CLIMATE AND DEPOSITIONAL ENVIRONMENT OF GLYPTOSTROBUS FOREST SWAMPS THAT FORMED THICK LOW-ASH COALS IN THE PALEOCENE POWDER RIVER BASIN

Satchell, L.S., Exxon Company U.S.A., Houston, Texas

The Late Paleocene Anderson-Canyon coals of the Fort Union Formation are sedimentologically interesting and economically important because of their thickness and low ash content in proximity to active clastic environments. Pollen analysis and petrography of cores show that most of the coal was produced by dense forests comprising almost pure stands of trees of Taxodiaceae and that the swamps accumulated a woody peat. The trees were probably of the genus Glyptostrobus, the East Asian swamp tree which is the most common taxodiaceous leaf type in Late Paleocene leaf floras of the area. Today, pure stands of Taxodium and Glyptostrobus grow in topographic low swamps where more or less permanent standing water excludes other swamp trees. This low-lying environment of taxodiaceous swamp forests has often served as a model for reconstructing the environments of deposition of Tertiary coals derived from Taxodium and Glyptostrobus.

The problem is that, in the low taxodiaceous swamps, economic peat deposits are not accumulating because of periodic flooding and sediment influx. Thus, the environment of deposition of the thick Anderson-Canyon coals cannot be compared to the environment of living taxodiaceous swamps (McCabe 1984). To exclude clastics from the swamp for the long periods needed to accumulate thick clean peats, sedimentological studies have proposed raised swamp models (McCabe 1984 and references cited therein). A swamp can build above the surrounding flood level as long as the water level in the swamp can be sustained at the surface of the peat. A higher water level is maintained by high rainfall which is evenly distributed throughout the year so that precipitation always exceeds evaporation (Moore and Bellamy 1976).

In contrast to the precipitation regime of a raised swamp, the low taxodiaceous swamps grow in climates with seasonal drought (in the southeast U.S. and southeast China). Both swamp genera are relict; in the Tertiary Taxodium and Glyptostrobus were widely distributed geographically and had broader climatic range. Thus, the present-day depositional environment of relict swamp forests in seasonally drought-prone climates is probably not a useful model for Tertiary taxodiaceous swamps. A sedimentological model may be prerequisite to reconstructing paleoenvironments and paleoclimates of swamp vegetation. Since precipitation, not vegetation type, determines the geometry of a peat, and since sedimentology supports a raised peat model for these thick Powder River Basin coals, I suggest that the Glyptostrobus forests formed raised swamps in a warm climate with high, nonseasonal rainfall.

REFERENCES