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Once a swamp, always a swamp: A multiproxy investigation reveals the persistence of bald cypress swamp environments since the last ice age

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Terrestrial environments, such as subtropical cypress swamps, were established on the exposed continental shelf during the last ice age when sea level was lower. However, such environments are rarely preserved due to the erosive nature of the subsequent marine transgression. Here we investigate two sites in the northern Gulf of Mexico (nGOM) with well-preserved terrestrial deposits to better understand ice age coastal environments. The first site, known as the Alabama Underwater Forest, is located ~13 km south of Gulf Shores, AL, at ~15 m water depth, and formed around the Wisconsin glaciation (dated to 72−56 ±8 (1σ) ka via optically stimulated luminescence). The second site is ~22 km south of Horn Island, MS, at ~25 m water depth, and the deposits date to the Early Holocene (^{14}C dated to 10,228−11,175 cal yr BP, 2σ). We analyzed the terrestrial sections of three sediment cores for pollen, spores, foraminifera, and stable isotopes (δ^{13}C (bulk organic) for C3 vs C4 vegetation, δ^{15}N for nutrient cycling, δ^{34}S for freshwater vs marine) to determine the type of environments that existed during these time intervals. The δ^{13}C values averaged −28.5‰ ±0.2, 1σ (AL) and −27.8‰ ±0.3, 1σ (MS), indicating C3-dominant vegetation (i.e., more trees and not marsh grasses). Palynological analysis confirmed that both sites were arboreal dominant with *Taxodium distichum* (bald cypress) and *Quercus*spp. (oak). We found no foraminifera in the terrestrial sections of these cores, suggesting these sites were inland when buried. We developed a model using linear discriminant analyses of δ^{13}C, δ^{15}N, δ^{34}S, and C/N trained with 1,400 legacy data values representing seven environments present along the modern nGOM to determine a likely depositional environment. This analysis classified both core sites as freshwater swamps at time of deposition. Swamps are common in the southeastern United States (SE US) and though the sites in this study are older, similar environments have been documented, both isotopically and micro paleontologically, on the previously exposed continental shelf. Our multiproxy, model-based approach suggests that despite differences in climate and sea level during glacial and deglacial intervals, SE US coastal environments have kept similar ecologic compositions that migrate with shifting coastlines due to changing sea level.