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Changes in carbonate state and other properties of fallow soils in the forest-steppe and steppe zones of Russia

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In the forest-steppe and steppe zones of Russia, soils are subject to prolonged agricultural impact which affected their properties and processes. Therefore, the study of soil transformation under different land-use regimes is an urgent task. The aim of the study is to examine the general patterns of changes in the carbonate state and other properties of soils of the steppe and forest-steppe in Russia of land-use changes from arable to abandoned land (fallow).

The objects of research are chronosequences of fallow Chernozems and Phaeozems. The first chronosequence is located in the Belgorod region, Russian Federation. It consists of a virgin, arable Phaeozems, and Phaeozems being in the fallow for 40-45 years. The second chronosequence is located in the Rostov region. It consists of arable Chernozem and abandoned during 14, 20, 30, and 86 years Chernozems. The third chronosequence is located in the Lipetsk region. It consists of arable Chernozems and abandoned during 15, 25 years Chernozems. The fourth chronosequence is located in the Kursk region. It consists of a virgin, arable Chernozems and abandoned during 10, 25, and 50 years Chernozems.

It is noted that all soils in the abandoned land tend to restore virgin properties. Restoration of vegetation and water regime plays the main role in the acquisition of natural soil properties. For 25-30 years, the structural state is restored in Chernozems and Phaeozems. Overconsolidation of the subsurface horizon disappears in Chernozems in 10-15 years, and in Phaeozems it persists up to 40 years. The restoration of the organic carbon in Chernozems and Phaeozems proceeds in different ways. If in Chernozems, in general, there is an increase in the content and reserves of organic carbon, then in Phaeozems, in the opposite, their decrease is observed. In the transition from arable to fallow soils, there is a decrease in the content and reserves of carbonate carbon due to a change in the water regime: the intensity of the ascending water flows decreases and descending - increases.

In fallow soils, the radiocarbon age of pedogenic carbonates decreases. In arable land "ancient" carbonates are pulled up closer to the day surface. And when plowing stops, they are gradually washed out into the depth of a profile. The greatest ¹⁴C age of carbonates is observed in fallow soils with large herbaceous vegetation, which sucks the moisture out from the depth with

powerful roots.

The recovery time of the natural soil properties depends on the initial state of the soil, the intensity of the agrogenic impact, the use of soil-saving technologies under plowing, and fertilizers use. In general, Chernozems restore faster than Phaeozems. The carbonate state in all chronosequences acquires the virgin (before plowing) features after about 30 years.