead concentrations and isotopic compositions in a paleosoil buried under an Iron-Age kurgan in the Lower Volga region of Russia, and comparison to modern soils.

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The aim of this study was to evaluate the level of modern anthropogenic contamination of soils with lead by using concentrations and isotopic ratios of lead in buried paleosoils as background. Concentrations and isotopic composition of Pb in both total and acid-extractable (0.5N HNO_3) forms were determined at three sites: in a paleosoil buried beneath a Sarmatian kurgan from around the 1st century AD, in a modern “reference” soil, and in presumably polluted roadside soils, all Chestnut soils in the dry steppe region of Lower Volga, Russia (v. Peregruznoe, Volgograd region, 47°53’22.7"N, 44°00’46.7"E).

The potential of a kurgan (burial mound) to protect the underlying soil from lead deposited during the two millennia since construction was assessed by profile analyses of 210Pb. Among all soil profile samples, only the surface horizon (0-10 cm) of uncovered modern soils contained detectable amounts of unsupported 210Pb (of which most originates from atmospheric deposition during the past century). This suggests slow vertical migration and probably insignificant input of anthropogenic Pb to a buried soil starting at 1 m depth.

Highest concentrations and the least radiogenic isotopic signature of Pb in both total and acid-extractable forms were found in the upper (0-10cm) layer of the roadside soils (within 10 m from the road), suggesting a local influence of leaded gasoline. On the other hand, when comparing buried and modern “reference” soils, no statistically significant difference was found for the total Pb concentrations along the whole soil profile. However, in the upper horizons of the modern soil, the acid-extractable portion in the total Pb pool was about twofold compared to paleosoil, and the apparent Pb accumulation on carbonates (Pb/Ca ratio in the acid-extractable fraction) was threefold, whereas the values at depth were similar in both cases.

The isotopic composition of Pb in the modern "reference" soil profile was slightly shifted from the buried soil towards the less radiogenic values found in roadside soils, both in total and in acid-extractable fractions. This shift of isotopic ratios in combination with an increased portion of acid-extractable Pb in the modern soils may reflect a mixing of geogenic Pb, inherited from the parent rock, with modern mobile gasoline-derived Pb with a less radiogenic isotopic signature.

Thus, an anthropogenic influence in the modern "reference" soil could be detected in the acid-extractable fraction of lead, but was practically undetectable in terms of concentrations of total lead. Only modern roadside soils showed a clear influence in terms of both concentration and isotopic composition, at least within 10 m from the motorway.