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THUNDERSTORM DISCHARGES AND GENERATION OF 14C ISOTOPE

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Generation of 14C radioisotope in the Earth atmosphere occurs by the 14N(n,p)14C reaction under cosmogenic fluxes and this process is considered as the main source of radiocarbon creation with rate of accumulation is evaluated as ˜ 6.6 kg per year. An exclusively opportunities of dating based on the analysis of 14C concentration in the very old and ancient organic samples led to the discovery of short-term secular variation of radiocarbon in tree rings [1] and to the hypothesis of 14C generation under thunderstorms flashes.

The nature of the lightning phenomena in fact is connected with the development of electron avalanche in the strong atmospheric electric fields (about 300 kV/m and even up to 1000 kV/m) [2]. The very fast electron avalanche growth in the cloud electric fields ensures the phenomenon of terrestrial gamma-ray bursts [2,3]. These energetic gamma-rays generate the photonuclear reactions on atmospheric isotopes (with significant yield for hard photons of energy Eg up to 60 MeV) as 14N(g,n)13N, 16O(gamma,n)15O, 40Ar(gamma,n)39Ar.

An increase of neutron flux causes the next series of (n,gamma), (n,a), (n,p)-reaction and the 14N(n,p)14C is the top important for dating problem. For evaluating of the radiocarbon generation under thunderstorm conditions (and creation of another atmospheric isotopes too) it was proposed the model (realized in the spherical-layer geometry). The calculation were made at the several altitudes of the lower part of the atmosphere at the altitudes from 250 m up to ˜15 km (that allows to cover the possible heights of detected lighting) [4].

Decrease of the atmospheric densities at increase of the altitude is critical for electron avalanche evolution and is included in the model. It was obtained the yield of C14 from thunder discharges evaluated as 0.0001 % relative to cosmogenic one. The results support the hypothesis that radiocarbon rise in the old tree rings (at AD 774–775) [1] can be explained by increased Sun activity of the Sun at this time interval.

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