PALYNO-PETROGRAPHIC INVESTIGATIONS OF PEAT DEPOSITS: IMPLICATIONS REGARDING ANTHROPOGENIC IMPACTS, REMEDIATION OF HAZARDOUS WASTES, AND WETLANDS RESTORATION

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Peat deposits can be excellent archives of past anthropogenically-derived alterations in local vegetational and depositional environments. One method that we have found to be especially useful in identifying and resolving these paleoecological changes involves combining standard palynological techniques with petrographic-botanical analysis of oriented microtome sections. By correlating these paleoecological results with laboratory sorption/desorption experiments conducted under controlled conditions with specific contaminants and representative peats, it is also possible to predict whether a particular peat deposit will act as a natural filter or bioremediator of hazardous waste substances that may later be introduced into the deposit from contaminated ground water or surface water.

Examples of this approach are presented from our studies of two peat deposits, one at the Savannah River Site near Aiken, South Carolina (run by Westinghouse Company for the U.S. Dept of Energy) and the other in the Everglades of Florida (Water Conservation Area 2-A, managed by the South Florida Water Management District [SFWMD]). The SRS deposit is located down-gradient from L Lake (a cooling reservoir for a nuclear reactor). This lake was built about 10 years ago by damming of Steel Creek, a tributary of the Savannah River). The peat is formed in an oval depression, which has previously been called a Carolina Bay, but which may be a portion of an abandoned tributary of a nearby stream. A transect of cores (4) was collected across this deposit. A basal radiocarbon date of about 3,000 yrs B.P. was obtained from one of the cores. Although the final palyno-petrographic analyses were not yet completed at the time of this writing, initial results indicate significant recent changes in hydrology (water levels) due to site development and several major pre-development ecological changes unrelated to site construction.

The Everglades samples come from a transect of three equally-spaced peat cores collected down-gradient from agricultural lands. Isophosphate contours of surface waters obtained from the SFWMD indicate that one core site was located in a contaminated zone, one in an intermediate zone, and one in an uncontaminated zone. Rates of accretion and time lines were obtained from each core by Cs-137 and Pb-210 dating of closely-spaced (2-cm interval) samples. The combined palyno-petrographic method was able to detect with some certainty the first appearance of contaminant-driven plant types into the region, with the petrographic method being more accurate in determining the actual presence of invading plants at a particular site and the pollen analysis providing a much broader picture of both local and regional changes in the ecosystem. Typha (cattail), for example, which dominates the surface at the most contaminated site today, was not found to be present at this site prior to the Cs-137 peak (1996/63). Although Typha pollen were present near the surface at the other two sites, the petrographic analysis showed conclusively that it was never actually present at these sites. Lemna (duckweed) was found to be an even more recent invader of only the most contaminated site. One site, which is now dominated by Cladium (saw grass), was formerly in the center of the Everglades drainage, as indicted by the continuous presence prior to 1962/63 of deeper water floating aquatics, such as Nymphaea (water lily) and Utricularia (bladderwort). The two other sites, which were apparently less centrally located relative to a past, primary, water flow pathway, also had greater Nymphaea prior to 1962/63, indicating an overall wetter former Everglades. This type of paleoecological and paleohydrological information may prove to be especially valuable for future restoration efforts.

Laboratory experiments with water lily, sawgrass, cypress, and other peats representative of both study areas reveal striking differences in sorptive properties of these peats for several different contaminants, including metals (Cd, Cu, Pb, Ni, and Zn) and gasoline-derived hydrocarbons (benzene, toluene, ethylbenzene, and xylenes). This information allows one to construct models with which to predict not only how much of these contaminants might be trapped or remediated by each deposit, but also potential locations of contaminant hot spots within each deposit.