Cardott and Lambert (1985) proposed a single linear relationship to predict vitrinite reflectance values as a function of depth for the Woodford Shale within the Anadarko basin. They tested their proposed relationship by comparing published vitrinite data with that predicted by the regression. Several measured reflectance values proved to be significantly less than those predicted by the regression. Cardott and Lambert implied that the lack of correlation is due to analytical and interpretive error, the need for some refinement in the regression, and the presence of a thermal anomaly within the basin.

We believe, however, that the observed discrepancies may be more fundamental, particularly those observed in deeper samples where much of the variability occurred. A single regression relating reflectance to depth of an individual unit does not take into consideration natural geologic variation due to analytical and interpretive error, the need for some refinement in the regression, and the presence of a thermal anomaly within the basin.

Within the Anadarko basin, present geothermal gradients range from 20°C/km to 24°C/km (1.1°F/100 ft to 1.3°F/100 ft) (Cheung, 1978; Harrison et al., 1983). With such variations in gradient, differences in subsurface temperatures greater than 10°C (18°F) may be expected at depths as shallow as 2.5 km (8,200 ft). A difference of 10°C (18°F) in absolute temperature would result in an approximate doubling of the maturation rate (Waples, 1980). At depths of 7.5 km (24,600 ft), variations as much as 30°C (54°F) are possible. Such a variation could result in an eight-fold difference in maturation rate. Over time, such differences in maturation rate would clearly be manifested in the observed maturity levels, even if the stratigraphic units had similar burial and erosional histories.

Furthermore, a single regression of vitrinite reflectance data with depth would also have to assume either continuous subsidence and deposition throughout the basin or that any unit at a given subsurface depth anywhere in the basin would have a similar burial history. Adler (1971) and Fay et al. (1979) pointed out that, in the Anadarko basin, neither is the case in post-Woodford time. The pre-Desmoinesian and pre-Morrowan unconformities, which represent Pennsylvanian uplift and erosion, vary across the basin.

The variation in the magnitude of these tectonic episodes throughout the basin clearly impacted the burial and thermal histories and, hence, the level of thermal maturity throughout the pre-Morrowan sequence across the basin. In those portions of the basin which have a continuous post-Chesterian section, the Woodford Shale would have had continuous burial and, hence, a continuous increase in vitrinite reflectance. In contrast, in those portions of the basin where erosion occurred, the cooling associated with the removal of sedimentary overburden may have been sufficient to “freeze” the observed level of thermal maturity (Hood et al., 1975). These differences in burial history could impact any regression by bringing samples of varying maturities to shallower depths. In addition, since uplift and erosion have been more important on the basin margins (Fay et al., 1979), a biasing of any regression toward higher maturities at shallow depths would also exist.

We believe that in situations similar to the Anadarko basin, where a significant amount of spatially distributed thermal maturity data are available, a better understanding of maturity as it relates to regional geology can be accomplished by contouring such data. Cardott and Lambert did provide such a display (their Figure 3), and for this we commend them.

REFERENCES CITED


