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Recognition of embedded micrometeorites in thin-sections

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The Earth gains roughly 30.000 metric tons on a yearly basis as a result of an influx of largely minute extraterrestrial particles. These particles, ranging in size from 50-500 μm, reflect the debris left over from the early formation of the solar system to tiny particles formed by impacts on heavenly bodies such as the moon or planet Mars. These 'micrometeorites' are often collected and studied on accumulation sites such as ice caps in arctic regions, deep-seafloor sediments, various sedimentary rocks, desert sands and swamps. While every square meter land surface is subjected to a continuous influx of micrometeorites, no micrometeorites have been recognized and reported in soil micromorphological studies. We present an inventory of micrometeorites in samples and thin sections of well dated and studied mormoder humus forms in The Netherlands that aimed in exploring and describing the excellent accumulation environment for such particles in ectorganic horizons.

Meteorological field studies combined with a microscopic inventory of deposited spherules explored the influence of meteorological parameters. Sampling of humus forms in humus boxes (size: 25/25/10 cm; vertical sample interval 1 cm) for extraction of micrometeorites; sampling of humus forms in Kubiena boxes (5/5/10 cm) for the production of thin sections. Extraction of non-decomposed candidate particles from the humus was achieved using the magnetic susceptibility associated with the mineralogical characteristics of meteoritic particles. Particles were visually identified and selected under a polarization microscope based on visual characteristics determined by standing micrometeoritic studies. The exact mineralogical composition of these particles was studied by a cross-section analysis using SEM to identify unique isotope and mineral ratios.

Humid climates with moderate precipitation are shown to have a beneficiary influence on deposition rates. This translates to an increased accumulation of particles in ectorganic horizons on forest floors. Selected sample locations have >100 years of litter deeper into the profile when humus decomposes and compacts. Given the yearly estimated influx, global circulation models and the hypothesised increase in deposition rates for more temperate latitudes, micrometeorites are considered to be a statistically plausible and identifiable constituent in humus and topsoils. The collected particles reflect the combined deposition of man-made and extraterrestrial sources into the environment, hence requiring a more detailed selection to discern their origins. Several particles have been positively identified as micrometeorites based on their morphology and mineralogy. The micromorphological characteristics were cross-matched with thin-sections of the sample sites obtained from earlier field studies. Analyses of these thin-sections show potential particles to visually match the properties of micrometeorites, indicating a previously unknown constituent in the description of humus forms.
In lake deposits and peat bogs are, just vas humus forms, systems where micrometeorites will be sin sedimentary included in the deposits. Stable land surfaces are also subjected to a continuous influx of micrometeorites. Arising research needs resulting from this study identify the relevance of a detailed micromorphological analysis of mineral horizons to understand post sedimentary soil infiltration of the continuous influx of micrometeorites.

Micrometeorites can be extracted from samples of ectorganic horizons and the micromorphology of these particles can be described. In thin sections of mormoder humus forms, embedded micrometeorites can be recognized in the organic soil matrix. This study adds a new class of particles to the existing micromorphological interpretations of particles in humus forms and topsoils.