

The Stable Isotopic Composition of Pedogenic Carbonate in the Minusinsk Basin, South Siberia

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Abstract : Carbonate minerals' isotopic composition is widely used as a proxy for environmental parameters of the past. Pedogenic carbonate coatings on lower surfaces of coarse rock fragments are studied in order to indicate the climatic conditions and predominant vegetation under which they were formed. The purpose of the research is to characterize the isotopic composition of carbonate pedofeatures in soils of Minusink Hollow and estimate its correlation with isotopic composition of soil pore water, precipitation, vegetation and parent material. 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. 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), and the smallest value -13.9‰ corresponds the coatings found between two buried soil horizons which ^{14}C dates are 4.6 and 5.2 kyr BP. That may indicate cooler conditions of late Holocene than nowadays. In Sayanogorsk carbonates' $\delta^{18}\text{O}$ range is from -8.3 to -11.1‰ and near the Hankul Lake is from -9.0 to -10.2‰ all ranges are quite similar and may indicate coatings' uniform formation conditions. $\delta^{13}\text{C}$ 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 strongly 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 -13.5‰ (vs V-SMOW). Precipitation waters show $\delta^{18}\text{O}$ values from -6.6‰ in May and -19.0‰ in January (snow) due to the temperature difference. The main conclusions are as follows: pedogenic carbonates $\delta^{13}\text{C}$ values (-7‰ ... -2.5‰) show no correlation with modern C3 vegetation $\delta^{13}\text{C}$ values (-30‰ ... -26‰), expected values under such vegetation are (-19‰ ... -15‰) 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 does not contradict with paleocarpology data obtained for the region. The research was supported by Russian Science Foundation (grant №14-27-00083).

Keywords : carbon, oxygen, pedogenic carbonates, South Siberia, stable isotopes

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