CLASSIFICATION OF PEAT AND PEATLAND

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Summary

Peat is a peculiar product of waterlogged ground, and peatland is the place where peat accumulates. To date, there are no widely agreed definitions of peat and peatland, because different scholars have adopted different standards.

Peat consists of liquid, gaseous, and solid state matter, and its most important constituent is organic matter. Undecomposed plant debris from dead peat-forming plants, accumulate where they grew, and form peat. There is a certain relation between the compositions of peat and the peat forming plant community, but they are not directly equivalent. The most important part of peat stratigraphic sequences is the peat layer, then the underlying base and the surface layer.

There are many kinds of classifications of peat and peatland, but no widely accepted classification. For peat classification geo-botanical properties are broadly used and applied in classification methods. For peatland classification, there are three methods, which individually focus on the characteristics of peatland strata, geomorphological conditions under which peatland originated and developed, hydrology, and topography. There is inevitably some overlap between these systems.

1. Characteristics of peat and peatland

Peat is a peculiar product of waterlogged ground, and it was formed by the prolonged accumulation of plant debris which did not decompose fully under the anaerobic environment associated with a constantly very high water level. Peatlands are the accumulation places of peat, and peat deposits are the natural layers of peat, in their place of origin.
To date, there is no widely accepted definition of peat. The focus of contention is the minimum content of organic matter in peat. Some experts have expressed the opinion that the content of organic matter in peat must be above 50%, otherwise, it cannot be thought of as peat. Others consider that if the content of organic matter is above 30%, it can be regarded as peat.

Strictly speaking, the content of organic matter in peat must be above 50% because organic matter is the most important component of peat. But during the accumulation, the invasion of extraneous silt often caused the relative reduction of the organic matter content. The terms for peat used in different countries are different: turf in Ireland torf in Germany and Poland, torv in Sweden, turba in Italy and Spain, and veen in Holland, etc.

Definitions of peatland or peat deposits change according to the focus of research, and potential uses. C. A. Weber (a German peat scientist) considered that peatland must have at least a 20 cm peat layer after drainage; E. Granlund (from Sweden) thought that under natural conditions, peatland must have a 40 cm thick layer of peat. In addition to these, the thickness of peat layer set by Austria is 50 cm, Denmark 33 cm, the former Soviet Union (1934) 35 cm, England 60 cm, the Forestry Commission in UK 15 cm, and China 30 cm. The thickness of the peat layer is useful as the criterion for deciding whether an area of land qualifies as peatland because the peat must have a minimum thickness to be exploited as an industrial fuel or resource. Thickness of peat layer also has an important influence on crop cultivation when peatlands are drained and used as farmland. The different standards used for peatland around the world have led to incompatibility in statistics on areas of peatland and reserves of peat.

2. The main components of peat

Under natural conditions, peat is composed of liquid, gaseous, and solid state matter (see Figure 1.)

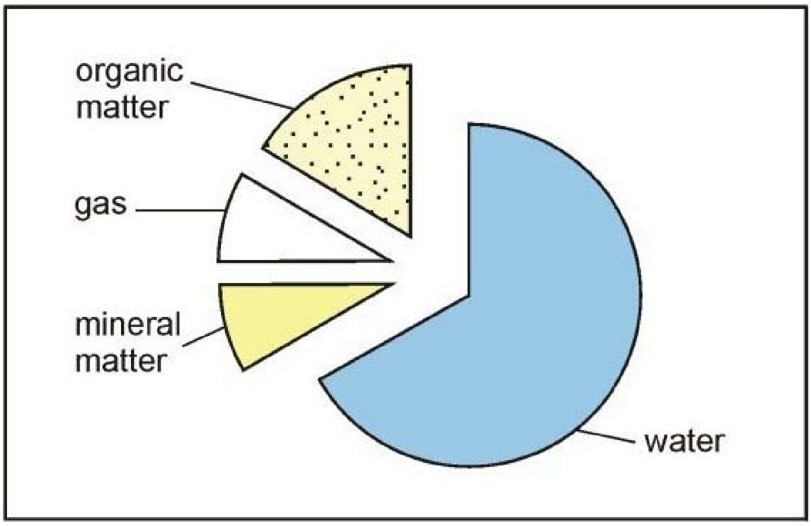

Figure 1. Matter compositions of peat

The water content of peat is high, usually ranging from 50 to 70% by weight, but it can reach as high as 90%. A.V.Duanski classified peat water into four kinds: chemically bound water, physically bound water, permeable bound water, and free water in pore spaces.

The solid component of peat consists of organic matter and mineral matter. Organic matter is the main component of the solid phase of peat, including humus and plant debris which did not decompose fully. Plant debris comprises the main part of organic matter of peat and also the most valuable part; it includes plants' roots, stems, leaves, fruits, seeds, spores, and pollen, etc. Humus, accounting for 20 to 70% of the organic matter of peat, is an organic chemical complex with a complicated structure which arose during the peat-forming process.

The mineral matter of peat may be of two types: material that was carried into peat by running water and wind during the accumulation process, or material that was formed by the decomposition of plant debris. The former is called secondary ash; the latter is called original ash, and their sum is total ash—the total content of mineral matter in peat.

3. Composition of peat-forming plants

Peat is a peculiar organic deposit formed from the incomplete decomposition of debris of dead wetland plants, after lengthy accumulation. Different species of peat-forming plants produce different kinds of peat.

3.1. Relations between compositions of wetland plants and the peat-forming plant community

Not surprisingly, there is a close correlation between the community of plant species growing on a mire and the compositions of species present in the underlying peat. It is not, however, a perfect match. Research has shown various differences in percentage composition between peat and its associated plant community because different species, and different parts of the plants, decompose to different degrees. Those plants most resistant to decomposition became dominant in peat.

Bog plants can be either perennials or annuals, but the former predominate. The cell fiber of the roots, stems and leaves of annual plants is not strong, and cell walls are thin, so annual plant debris decomposes fully every year. Typical annuals growing on peatland include *Stellaria spp.* and *Epilobium palustre*. Among the perennial plants, some species such as *Slum suave*, and *Caltha palustris* decompose readily into humus in a short period, so they are poorly represented in the debris. Peat is mainly composed of the debris of perennial plants with thick cell walls and strong cell fibers, which do not decompose fully in an anaerobic environment. This particularly includes the Ericaceae, Cyperaceae, Graminea, and Sphagnaceae, and the roots, branches, leaves and bark of some other woody species.

Research has shown that ligneous cortical tissue in the debris of wetland plants survives well because it contains matter which is resistant to decomposition, such as cutin, lignin, and suberin. For peat with a low degree of decomposition, the plant debris bears a close quantitative correlation to the bog plant community. While for peat with a high decomposition degree, plant debris has no obvious relation to the bog plant community.

3.2. Plants Debris of Peat

Peat forming plants do not change fully into the plant debris of peat, and some of them eventually decompose fully into humus and become unrecognizable. Even if they formed into the plant debris of peat, the material which remains is different from the original. For example, the debris of *Menyanthes trifoliata* decomposes readily, at a rate of about 75% per year, with only the seeds and partial debris remaining for long in peat. The debris of *Sphagnum palustre* decomposes at a rate of only 5 to 10% per year, and survives well in peat, in a spongy or fibrous state. The fiber of perennial herbs is stronger than that of annual herbs, so only half the debris of perennial herbs decomposes; the remainder is in the form of fiber. Coniferous trees decompose slower than broad leaved trees, so the debris of conifers can be well represented in peat.

The condition of plant debris and peat is also related to the peatland environment. Where there is strong seasonal variation in water supply, the surface is able to dry out for part of the year. This increases aeration, and the temperature is also able to rise. At such times the environment is more beneficial to the activity of aerobic microorganisms, leading to accelerated decomposition of plant debris. With perennially waterlogged conditions, aerobic decomposition only takes place in the uppermost part of the surface, and the temperature is lower Plants decompose very slowly under the action of anaerobic microbes, so the material survives well once it has been buried in an anaerobic layer. The upper layers of a peat bog therefore contain debris from a mixture of plant species, decomposed to different degrees.

Plant debris in peat also undergoes secondary changes. These are primarily caused by the penetration of roots and root-stems into earlier peat layers. For example, the roots and stems of *Phragmites communis* can penetrate deep into peat and develop many branches. This causes secondary changes in the composition of peat. Further changes arise from the penetration of the roots of plants which colonize peat after a fire. These can be species which do not normally take part in the peat-forming process.

4. Peat stratigraphy

Peat stratigraphic sequences are akin to a sedimentary series of peat layers, with each layer being able to provide information on the conditions prevailing at the time of formation. Since the Quaternary period, the embedded history of deposition of peat provides information on local geology, landforms, tectonic movements, and transportation media.

4.1. Structure of peat stratigraphic sequences

The peat layers are the most important part of the stratigraphic sequence; the subsidiary parts are the underlying base, and the surface, or the roof over the peat. For modern peat bogs, the thickness of the peat layer is the vertical distance between the surface and the underlying mineral base; for buried peatlands, it is the vertical distance between the roof and the underlying base. The thickness of a peat layer may change greatly horizontally, and the shapes of peat layer profiles are variable. In depressions, peat profiles usually look like a lens, thick in the middle and thin at the sides. In gullies, the shape may be an irregular lens. On a broad flood plain, the profile usually appears as an asymmetrical lens. In lakes, it usually appears as a fairly even layer. The profile shape mainly depends on the original landform, the hydrological conditions, and the depositing environment during the forming process.

Contact relations between the peat layer and the underlying base are different for different peat forming environments. If peat developed under water, the underlying base is usually of mud; if it developed on land, the underlying base is usually a humic soil. In some areas, there is no clear transitional horizon between the peat layer and the underlying base, as peat developed directly on the clastic matter of the underlying base. In some areas where the sedimentary environment has changed over time, many peat layers may have developed, with mineral deposits, of sand, fine sand, silt, and clay between the layers. The roof of a buried peat deposit is often composed of sand, or silt, as either sand was blown over the peatland during a very dry period or it was inundated by a flood which deposited sediment over the bog vegetation, thus interrupting the process of peat formation.

4.2. Bedding of Peat Stratigraphic Sequences

Horizontal, diagonal and wavy beddings are commonly found in peat stratigraphic sequences. These were determined by hydrological conditions when the material was laid down. Peat that accumulated in a still water environment forms horizontal bedding. Diagonal bedding only occurs on a waterlogged slope, probably with emerging groundwater. Wavy bedding is a consequence of climate changes or alternating periods of peat formation and mineral sedimentation.

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Biographical Sketches

Professor Ma Xuehui was born in 1938. In 1960, she obtained a Bachelor Degree in geography at Northeast Normal University. In the 1960s, she undertook research on mires and peat. During this period, she took part in research and experimentation on peatlands in the Sanjiang Plain, the Zoige Plateau, the Xin'anlin Mountains, the Changbaishan Mountains, Xinjiang Province and some other provinces in southern China. In the 1970s, she took part in a wilderness resources investigation in the Sanjiang Plain of China. In the 1980s, under the support of the national scientific fund, she undertook several key projects to investigate the comprehensive exploitation, with experimental demonstration research, of the natural resources in the Sanjiang Plain. In recent years, she has undertaken research on carbon cycling, microgas emission and factors affecting the peatlands of the Sanjiang Plain.

In 1992, she was appointed associate professor, then professor by Changchun Institute of Geography, Chinese Academy of Sciences. She is also a member of the Chinese Coal Society and the Jilin Peat Society, and managing director of the Editorial Research Society of Natural Scientific Journal, Chinese Academy of Sciences.

To date she has published about 60 scientific papers on peat and wetlands in Chinese as well as in international professional journals. She co-edited several books in Chinese, such as *Mires in China*, *Mires in the Zoige Plateau,* etc.

Hu Jinming PhD was born on February 14, 1973. He obtained his Bachelor's degree in Geography in 1995 at Anhui Normal University, Wuhu City, China, and his Masters in Physical Geography in 1998 at Changchun Insitute of Geography. He is now studying in the Department of Urban and Environmental Science in the doctor program, Peking University. His main research is on environmental change under human impact. He has published several scientific papers in Chinese Journals.