Pollen Analysis of the Peat Member from the Lee Creek Mine

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ABSTRACT

A pollen analytical study of the peat horizon exposed in the Lee Creek phosphate mine indicates that it was deposited in a freshwater environment during interglacial time (probably Sangamon). The freshwater nature of the deposit is suggested by the high percentage of sedge and grass pollen; the presence of *Potamogeton*, *Brasenia*, *Nuphar*, *Myriophyllum scabratum*, *M. heterophyllum*, *Pontederia*, *Sagittaria*, *Nymphaea*, *Typha-Sparganium*, and *Isoëtes*; the occurrence of *Botryococcus*, *Pediastrum boryanum*, and *Tetraedron*; the low percentage of chenopod-amaranth pollen; and the absence of brackish indicators, such as *Ruppia* and *Iva*. The interglacial age (rather than interstadial) is suggested by the general absence of "boreal indicators," the similarity of the tree pollen frequencies to those from interglacial deposits both to the north and south, and the general similarity of the fossil spectrum to modern pollen assemblages from eastern North Carolina.

Introduction

Stratigraphic work on the sections exposed in the Lee Creek phosphate mine (Belt, Frey, and Welch, herein) has indicated the probable existence of at least four depositional sequences of Pleistocene age. The uppermost cycle (cycle IV) consists of fluvial channel materials, which cut into deposits of both cycles III and II, a clay member (apparently deposited in the abandoned river channel), a peat member (discussed in the present paper), and a marine unit overlying the peat. The radiocarbon age of the peat is >42,000 BP (SI-1829).

Given the sequence of sediments associated with this depositional cycle, it would be of interest to determine whether the peat represents a freshwater deposit (a freshwater marsh deposit associated, at least initially, with the abandoned river channel) or whether it was formed in a brackish environment (related to the continuing transgression that produced the overlying marine sediments). Given the infinite radiocarbon date, it would also be of interest to determine whether this depositional unit dates from the Sangamon or from a mid-Wisconsinan interstadial. With these general questions in mind, I undertook a pollen analytical investigation of the peat.

Methods

Four samples of the peat and/or clay were analyzed. Two samples derived from trench III, one from trench IV, and one from the east wall (Figure 2 of Belt, Frey and Welch, herein). The samples were prepared by a standard procedure (boiling in KOH, demineralizing with HCl, boiling in conc. HF, and acetolysis) and mounted in silicone oil. Counting was carried out at a magnification of 400 diameters using a Leitz Orthoplan microscope with apochromatic objectives.

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Results

The samples from trenches III and IV contained too little pollen for detailed analysis. The slides consisted of finely comminuted organic debris, mostly too fine and badly preserved to identify. Only five or six pollen grains were present on each of the slides and they were often badly corroded.

The peat sample from the east wall differed in that the organic fragments were larger (mostly vascular tissue and leaf cuticular remains) and pollen was both more abundant and better preserved. Three entire slides were counted to obtain sufficient pollen for reasonable interpretations. The results are presented in Tables 1 and 2. Note that two sets of percentages are given. "Percent of total pollen" involves a pollen sum including all tree, shrub and herb pollen, but excluding obvious aquatics. "Percent of arboreal pollen" are percentages for three types based on a pollen sum including only arboreal pollen (AP). The latter calculation was necessary so that the spectrum could be compared more directly with other fossil and modern spectra from the southeast (few published modern and fossil spectra have such high percentages of non-arboreal pollen).

Interpretations

The high percentages of non-arboreal pollen (NAP) (mostly grass and sedge), and the pollen of a number of different aquatic plants suggest that much of the pollen was locally derived and that the depositional environment was characterized by standing water for at least a portion of the year. This is further substantiated by the presence of fossil algae (*Botryococcus*, *Pediastrum boryanum*, and *Tetraedron*). A number of the aquatics represented occur in a wide range of coastal plain environments, sometimes including brackish waters (these include *Typha*, *Potamogeton*, *Sagittaria*, and *Nuphar*). However, others apparently occur only in freshwater habitats (both species of *Myriophyllum*, *Brasenia*, *Nymphaea*, *Pontederia*, and *Isoëtes*) (Radford, Ahles, and Bell 1964). Furthermore, the algae mentioned above are characteristic freshwater taxa (Smith, 1950:243, 269, 404).

TABLE 1.—Arboreal, shrub, and herb pollen data from the Peat Member, Lee Creek Mine

Type of pollen	No. of grains	% of total (arboreal) pollen
ARBOREAL POLLEN		
Pinus	147	16.44(54.85)
Picea	6	0.67 (2.24)
Abies	1	0.11 (0.37)
Cupressaceae	21	2.35 (7.84)
Quercus	60	6.71(22.39)
Carya	5	0.56 (1.87)
Betula	8	0.89 (2.99)
Fraxinus	3	0.34 (1.12)
Corylus	5	0.56 (1.87)
Nyssa	4	0.45 (1.49)
Liquidambar	2	0.22 (0.75)
Ostrya - Carpinus	2	0.22 (0.75)
Castanea	3	0.34 (1.12)
Populus	1	0.11 (0.37)
Subtotal	268	29.98
SHRUB POLLEN		
Alnus	140	15.66
Lonicera	1	0.11
Ericaceae	5	0.56
Viburnum	1	0.11
Subtotal	147	16.44
HERB POLLEN		
Gramineae	215	24.05
Cyperaceae	197	22.04
Compositae	35	3.91
Liguliflorae	2	0.22
Ambrosia	5	0.56
Artemisia	1	0.11
Rosaceae	1	0.11
Ranunculus	1	0.11
Thalictrum	5	0.56
Umbelliferae	5	0.56
Sanguisorba canadensis	1	0.11
chenopod-amaranth	11	1.23
Subtotal	479	53.58
Total	894	

Thus, microfossil evidence is consistent with peat deposition in a freshwater rather than brackish environment. Furthermore, in brackish water sediments I would expect far higher percentages of chenopod-amaranth type pollen, low percentages of sedge pollen, pollen of typical saltmarsh shrubs (such as *Iva frutescens*), and pollen of *Ruppia*

TABLE 2.—Aquatic, algal, and miscellaneous pollen data from the Peat Member, Lee Creek Mine

Type of pollen	No. of grains	% of total pollen
AQUATICS		
Polygonum (*Persicaria* type)	2	0.22
Potamogeton	2	0.22
Brasenia	6	0.67
Nuphar	3	0.34
Myriophyllum scabratum	3	0.34
Myriophyllum heterophyllum	1	0.11
Pontederia	2	0.22
Isoëtes	3	0.34
Sagittaria	6	0.67
Nymphaea	1	0.11
Typha-Sparganium type	5	0.56
ALGAE		
Botryococcus	27	3.02
Pediastrum boryanum	2	0.22
Tetraedron	1	0.11
MISCELLANEOUS		
Sphagnum	11	1.23
Botrychium cf. *dissectum*	1	0.11
Osmunda regalis	2	0.22
Monolete fern	62	6.94
Trilete fern	1	0.11
Unknown	15	1.68
Unidentifiable	51	5.70

(e.g., Butler, 1959; Heusser, 1963). Consequently it is quite reasonable to assume that the peat is of freshwater origin.

Much of the herb and shrub pollen (composites, *Thalictrum*, *Sanguisorba canadensis*, alder) probably derived from wet shores immediately surrounding the marsh habitat itself.

The question of the age relationship of the peat deposit can also be resolved, but not quite as definitively. The virtual absence of pollen of "boreal" taxa certainly suggests a temperate environment. Of the many such taxa known from full-glacial and late-glacial deposits in the southeast (e.g., Whitehead, 1963, 1964, 1965, 1967, 1973, 1981; Frey, 1951, 1953, 1955; Craig 1969; Watts 1970), only *Picea*, *Abies* (a single grain), and *Sanguisorba* (a single grain) are represented in the peat. If one ignores the spruce (0.67% total pollen, 2.24% AP), then the spectrum is remarkably like modern pollen assemblages from both northeastern and southeastern North Carolina (e.g., Whitehead, 1967, 1981; Whitehead and Tan, 1969; Frey 1951, 1953). The dominant tree types are pine and oak with a number of other temperate deciduous and coniferous taxa represented. The overall impression is of a vegetation reasonably comparable to the present, with climate perhaps a trifle cooler.

It is thus apparent that the peat was deposited either during an interglacial or during a rather warm interstadial such as the Mid-Wisconsinan Plum Point or Port Talbot (Whitehead, 1973: 630; Dreimanis, 1973:377). The obvious approach is to compare the pollen spectrum from the peat with known interglacial and interstadial spectra from the same general area. Mid-Wisconsinan interstadial spectra are known from the Bay Lakes of Bladen County, southeastern North Carolina (Frey, 1951, 1953, 1955; Whitehead, 1965, 1967), from Rockyhock Bay in Chowan County, northeastern North Carolina (Whitehead, 1973, 1981), and from an exposure along the intracoastal waterway near Long Beach in southeastern North Carolina (Whitehead and Doyle, 1969). Interglacial spectra are known from the exposure at Flanner Beach on the Neuse River (only 50 km from the Lee Creek site) (Whitehead and Davis, 1969) and from the Kempsville formation in southeastern Virginia (Whitehead, unpublished data; Oaks and Coch, 1973). Basically, the spectrum from the peat horizon is more similar to the interglacial spectra. The interstadial spectra differ consistently in having higher percentages of spruce and more frequent occurrence of boreal taxa, such as *Sanguisorba canadensis*, *Arceuthobium*, *Abies*, *Schizaea pusilla*, *Lycopodium annotinum*, *L. lucidulum*, *L. clavatum*, and *L. obscurum*. However, the spruce percentage from the peat is higher than that recorded at either the Neuse River site or in the Kempsville Formation. Although the spruce data make assignment of the peat to an interglacial a little less certain, it should be emphasized that our knowledge of vegetational changes in the southeast during the Sangamon interglacial is much less nearly complete than our understand-

ing of conditions during the Plum Point and Port Talbot interstadials. It is obvious that conditions would be appropriate for the survival of some boreal taxa at either end of any interglacial sequence.

In summary, the pollen data from the peat horizon exposed in the sections at the Lee Creek Mine suggest clearly that the depositional environment was fresh water rather than brackish and that the peat was probably deposited during a portion of an interglacial rather than during an interstadial.

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