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Characteristics and origin of organic matter and basal respiration of soils from Majella massif (Central Apennines, Italy)

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The effects of the global climate change on the soil organic matter (SOM) are still open to debate. Many studies hypothesize an increase of the CO2 fluxes from the soil following the rise of air temperature, especially for the high latitude soils where the low temperatures have a protective effect on the SOM, holding the mineralization reactions back. We studied the feedback between soil and climate change in the Mediterranean environments, on patterned ground soils and soils developed from glacial lacustrine sediments found in the high-elevated areas (2500 m a.s.l.) of Majella massif (Central Apennines, Italy). Here, several profiles were opened and the soil described and sampled according to the recognized horizons. The samples were characterised according to the routine analyses and the SOM extracted according to the International Humic Substances Society protocol. The obtained humic and fulvic acids were characterised for elemental composition and by Fourier-transform infrared (FT-IR) spectroscopy. Further, the basal respiration at 5°C, 20°C and 30°C for 20 days was determined on the samples collected from the superficial horizon of each soil.

The extracted humic substances showed a particular composition, being mostly comprised of proteinaceous residues (amides II and III), polysaccarides, and esters and aliphatic compounds. This unusual chemical structure and the paucity of vegetation in the study area could support the hypothesis of a mainly soil animal origin of the SOM, probably due to residues of insects, arachnids and arthropods. In fact, the species belonging to these Orders are abundant in these ecosystems and, further, are often characterised by the presence of compounds, such as glycerine and glycoproteins, in their organic fluids that act as antifreezing systems.

The basal respiration experiments indicated that the soil microbial community was active at 5°C, while at 20°C or 30°C rather no respiration occurred; further, after 20 days at both 20°C and 30°C, the microflora started over its activity if the samples were placed at 5°C. These results suggested that the CO2 fluxes to the atmosphere deriving from the mineralization of SOM following the warming of these areas could be lesser than that produced at lower temperature.

The obtained data indicated that many uncertainties still exist on the feedback between the predicted global warming and the soils of glacial and periglacial environments.