	decrease in abundance of primary dolomite grains
Transgressive	Upward decrease in maximum and median grain diameter; upward increase in abundance of primary dolomite grains
Non-marine	Wide range of grain sizes; primary dolomite grains absent; abundant carbonaceous material

These petrographic properties may be used to identify and correlate units in problem areas.

8. DONALD R. BAKER, Marathon Oil Company, Littleton, Colorado

PETROLEUM EVOLUTION: PROGRESS AND PROBLEMS

The three-fold concept of the *origin* of hydrocarbons from organic materials in a source bed, their primary *migration* from the source rock during compaction, and their *accumulation* in traps, has been a part of geological philosophy since the early days of petroleum exploration. But except for adding some substantiating geologic evidence, it was not until the talents of chemists, biologists, and physicists were directed at these problems that new information with profound implications to concepts of petroleum evolution was obtained.

For example, studies of carbon isotopes in sediments and crude oils suggest that terrestrial plants, instead of marine plants and animals, may be the principal primary substance from which petroleum is derived. Further, the discovery of hydrocarbons in Recent sediments demonstrated the early formation and availability of petroliferous materials in depositional basins. However, characterization has revealed differences in the nature and abundance of hydrocarbons in Recent sediments compared with crudes and ancient rocks, indicating that modification and formation of hydrocarbons during diagenesis may be essential for the development of a source rock. Further, the distribution and character of hydrocarbons in ancient sediments indicate that some environments lead to the generation of more hydrocarbons than others, confirming the geologic opinion that there is a considerable range of variation in the nature of petroleum source beds. However, the recognition and evaluation of source rocks on the basis of absolute hydrocarbon content may be an oversimplification in that the hydrocarbons may not be indigenous, or may have formed subsequent to primary migration, or that some rocks may have yielded only a small part of their indigenous hydrocarbons. Finally, comparison of crude oil-source rock pairs indicates that the development of geochemical correlation techniques will be difficult and complicated by the likelihood that primary migration is inefficient, selective, and probably causes considerable modification of hydrocarbons en route.

Although contributions of non-geologists are essential, laboratory results will probably remain obscure unless interpreted in the light of a thorough knowledge of geological factors. The problem of petroleum evolution seems ripe for an integrated attack by geologists supported by physicists, chemists, biologists, and geochemists. The belief that an ultimate comprehension of petroleum evolution can only be developed by the interpretation of experimental and analytical data on a sound geological basis should be the underlying philosophy of future research on petroleum evolution.

9. J. D. LOVE AND W. R. KEEFER, U. S. Geological Survey, Laramie, Wyoming

CONTRASTING TECTONICS OF CRUSTAL BLOCKS IN CENTRAL AND NORTHWESTERN WYOMING

In northwestern Wyoming the northern part of the Green River basin was overridden first by the Hoback Range from the west and later by the Gros Ventre Mountains from the northeast. The fault plane underlying the Hoback Range dips 10–30° westward and southwestward; that under the Gros Ventre Mountains, where observed, dips north and northeast about 45°. Eastward displacement of the rocks in the Hoback Range was of such magnitude that it brought markedly contrasting facies within 2 to 4 miles of one another at the northern end of the Green River basin.

Major folding and faulting of most basin margins occurred during Paleocene and earliest Eocene time, but major deformation of the Gros Ventre Mountains was post-early Eocene. Magnitudes and types of movement are interpreted as follows.

Subsidence (in feet)	*Uplift*	*Heave along basin margin fault (in miles)*
Wind River basin (north-central) 16,000	Owl Creek Mtns. 17,500	2
Wind River basin (northeastern) 16,000	Bighorn Mtns. (south. margin) 16,000	3
Wind River basin (central-eastern) 14,000	Casper arch 7,500	1
Great Divide basin (northeastern) 12,000	Granite Mtns. 20,000	4
Great Divide basin (northwestern) 11,000	Wind River Mtns. (southern margin) 18,000	3?
Green River basin (north-N.E. margin) 17,000	Gros Ventre Mtns. (southeast end) 18,000	4
Green River basin (N.W. margin) 15,000	Gros Ventre Mtns. (west-S.W. margin) 20,000	5
Green River basin (N.W. margin) 15,000	Hoback Range (northeast end) 15,000	15+

10. WILLIAM C. PENTTILA, Atlantic Refining Company, Durango, Colorado

PRE-NIOBRARA UNCONFORMITY AND ITS RELATIONSHIP TO OIL ACCUMULATION—SAN JUAN BASIN

Major oil production in the San Juan basin is from isolated sandstone lenses in the Mancos shale of Upper Cretaceous age. These oil-productive sandstones have been termed Gallup, Tocito, or Horseshoe Gallup and have been described as offshore bars or strand-line features related to the regressive Gallup formation.

Detailed measured surface sections, electric log correlations, and faunal data indicate that the oil production is not from sandstones of the Gallup formation of