LATE MIOCENE VEGETATIONAL HISTORY OF JACKSON HOLE, WYOMING

C. W. Barnosky
Department of Geological Sciences
University of Washington

The frequent reassortment of angiosperms to form new communities, a dominant feature of the Quaternary record, has seldom been recognized in earlier periods. In fact, analysis of fossil floras in North America suggests that Tertiary plant communities were relatively stable over long periods of time (for example, Hickey, 1977; MacGinitie, 1969; Wolfe, 1975). This stability suggests that either the record has not been studied in sufficient detail or that the factors controlling plant and environment interactions were less variable than in the Quaternary. If the latter hypothesis is true, the botanical record of the last 1.8 x 10^6 yr may be an atypical model on which to base our understanding of community evolution .

To assess the importance of short-term variation in Tertiary plant communities, detailed botanical analyses of continuous stratigraphic sections are needed. In particular, a pollen record through a lacustrine sequence is critical for recognizing rapid, floristic or vegetational changes on a regional scale. Thus far, such recognition has been difficult because our understanding of floristic development is based primarily on plant megafossils. While such material provides information on the riparian flora adjacent to a depositional site, it reveals little about regional patterns.

Objectives

The aim of this research is to examine the importance of short-term floristic and vegetational changes during the Neogene of the Northern Rocky Mountains by studying a long, continuous pollen record from the late Miocene Teewinot Formation. The Teewinot Formation, an 1800-m sequence of nonmarine strata in Jackson Hole, consists of interbedded limestone, claystone, pumicite and diatomite that are finely laminated and widespread. These sediments were depcsited in an ancient lake prior to uplift of the Teton Range (Love, 1956) and are well-suited to a study of plant associations over long and short periods of time for the following reasons:

1. Fossils. Abundant pollen, molluscs, ostracodes, diatoms and vertebrates have been collected from the formation.

2. Geologic setting. The Teewinot Formation was deposited during a period of tectonic quiescence that lasted at least 150,000 yr.

3. Nature of sediments. Thick sequences of laminated clay,

possibly varved, can be traced in exposures over long distances.

4. Radiometric chronology. One K-Ar date has been obtained; however, there are suitable lithologies for additional K-Ar and fission-track age determinations.

5. Previous research. Detailed stratigraphic sections (J. Love, unpublished, 1979), and geochemical and paleontologic analyses (K. Lohman, unpublished data, 1975; Sohn, 1956; Taylor 1956) are available. I have been evaluating and adding to existing stratigraphic sections, and have collected over 600 samples for possible pollen analysis.

Methods

Two correlative sections in the upper facies of the Teewinot Formation were studied to define both long- and short-term floristic fluctuations and to verify the lateral consistency of pollen assemblages. One section (SE¼ sec. 25, T. 42 N., R. 116 W.) outcrops along the Gros Ventre River in Grand Teton National Park; the other (NW¼ sec. 36, T. 42 N., R. 116 W.) is exposed in the National Wildlife Refuge. Samples were collected every 25 cm from both sections and of those, 150 levels were suitable for pollen analysis. Samples were processed using techniques described by Faegri and Iversen (1975). A minimum of 300 pollen grains was counted at each level under 400x and 1000x magnification. Pollen and spores were identified by comparison with reference material and published keys (Kapp, 1969; Faegri and Iversen, 1975; Moore and Webb, 1978).

Interpretation of the assemblages will be based in part on the relationship of modern pollen to present vegetation. Because many of the Miocene taxa are still extant in Jackson Hole, an altitudinal transect of surface samples was collected in the summer, 1980 from lakes, bogs and moss polsters in the Teton area. The pollen and spores in these samples will be useful in defining the modern pollen rain of Jackson Hole. In addition, cores from Jackson Lake, made available to me by R. B. Smith (University of Utah), will also be used in determining present-day pollen spectra.

Results

Percentages have not been calculated for the fossil assemblages, so only qualitative results can be presented. In general, the pollen spectra appear fairly stable at both sections and do not show major fluctuations through time. The dominant taxa at both localities are Pinus, Abies, Picea and Gramineae. The GTNP section shows a diverse shrub and herb assemblage that includes Sarcobatus, Compositae (Artemisia, Ambrosia), Cyperaceae and extinct species of Ulmus-Zelkova. The abundance of riparian and semi-aquatic taxa in the GTNP section suggests that it was a shallow water or shoreline facies, and the NWR section was deposited offshore acting as a catchment for more-regional pollen rain.

Surface samples from Jackson and Jenny Lakes and the NWR show higher

amounts of Artemisia and Picea than is present in the Teewinot record. In addition, Sarcobatus and Abies are poorly represented in the modern record.

Conclusions

Environmental reconstructions based on the Teewinot assemblages are not possible until fossil percentages are tabulated and comparisons are made with modern analogs. The pollen data indicate, however, that a very modern flora existed in Jackson Hole during the late Miocene. Most of the mixed mesophytic taxa (Juglandaceae, Tiliaceae and Platanaceae) so characteristic of the early Tertiary were apparently already extinct in the Rocky Mountain region by the late Miocene. The Teewinot assemblages do not show the same fluctuations observed in Pliocene and Quaternary assemblages. Whether this is the result of a more-stable climate during the late Miocene cannot be determined as yet.

Literature cited

Faegri, K. and Iversen, J. (1975). Textbook of pollen analysis (3rd edition). Blackwell.

Hickey, L. J. (1977). Stratigraphy and paleobotany of the Golden Valley Formation (Early Tertiary) of western North Dakota. Geological Society of America 150, 180 pp.

Kapp, R. O. (1969). How to Know Pollen and Spores. Wm. C. Brown.

Love, J. D. (1956). Geologic history of Teton County, during Late Cretaceous, Tertiary and Quaternary times. Jackson Hole: Eleventh Annual Field Conference Guidebook. Wyoming Geological Association. pp. 140-150.

MacGinitie, H. D. (1969). The Eocene Green River flora of northwestern Colorado and northeastern Utah. University of California Publication in the Geological Sciences 83. 203 pp.

Moore, P. D. and Webb, J. A. (1978). An Illustrated Guide to Pollen Analysis. Hodder and Stoughton.

Sohn, I. D. (1956). Pliocene molluscs from Jackson. Jackson Hole: Eleventh Annual Field Conference Guidebook. Wyoming Geological Association. pp.120-123.

Taylor, D. W. (1956). Pliocene molluscs from Jackson Hole. Jackson Hole: Eleventh Annual Field Conference Guidebook. Wyoming Geological Association. pp. 123-126.

Wolfe, J. A. (1975). Some aspects of plant geography of the Northern

Hemisphere during the Late Cretaceous and Tertiary. Annals of the Missouri Botanical Gardens 62, 264-279.