

The stable isotopic and chemical composition of pedogenic carbonate in the Minusinsk Basin, South Siberia

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Stable isotope composition of carbonate neof ormations can be used as a proxy for the reconstruct ions of environmental conditions of the past. Carbonate coatings on coarse rock fragments are studied in order to indicate the climatic conditions and predominant vegetation under which they were formed. Such coatings commonly occur in different types of soils and paleosols of South Siberian intermountain basins mainly in relatively dry modern conditions. The purpose of the research is to characterize the isotopic composition and chemical composition of carbonate pedofeatures in soils of Minusink Hollow and estimate its correlation with different factors. The samples of pedogenic carbonates, vegetation, carbonate parent material, soil water and precipitation water were analyzed using the Delta-V mass spectrometer with options of a gas bench and element analyser. The soils we studied are mainly Kastanozems that are poorly moisturized; therefore, soil pore water was extracted by ethanol. Minor and major elements content was also measured by ICP-MS. Carbonates mostly contain calcium (37-45%) and highly enriched in Pb, Tl and Ba. Oxygen and carbon isotopic composition of pedogenic carbonates was analyzed in 3 key sites. Kazanovka Khakass state national reserve, Hankul salt lake, region of Sayanogorsk aluminum smelter. Vegetation photosynthetic pathway in the region is mainly C3. $\delta^{18}\text{O}$ values of carbonate coatings in soils of Kazanovka vary in a range from -7.49 to -10.5‰ (vs V-PDB). The lowest values corresponds the coatings found between two buried mid-Holocene soil horizons. That may indicate cooler conditions of late Holocene than nowadays. In Sayanogorsk carbonates' $\delta^{18}\text{O}$ values' range is -8.3‰ to -11.1‰ and near the Hankul Lake is -9.0‰ to -10.2‰ all ranges are quite similar and may indicate close conditions of pedogenesis formation. $\delta^{13}\text{C}$ values of carbonate coatings in Kazanovka vary from -2.5 to -6.7‰ the highest values correspond to the soils of Askiz and Syglykug rivers former floodplains. For Sayanogorsk the range is from -4.9 to -6.8‰ and for Hankul from -2.3 to -5.7‰ where the highest value is for the modern salt crust. $\delta^{13}\text{C}$ values of coatings decrease from inner (older) to outer (younger) layers of coatings, that can indicate differences connected with the diffusion of organic material. Carbonate parent material $\delta^{18}\text{O}$ value in the region vary from -11.1 to -12.0‰ and $\delta^{13}\text{C}$ values vary from -4.9 to -5.7‰ . Soil pore water $\delta^{18}\text{O}$ values that determine the oxygen isotope composition of carbonates vary due to the processes of transpiration and mixing in the studied sites in a wide range of -2.0‰ to -3.5‰ (vs V-SMOW). Precipitation waters show $\delta^{18}\text{O}$ values from -6.6‰ (spring) to -19.0‰ (winter snow). The main conclusions are as follows: pedogenic carbonates $\delta^{13}\text{C}$ values (-7‰ to -2.5‰) show no correlation with modern C3 vegetation $\delta^{13}\text{C}$ values but are closer to C4 vegetation. Late Holocene climate for the Minusinsk Hollow according to obtained data on isotope composition of carbonates and soil pore water chemical composition was dryer and cooler than present, that fact does not contradict with paleocarpology data obtained for the region. The research was supported by Russian Science Foundation (grant №14-27-00083).
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