# KANSAS GEOLOGICAL SURVEY
# OPEN-FILE REPORT 77-17

## VITRINITE REFLECTANCE MEASUREMENTS

by

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Kansas Geological Survey
Open-File Report 77-17

Cook, KGS
open file
77-17

## Vitrinite reflectance measurements

(Progress as of early January 1977).

Sixteen specimens from nine locations in Kansas were examined and where possible the mean maximum reflectance of the vitrinite was determined. Eight of the locations were in the Cherokee Group and one in the Douglas Group. In one sample the stringers of vitrinite were too thin and heavily mineralized for a useful determination to be made, and in a further sample no vitrinite was found. All of the material from the Cherokee was judged to be autochthonous from combined examination in hand specimen and under the microscope. The Clinton Dam material may be autochthonous and, if allochthonous, shows no evidence of the kind of reworking or oxidation which would invalidate its use as an indicator of the level of organic metamorphism for that horizon and location.

The distribution of the results presently available is far from ideal but shows that the rank of coaly material is relatively low in the northeast with increasing values to the south and west. Within this overall pattern the values obtained within Ness County are lower than what appears to be the overall trend and the values from Kukuk 25 in Cowley County are similarly higher.

In terms of the conventional ideas of the oil generation zone (0.50% to 1.00% vitrinite reflectance), the Cherokee Group lies at the extreme top of the zone in the northeast of Kansas and just below the "oil deadline" in Wichita County in western Kansas. Since sampling has so far been confined essentially to the one horizon, no indications of the vertical rank gradient are as yet available. Therefore it is not

possible to draw conclusions about the possible location of the upper and lower boundaries of the oil generation zone except in the generalized terms used above.

In relation to the lower oil deadline two points should be made. Firstly, it is possible (although generally not considered a "normal" phenomenon) for oil to migrate back down into horizons below the oil "deadline" when temperature conditions become less severe as may occur with the removal of cover or with a decrease in the geothermal gradient. Secondly it has been noted in both Germany and Australia that oil accumulations may be associated with vitrinite reflectance of up to 1.30%, although in the Australian cases the oils are of extremely high API gravity (typically in excess of 45°).

From the preliminary information obtained on vitrinite reflectivity it appears probable that a large part of the Pennsylvanian succession in northeast Kansas is too immature for oil to have been generated. If the Ness County results are representative, the same may hold, for some parts at least, of the area of the Central Kansas Uplift. It also appears probable that the succession below the Pennsylvanian in large parts of south and west Kansas is below the main zone of oil generation.

The maceral composition of the Cherokee coals in eastern Kansas is characterized by a relatively high percentage of exinite derived from spores and to a lesser extent cuticles. No alginite was noted. If this is representative of the organic matter in the assoicated sediments the latter would be expected to be a source dominantly of paraffinic oil with large volumes of gas. The coal particles and phytoclasts present in the western samples (Ness and Wichita counties) also have a relatively high exinite content. This suggests that a similar provenance of terrestrial organic matter may have been in evidence in western Kansas in

Cherokee time as in eastern Kansas, notwithstanding the general absence of coal seams in western Kansas.

Further work.

Additional samples will be collected and determined to widen the geographic range of sample points. An attempt will also be made to measure vertical gradients in at least the western portion of Kansas to try to locate more precisely the zone of oil generation.

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1/10/77

| Sample No. | County | Name | Depth | Sample | $\bar{R}_{max}$ |
|---|---|---|---|---|---|
| K2 | Bourbon | Shell Kansas #2 | 381' | Coal | 0.67% |
| K3 | Johnson | Brazos Haver | 517' | Coal | 0.53%<br>0.56% dupl. |
| K13 | Johnson | Brazos Haver | 517' | Coal | 0.53% |
| K5 & K6 | Douglas | Clinton Dam | Surface | Vitrinite stringers in ss. | 0.51% |
| K30 & K31 | Ness | Sinclair Prairie | | Vitrinite stringers in ss. | 0.68% |
| K32 | Ness | Tilley #2 | | 3 Coal grains in shale | 0.63% |
| K33 | Ness | Tilley #2 | | Carb. shale | (N/D but >0.33%) |
| K34 | Ness | Kern Landos Moore #1 | | Clay shale | (N/D) |
| K35 | Cowley | Kukuk #25 | | Ss. with vitrinite stringers | 0.98% |
| K36 | Cowley | Kukuk #25 | | Vitrinite grains extracted from ss. | 1.03% |
| K37 | Crawford | Croweburg Coal, 15 28S 25E | Near Surface | Coal | 0.70% |
| K2G & K2GA | Wichita | Lauck Lehman | 4849-50 | Hand picked coal and vitrinite out of seat earth | 1.05% |

N/D - no determination possible

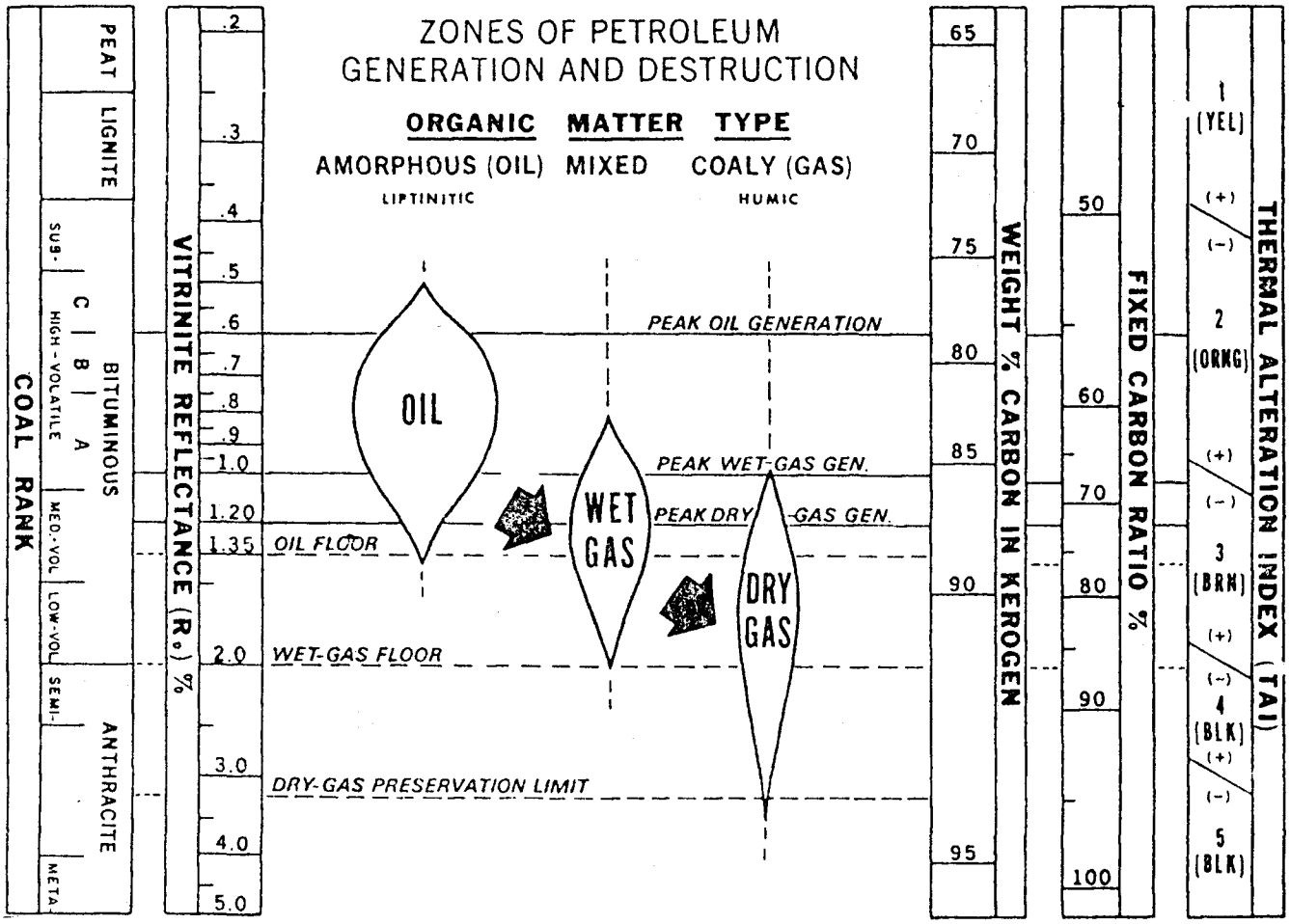


FIG. 2 Correlation of coal-rank scale with various maturation indices and zones of petroleum generation and destruction. Relative importance of each petroleum-generation zone depends on composition of original kerogen. From Dow (1977b).

teria of organic richness, kerogen type, and thermal maturity.

Potential Souce Bed—A unit of rock that has the capacity to generate oil or gas in sufficient quantities to form commercial accumulations but has not yet done so because of insufficient thermal maturation.

## PRODUCTION AND ACCUMULATION OF ORGANIC MATTER

### Organic Productivity

Production and accumulation of organic matter are the first stages in the formation of petroleum source beds. The basis for the production of primary organic matter is photosynthesis which occurs on land or in the upper 200 m of the sea. At present, terrestrial plants and marine phytoplankton produce about equal quantities of organic carbon. Terrestrial organic matter is most common along continental margins, especially in areas of major river runoff. Marine organic-matter production is controlled by light, temperature, and the nutrient content of seawater. Upwelling of deep ocean water can introduce large quantities of nutrients such as phosphate and nitrate into the euphotic zone, resulting in areas of high organic production. Upwelling is controlled primarily by trade winds and Coriolis forces and is most common along the west coasts of continents (Fig. 3). Areas of upwelling correlate closely with areas of high, marine organic productivity (Fig. 4). These areas contain some of the richest known source beds.

Sediments deposited along the east coasts of continents typically contain a greater percentage of detrital terrestrial-organic matter as a result of lower productivity of marine organic matter. Marine productivity is important because marine phytoplankton contain abundant lipids and lipid-related compounds which are the most important precursors of petroleum. Terrestrial plants, however, are rich in hydrogen-deficient skeletal material which primarily yields gas rather than oil. Some components of terrestrial kerogen such as spores, cutin, resins, and waxes are capable of yielding wet gas and paraffinic oils, if they are sufficiently concentrated. Nearshore reducing depositional environments, either marine or more commonly lacustrine, typically contain this kerogen type.

### Organic-Matter Accumulation

Incorporation of organic matter into sediments ultimately depends on processes which not only con-