Extract of PhD thesis "Hydrogeomorphic Classification of Mire Ecosystems within the Baker and Pascua Basins in the Region Aysén, Chilean Patagonia"
(Faculty of Life Sciences-Humboldt Universität zu Berlin. July of 2015)






Organic substrate types in Mires of the Baker and Pascua Basins, Aysén-Chile

(Keys for their recognition)






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Keys for the recognition of organic substrate types in mires of the Baker and Pascua Basins, Aysén-Chile.

The classification of the different substrates compounding the peat soils of mires in the Baker and Pascua Basins (Aysén-Chile) detailed in the next section, is conceptually and graphically inspired by the German Soil Mapping Directions (A.G. Boden, 2005) and in the Description of Mire Substrates realized by Meier-Uhlherr, R., Schulz, C. and Luthardt, V. (2011) from the Eberswalde-University of Applied Sciences for Sustainable Development. As in those works, this chapter is oriented to the praxis and field work dealing with mires, portraying the ideal, typical and essential ecological characteristics of the different peat types found during the years of my PhD field research in Aysén. The substrate types that can be found in a mire will depend on its hydrogeomorphic and ecologic types. The hydrogeomorphic type depends on the relieve and hydrology that allowed a water saturated environment to form in the landscape. The ecological type or ecotype will depend on the vegetation that grew and accumulated as peat year after year, giving place to a mire, which could have changed and evolved through the time. Related to that, for mires in Aysén the classification exposed in Figure 1 is available.

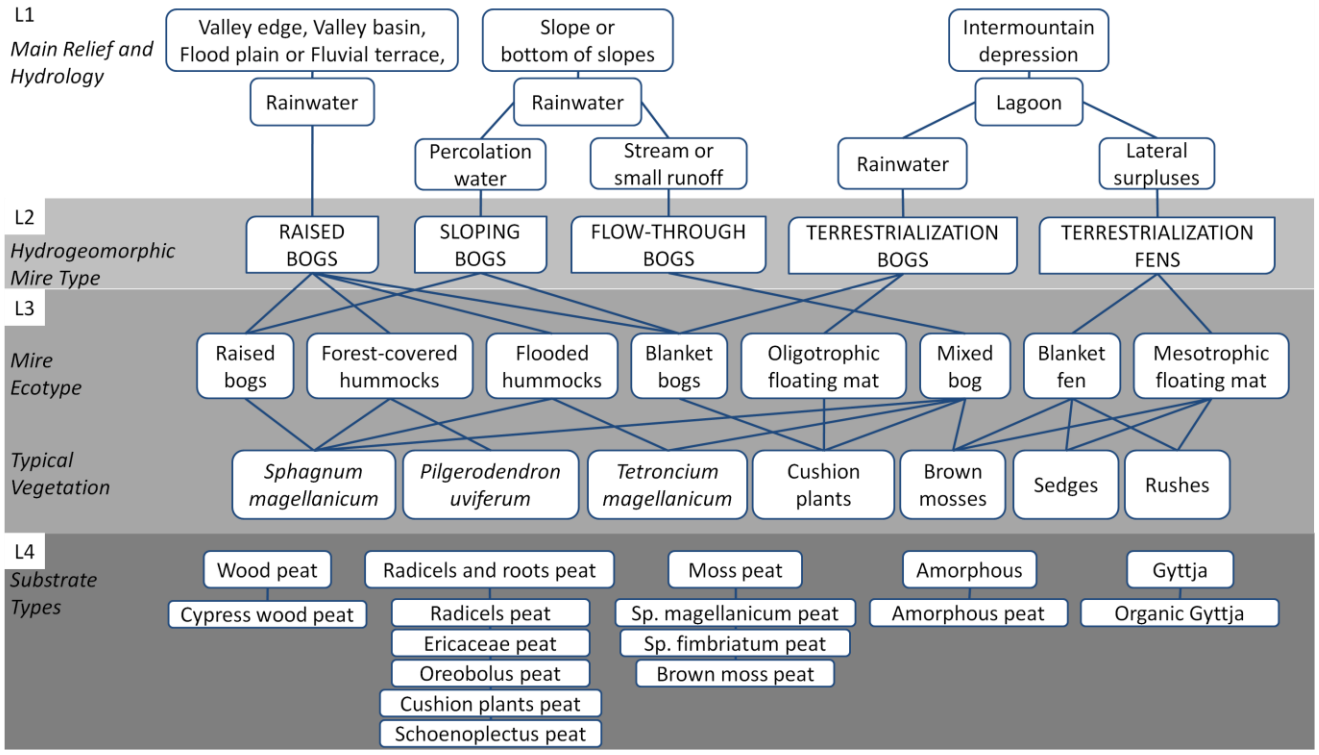


Figure 1: Classification system for mires and organic substrates in the Baker and Pascua River Basins, Aysén-Chile (Rodríguez, 2015)

This material is based on the fourth level of the classification presented in Figure 1, dealing with the organic substrates in mires studied in Aysén. The explanation is based on stereotypical peats, by which several mixed peat materials and other kinds of substrates are omitted. To facilitate the use of this section, peat types shown in this chapter are grouped and sub-grouped according to their main physical characteristics (Figure 2).

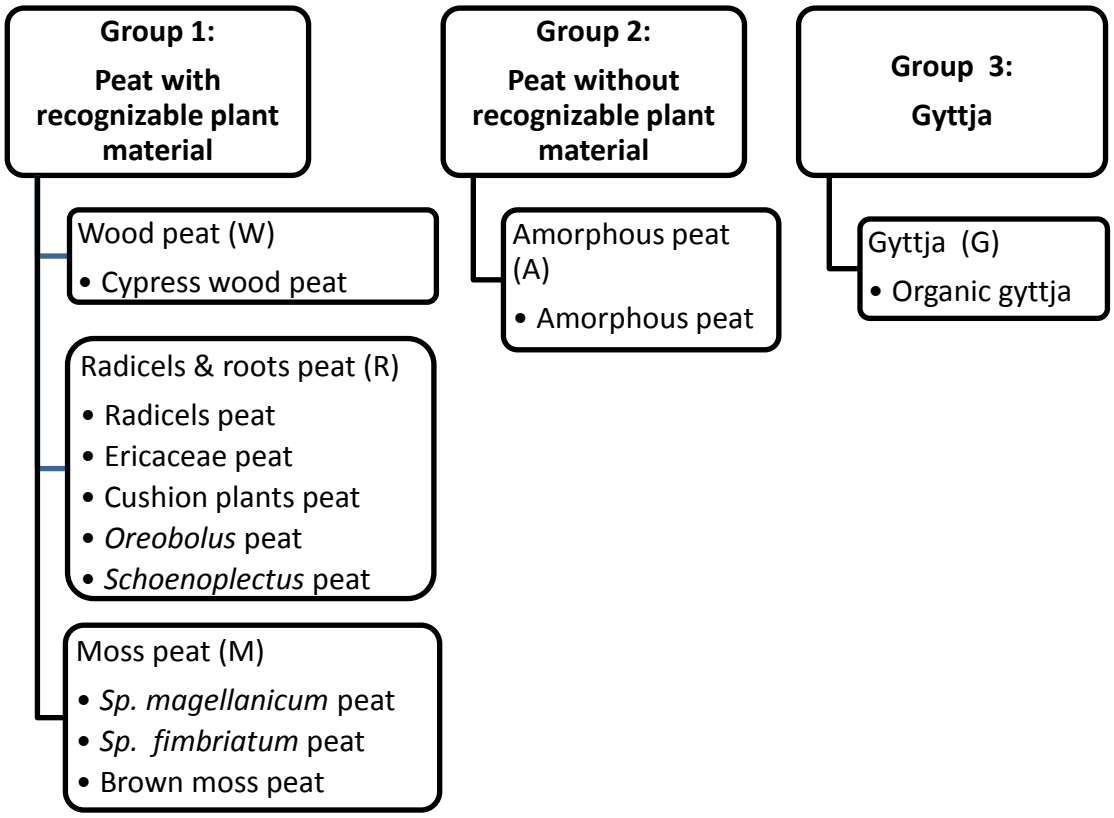


Fig. 2: Organic substrate types in mires of Aysén categorized in groups and subgroups

Group 1 presents those peats whose substrates contain macrofossils, plant remains or botanical category. Hence, this group contains peats typically found in the mire surface and in deep horizons under sufficiently anoxic conditions for the vegetative residues or structures to remain. Depending on the dominating plant materials, the sub-groups of wood, radicels and roots and moss peat can be differenced. Group 2 includes those peat types that, due to a strong grade of decomposition, terrestrialization (decomposition and blending of the peat with mineral material) or strong terrestrialization, are no longer able to be put into a botanic category. Amorphous peat is the result of a strong decomposition process, being found in terrestrial ecosystems. Group 3 includes organic gyttja which, as was exposed before, is a substrate formed by sedimentation processes at the bottom of

lakes and standing water bodies. The name of the mire substrates can be abbreviated to facilitate the data collection during the field work. A list of names is explained in Table. 1. Some of them are based on the German Soil Mapping Directives (Hhsy was translated as Hosy, Hhsa as Hosa, Hhi as Hoi, Hnr as Hgr, Hnb as Hgmm, Ha was conserved as Ha, and Fhh was translated as Gyo) and the rest on the native names of the substrate botanical types (Hoas, Hoob, Hoc, Hgsc). Their main characteristics are summarized and shown on the following pages.

Table. 1: Abbreviations for the different mire substrate types of Aysén

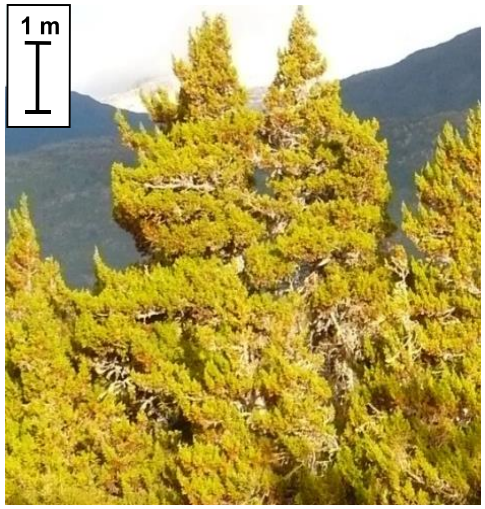
Group	Peat Type	Abbreviation
W	Cypress wood	Hoc (H: Humus, o: ombrogenic, c: ciprés)
R	Radicels	Hgr (H: Humus, g: geogenic, r: radicels)
	Ericaceae	Hoi (H: Humus, o: ombrogenic, i: family Ericaceae)
	Cushion plants	Hoas (H: Humus, o: ombrogenic, as: *Astelia pumila* and other cushion plants)
	Oreobolus	Hob (H: Humus, o: ombrogenic, ob: *Oreobolus*)
	Schoenoplectus	Hgsc (H: Humus, g: geogenic, sc: *Schoenoplectus*)
M	*Sp. magellanicum*	Hosy (H: Humus, o: ombrogenic, sy: *Sphagnum* class *cymbifolia*, species *Sp. magellanicum*)
	Sp. fimbriatum	Hosa (H: Humus, o: ombrogenic, sa: *Sphagnum* class *acutifolia*, species *Sp. fimbriatum*)
	Brown moss	Hgmm (H: Humus, g: geogenic, mm: musgos marrón-brown moss)
A	Amorphous	Ha (H: Humus, a: amorphous)
G	Organic gyttja	Gyo (Gy: Organic gyttja, o: organic)

The contribution of new peat types in the future, as a result of new research into the topic in Patagonia, is expected. We hope you will enjoy using this material when visiting and exploring mires in Aysén and the Chilean Patagonia.

The author

Peat forming plant

Pilgerodendron uviferum



Appearance

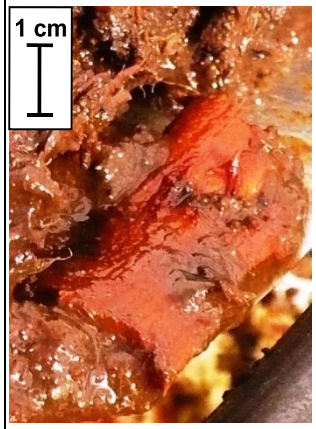
Cypress wood peat with DD H3

<u>Cypress Wood Peat/Turba de Ciprés (Hoc)</u>

Properties= cypress wood peat is common in the surface of the HGMT raised bogs and in the depth layers of the HGMT terrestrialization fens. Is the archetypical peat forming in the underground of the ME forest-covered hummock. Accompanying plant remains are *Sp. magellanicum*, brown mosses, *Carex magellanica* and *Nothofagus dombeyi*. Colour is brown to light brown.

DD= H3-H5 (n=7)	**pH-value=** 3,7–6,0 (n=7)
BD (g cm^3) = 0,05-0,07 (n=13)	**C/N =** 35–57 (n=2)
Water storage capacity= 90%-92% (n=13)	

Macrofossils



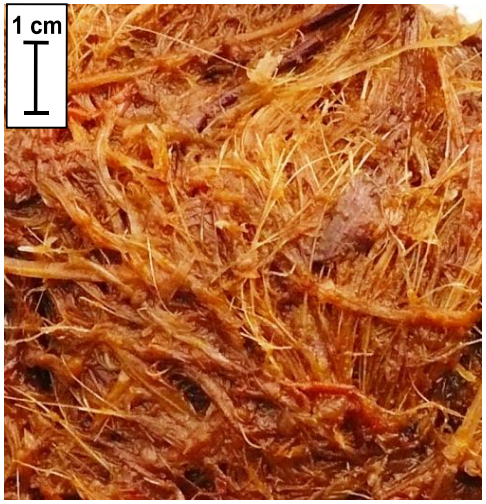
Current forming mire ecotype: forest covered hummocks

Peat forming vegetation

C. Magellanica/M grandiflorum

Appearance

Radicels peat with DD= H3-H4

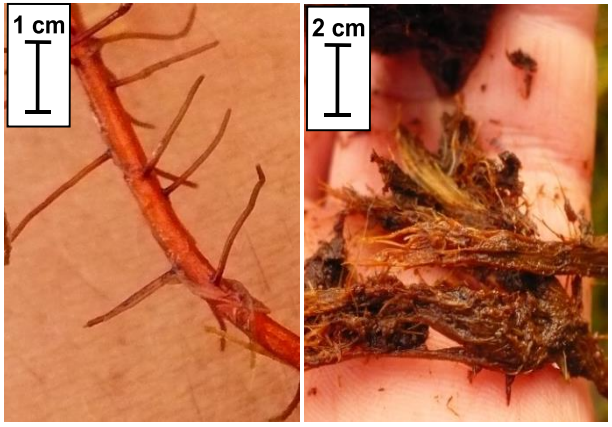


Radicels Peat /Turba de Radicelas (Hgr)

Properties= present in almost all HGMT, especially in terrestrialization fens, flow-through bogs and raised bogs. Current maximal formation based on *Carex magellanica* in the ME blanket fen. Also in the ME *Sphagnum* bogs and forest covered-hummocks, where *Marsippopermum grandiflorum* forms the peat Yellow to brown colour. Fine and coarse roots remains, tubular or compacted are abundant. Plant remains of *Sphagnum* and brown mosses, *Empetrum rubrum* and *Lepidotamus fonkii* can be found on it.

DD= H3-H8 (n=92)	**pH-value=** 3,0 -6,4 (n=92)
BD (g cm^3)= 0,07-0,1 (n=33)	**C/N=** 24-55 (n=9)
Water storage capacity= 83%-98% (n=33)	

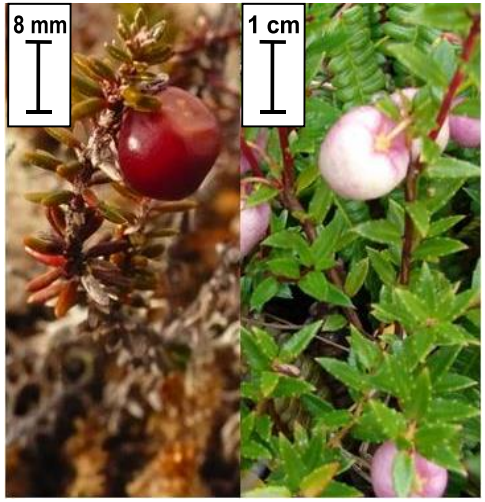
Macrofossils



Current forming mire ecotype: Blanket fen (left) and *Sphagnum* bog (right)

Peat forming vegetation

E. Rubrum/P. mucronata



Appearance

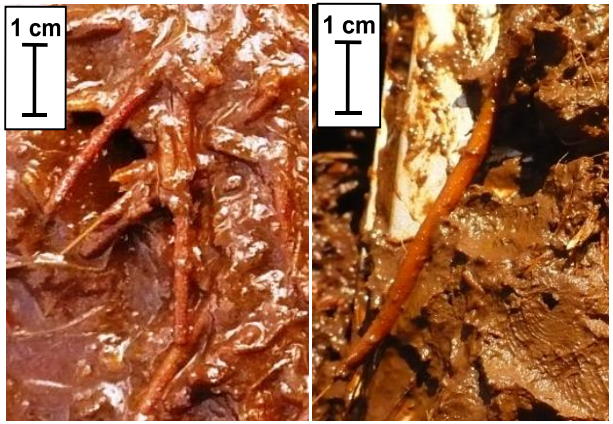
Ericaceae peat with DD= H4

Ericaceae Peat/Turba de Ericaceas (Hoi)

Properties= archetypical peat of the HGMT raised bog and sloping bog. Current formation in sloping or hummocky areas of the ME raised bogs, where the water level is below the surface, allowing vascular plants to grow. Characteristic reddish-brown colour with dark reddish small stems. Accompanying plant remains are *C. magellanica*, *M- grandiflorum* and *Sp. magellanicum* mosses.

DD= H3-H7 (n=37)	**pH-value=** 3,1 - 5,0 (n=37)
BD (g cm^3)= 0,06-0,07 (n=24)	**C/N=** 19-56 (n=6)
Water storage capacity= 91%-94% (n=24)	

Macrofossils



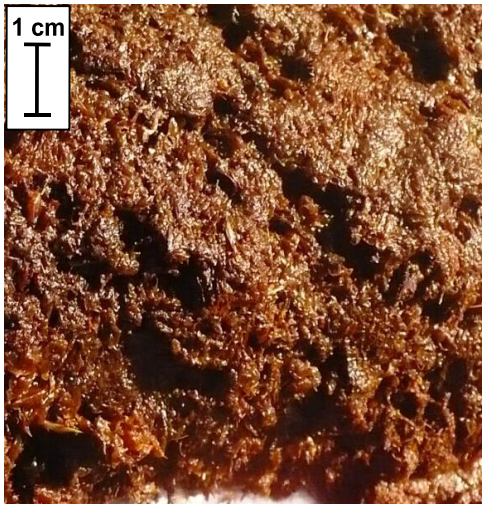
Current forming mire ecotype: raised bogs in sloping areas

Peat forming vegetation

Astelia Pumila

Appearance

Cushion plants peat with DD=H3

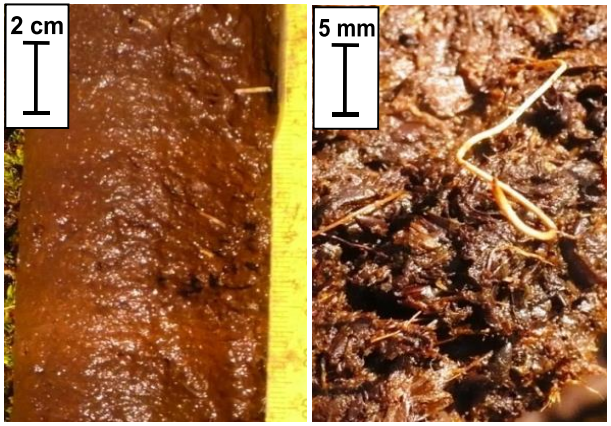


<u>Cushion Plants Peat/Turba Pulvinada (Hoas)</u>

Properties= typical peat in the ME blanket bog (HGMT raised bog), mixed bog (HGMT Flow-through bog) and ombrotrophic floating mat (HGMT terrestrialization bog). When high decomposed dominates a loose structure and a very reddish colour (see left picture of macrofossils), whilst under low decomposition a fixed structure and dark brown colour dominates (see right picture of macrofossils). Remains of *Sp. magellanicum* peat, *Oreobolus obtusangulus*, and brown mosses can be present.

DD=H3 – H8 (n=28)	**pH-value=** 3,1–4,6 (n=28)
BD (g cm^3)= 0,08-0,11 (n=27)	**C/N=** 21 – 45 (n=6)
Water storage capacity= 90%-92% (n=27)	

Macrofossils



Current forming mire ecotype: blanket bogs (left) and oligotrophic floating mats (right)

Peat forming vegetation

Oreobolus obtusangulus

Appearance

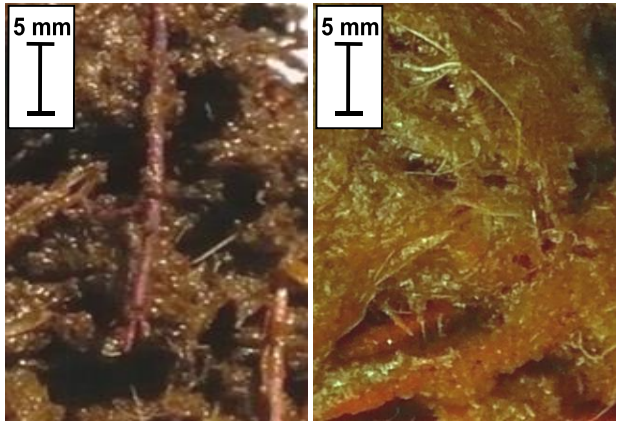
Oreobolus peat with DD=H4

<u>*Oreobolus* Peat/Turba de *Oreobolus* (Hob)</u>

Properties= rare peat. Detected growing associated to the ME blanket bog in the HGMT flow-through bog, and to the borders of flooded hummocks in the HGMT raised bogs. Typical dark red to dark brown colour. Moderate fixed texture, presenting coarse and fine tubular root remains and mostly low decomposition degree. Accompanied by radicels of *Donatia fascicularis* (in blanket bogs), and by *Marsippospermum grandiflorum* (in border of flooded hummocks)

DD= H3 – H6 (n=12)	**pH-value=** 3,5–4,1 (n=12)
BD (g cm^3)= 0,8-0,9 (n=5)	**C/N=** 38-45 (n=4)
Water storage capacity= 91%-94% (n=5)	

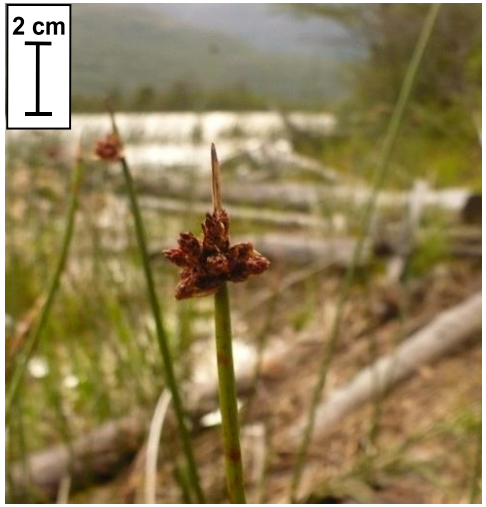
Macrofossils



Current forming mire ecotypes: blanket bogs (left) and border of flooded hummocks (right)

Peat forming vegetation

Schoenoplectus californicus



Appearance

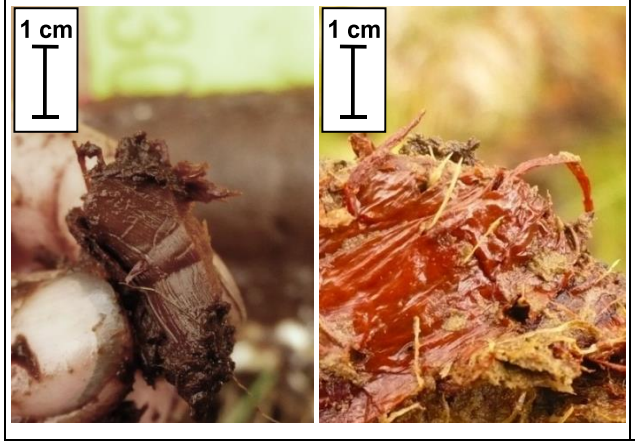
Schoenoplecuts peat with DD=H6

<u>*Schoenoplectus* Peat/Turba de *Schoenoplectus* (Hgsc)</u>

Properties= rare peat. Found only in the ME mesotrophic floating mat of the HGMT terrestrialization fen. Colour dark brown to black but if oxidative conditions are present, macrofossils can be reddish. Loose structure Low to moderate decomposition degree, with some macrofossils that made it identifiable and differentiable from the abundant accompanying brown mosses peat.

DD= H3-H6 (n=3)	**pH-value=** 4,6-6,2 (n=3)
BD (g cm^3)= 0,05-0,06 (n=5)	**C/N=** 35 (n=2)
Water storage capacity= 94-95% (n=5)	

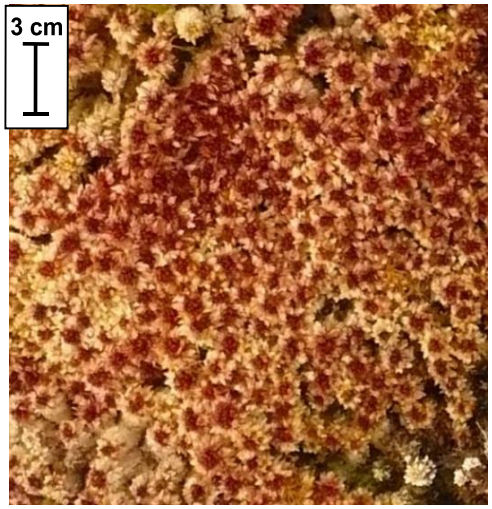
Macrofossils



Current forming mire ecotypes: mesotrophic floating mats

Peat forming vegetation

Sphagnum magellanicum



Appearance

Sp. magellanicum peat with DD=H3

<u>*Sp. magellanicum* Peat/Turba de Pompón (Hosy)</u>

Properties= archetypical peat of the HGMT raised bogs and sloping bogs. Also typical in flow-through bogs and less in terrestrialization bogs. Forming currently in the ME raised bog, forest covered hummock, flooded hummock, mixed bog and less in blanket bogs. Accompanied by Ericaceae and Cyperaceae plant remains. Depending on its DD, has a bulky to creamy structure. Its colour varies from reddish yellow (pure), to dark reddish (Ericaceae remains) and brown (Cyperaceae remains*)*.

DD= H3-H7 (n=134)	**pH-value =** 2,3-5,5 (n=134)
BD (g cm^3)= 0,03-0,07 (n=25)	**C/N=** 20–68 (n=8)
Water storage capacity= 84%-97% (n=25)	

Macrofossils

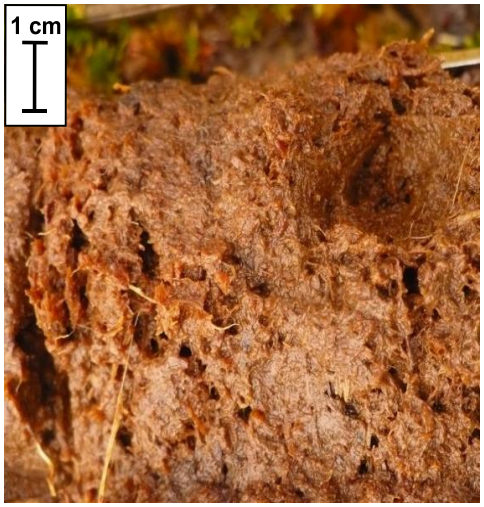
Current forming mire ecotypes: raised bogs (left) and forested hummocks (right)

Peat forming vegetation

Sphagnum fimbriatum

Appearance

Sp. fimbriatum peat with DD=H7

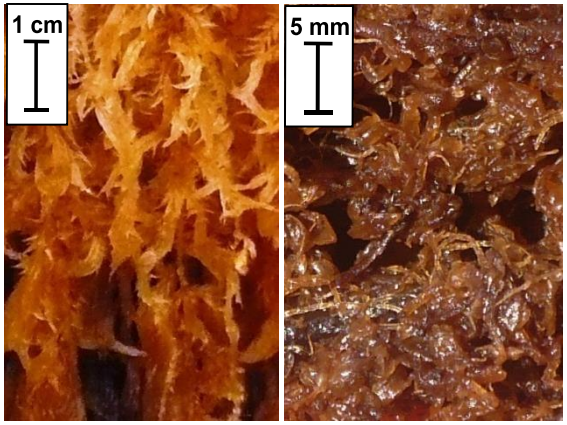


<u>*Sphagnum fimbriatum* Peat/Turba Fímbrica (Hosa)</u>

Properties= rare peat, found only where *Sp. fimbriatum* currently grows, in saturated borders of the HGMT sloping bog, as well as in the HGMT raised bog associated to saturated depressions in the border of the ME flooded hummock. Light brown to brown colour. Accompanying plant remains are radicels from Cyperaceae plants.

DD= H3- H7 (n=7)	**pH-value**= 3,0-5,5 (n=7)
BD (g cm^3)= 0,09-012 (n=3)	**C/N=** 37 (n=1)
Water storage capacity= 90%-95% (n=3)	

Macrofossils



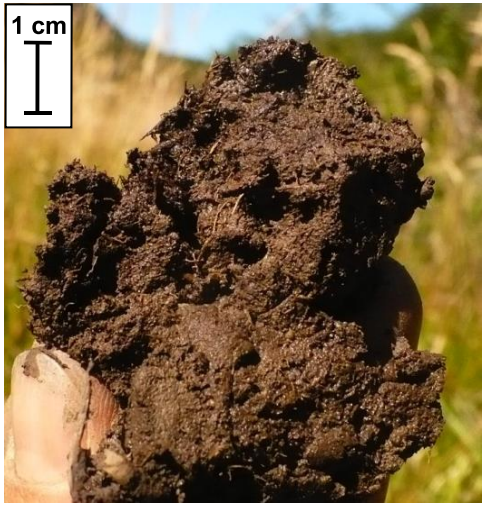
Current forming mire ecotypes: saturated depressions in the border of flooded hummocks

Peat forming vegetation

Acrocladium auriculatum

Appearance

Brown Mosses peat with DD=H6



Brown moss peat/Turba musgo marrón (Hgmm)

Properties= archetypical peat of the HGMT terrestrialization fen, where the water of the mire is enriched by lateral inputs. Also present in the HGMT flow-through bog, associated to areas where nutrients are conveyed into the surface by flow fluctuations. Currently forming in the ecotypes blanket fens and mesotrophic floating mats, and less in mixed bogs. Dark reddish to very dark brown colour is characteristic, as well as a compact to loose structure, depending on the DD.

DD= H3-H6 (n=5)	**pH –value=** 4,3-6,6 (n=5)
BD (g cm^3)= 0,07-0,11 (n=5)	**C/N=** 23 (n=1)
Water storage capacity= 91%-93% (n=5)	

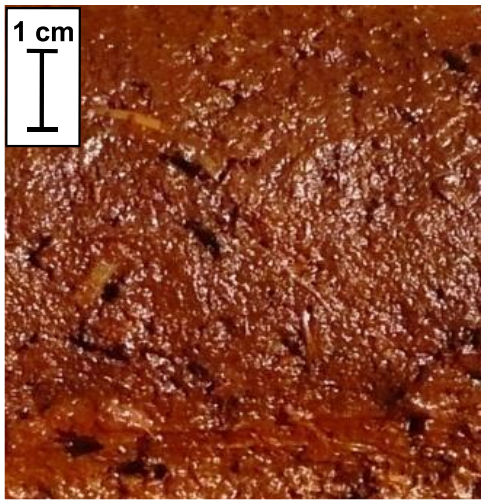
Macrofossils

Current forming mire ecotypes: blanket fens (left) and mesotrophic floating mats (right)

Amorphous Peat/Turba Amorfa (Ha)

Appearance

Amorphous Peat DD=H9-H10



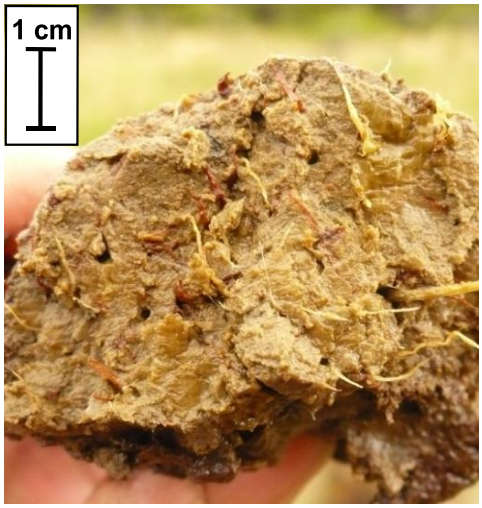
Properties= present in all HGMT, indicator of intermittent dry periods, and of the presence of Aerenchyms. These can be the specie *Sch. californicus* in the ME blanket fens and mesotrophic floating mats, and the cushion plant *A. pumila* in all ME where this grows and feed by degrading the peat with its oxygenating rooting system

DD= H9-H10 (n= 124)	**pH-value=** 3,0-6,4 (n= 124)
BD (g cm^3)= 0,09-0,12 (n=37)	**C/N=** 15-55 (n=7)
Water storage capacity= 86%-94% (n=37)	

Organic gyttja/ Gyttja Orgánica (Gyo)

Appearance

Organic gyttja



Properties= indicator of standing water ecosystems (e.g. old lagoons and lake bottoms). Forming in remnant lakes of the HGMT terrestrialization bogs and terrestrialization fens. Although it was not registered in small pools inside raised bogs, this is an environment where this substrate could potentially form. Its organic matter content varies from >15% to <30%, and owing to its high bulk density, it a substrate with an organic carbon content similar to that of peat substrates.

pH-value= 3,2-7,3 (n=22)	**BD (g cm^3)=** 0,17-0,27 (n=10)
C/N= 20-31 (n=2)	
Water storage capacity: 75%-84% (n=10)	

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