

Seven hundred years of peat formation recorded throughout a deep floating mire profile from Central Italy

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Floating mires are defined by the occurrence of emergent vegetation rooted in highly organic buoyant mats that rise and fall with changes in water level.

Islands floating and moving on a lake naturally were already described by Pliny the Elder in his *Naturalis historia* almost two millennia ago. Actually, he devoted a whole chapter of *Naturalis historia* to "Of Islands Ever Floating and Swimming", reporting how certain isles were always waving and never stood still.

The status of "flotant" has been defined transitory; in fact, these small isles often disappear, in most of the cases because of a transition from floating island to firm land during decades is likely to happen. That is why most of the floating islands described by Pliny the Elder (e.g., *Lacus Fundanus*, *Lacus Cutiliensis*, *Lacus Mutinensis*, *Lacus Statoniensis*, *Lacus Tarquiniensis*, *Lydia Calaminae*, *Lacus Vadimonis*) do not exist anymore.

In the present study, peat formation and organic matter evolution were investigated in order to understand how these peculiar environments form, and how stable actually they are. In fact, it is hoped that peat-forming floating mires could provide an exceptional tool for environmental studies, since much of their evolution, as well as the changes of the surrounding areas, is recorded in their peat deposits.

A complete, 4-m deep peat core was collected in July 2012 from the floating island of Posta Fibreno, a relic mire in the Central Italy. This floating island has a diameter of *ca.* 30 m, a submerged thickness of about 3 m, and the vegetation is organized in concentric belts, from the *Carex paniculata* palisade to the *Sphagnum* centre. Here, some of the southernmost Italian populations of *Sphagnum palustre* occur. The ^{14}C age dating of organic sediments isolated from the sample at 385 cm of depth revealed that the island formed *ca.* 700 yrs ago (620 ± 30 yr BP).

The top 100 cm, consisting almost exclusively of *Sphagnum* mosses, show a very low bulk density (avg., 0.03 ± 0.01 g cm $^{-3}$), an ash content ranging from 0.8 and 7.4%, an average gravimetric water content of 26.6 ± 7.7 g $_{\text{water}}$ g $_{\text{drypeat}}^{-1}$, and a pH generally increasing with depth (from 4.1 to 7.2). The C content along the profile ranged between 35 and 47% (avg., $41\pm 4\%$), whereas the N between 0.3 and 1.1% (avg., $0.5\pm 0.1\%$). Main atomic ratios (C/N, H/C and O/C) and FT-IR spectra seem to confirm what found during the visual inspection of the core, i.e., *Sphagnum* material so well preserved that it is hard to classify it as "peat". In fact, the ^{14}C age dating suggests that the first 110 cm of *Sphagnum* material accumulated in *ca.* 55 yrs, thus resulting in an average growing rate of 2 cm yr $^{-1}$.

The remaining 300 cm (from 100 to 400 cm of depth), i.e., the submerged part of the island, consist of peat showing completely different botanical composition (reed-fen peat and silty peat rich in reeds) and physical and chemical properties. In particular, both bulk density (avg., 0.09 ± 0.05 g cm $^{-3}$) and ash content increase, reaching their maximum at 300-325 cm of depth (0.27 g cm $^{-3}$ and 17%, respectively), whereas the average gravimetric water content significantly decreases (17.4 ± 9.0 g $_{\text{water}}$ g $_{\text{drypeat}}^{-1}$). The pH ranges from 6.6 and 7.4. Both C and N along this section of the profile show higher average contents (44 ± 3 and $1.3\pm 0.6\%$, respectively) compared to those recorded in the upper 100 cm layer; furthermore, the decrease with depth of C/N, H/C and O/C atomic ratios, as well as main absorption bands of FT-IR spectra, clearly indicate the occurrence of an organic matter highly humified. The estimated accumulation rate for the bottom 300 cm of the island is 0.5 cm yr $^{-1}$.

At the best of our knowledge, this work represents the first characterization of a (4 m) deep floating mire profile. At Posta Fibreno, the deep water layer below the base of the island (7 m) and the movement on the water surface probably avoided the transition from floating island to firm land, thus allowing this island to float during the last centuries.

The Authors thank the Municipality of Posta Fibreno (FR), Managing Authority of the Regional Natural Reserve of Lake Posta Fibreno, for allowing peat cores sampling.