Heat influences size of oil giants

HEAT flow is the transfer of thermal energy from the interior of the earth to the surface where it is dissipated.

It is expressed in the rate of increase of temperature with depth as related to the thermal conductivity of the rocks in which the thermal gradient is measured. Oceans and continents appear to have the same mean heat flow ; (about 1.5 microcalories/sq cm/sec). However, it is believed that the oceanic mantle has higher temperatures as its mafic rocks apparently contain higher concentrations of radioactive elements than those of the continental mantle. Variations exist in recorded heat-flow measurements, such as a decrease in the heat flow away from oceanic ridges and low heat flow in the vicinity of subduction trenches. High-heat flow occurs on back side of island arcs and in rift zones. Russian authors conclude that in the continental areas of the USSR many of the heat-flow variations are due to the tectonics of a given area. More than 3,000 heat-flow measurements taken around the world indicate that there is generally low-heat flow in Precambrian shield areas, average-heat flow in cratonic areas, and high-heat flow in many Mesozoic-Cenozoic orogenic areas at the continental margins, Fig. 3.

Observed-heat flow is generally compatible with the hypothesis of sea-floor spreading and plate tectonics, that is, high along ridges where hot material is supposed to be rising and low near trenches where a cold plate evidently is descending, Fig. 3.

This is taken from a more extensive paper to be published in the Princeton University Press. From the conference on petroleum and global tectonics at Princeton on Mar. 10, 11, 1972.

The author . . .

H. Douglas Klemme

H. Douglas Klemme is vice-president of Weeks Natural Resources Inc., Westport, Conn. He joined that organization in 1969 after 17 years with American Overseas Petroleum Co., during which time he was exploration manager, Libya (1957-1959); exploration manager, Indonesia (1961-1963); and assistant chief geologist in New York (1963-1969). Klemme is an Iowan, and received his B.A. from Coe College in 1942. Following military service he received his M.A. and Ph.D. from Princeton University. He then worked with Standard Oil of California as geologist from 1949-1952. He holds memberships to AAPG, GSA, AGU, AAAS, and API.

Temperature and hydrocarbon formation. Depending upon the thermal conductivity of rocks, heat flow has a

Fig. 1

Clastic/hydrocarbon model

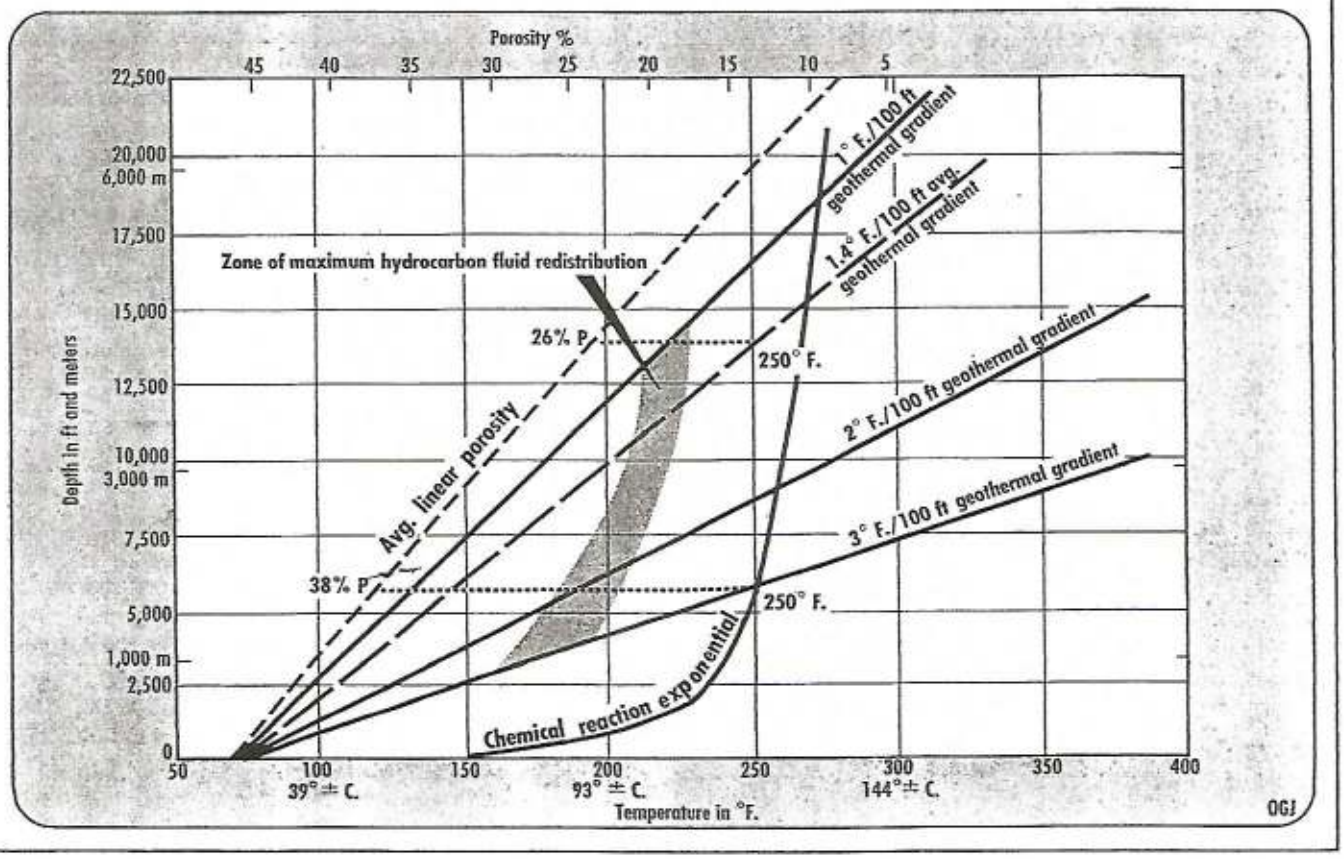


Fig. 4

Depth of production (reserves)

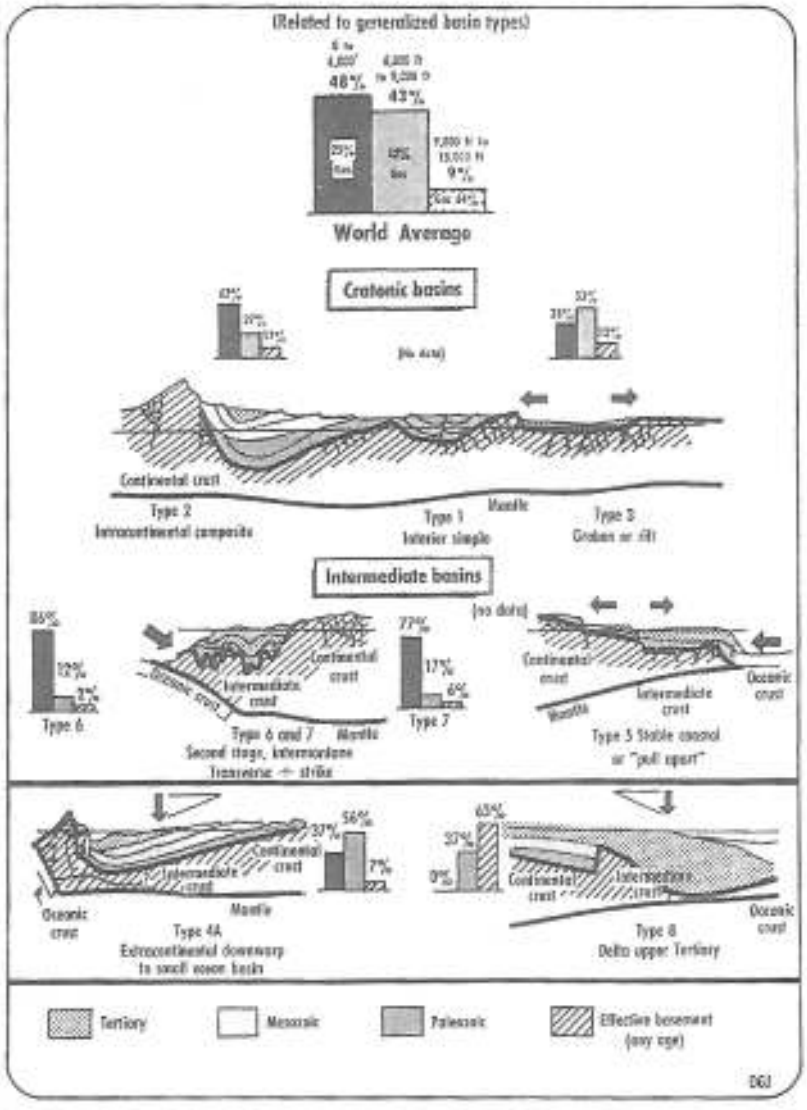
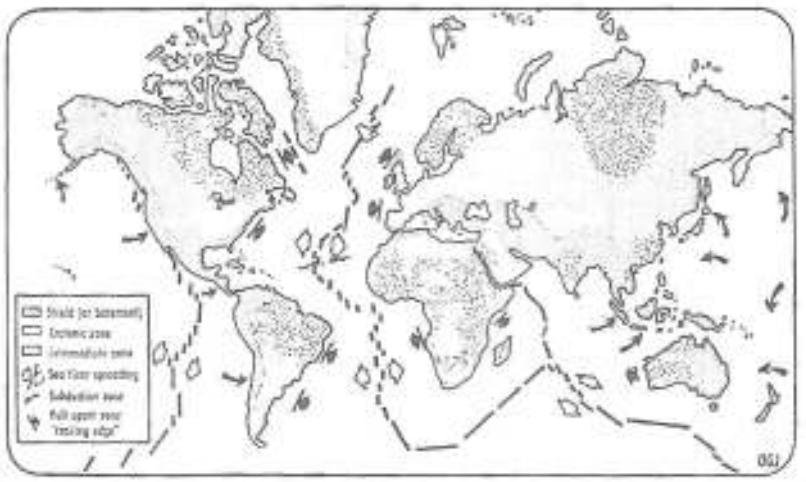


Fig. 3

World's basin zones



ubility.

Landes estimates that worldwide geothermal gradients range between 1.0 and 1.6° F./100 ft using deep wells below 15,000 ft. As an average, 1.4° F./100 ft could be used although extremes of 42° F./100 ft in the thermally active Imperial Valley to 0.3° F./100 ft in the Bahamas have been recorded.

Most authors generally agree and considerable field evidence indicates that shales are among the richest of sedimentary materials in organic matter—the source rock for hydrocarbons. Present analysis of shales indicates at least three phases of compressive dehydration. Burst (1969), using Gulf Coast data, has constructed a model of shale compaction, Fig. 1.

The first phase involves "squeezing" or discharge of pore water by compaction resulting from overburden pressure. A second dewatering phase appears to be related to thermal activity and possible clay transformation —as in the dehydration of montmorillonite—and results in the molecular discharge of water from clay interlayers (note zone of maximum hydrocarbon fluid redistribution Fig. 1). Montmorillonite contains and retains more water content than illite and kaolinite under compaction in lab experiments. The third phase is slow dehydration with little, if any, water or liquid-hydrocarbon movement. During this phase the density of the shales and their relative impermeability is increased.

Based on findings in the Gulf Coast, Burst has defined an interval in which maximum redistribution of pore water and hydrocarbons is most likely to occur. He documents this with field evidence based on the depth of production of the majority of the producing horizons in the Gulf Coast and assumes that hydrocarbon movement was initiated, mainly at the end of stage one and the beginning of stage two of his three-stage dehydration model. In this phase the hydrocarbons were then transported upward or laterally to the nearest reservoir and trap. It has been assumed that the petroleum moved either as globules or in micelle form (that is, as colloidal particles or like a soap suspension) during primary migration. Karstev and other Russian investigators concur with these findings and conclude that the "principle stage in the formation of petroleum corresponds with the reconstruction of

basins from which we have a history of over a 50-year period of development, including deep drilling, found 75% of their reserves in giant fields during the first 10 years of development. In these instances deep drilling has not added any substantial reserves. The temperature-related formation of oil and gas as outlined in Fig. 2 suggests an increasing percentage of gas to oil will be present at depths below 12,000 ft. It therefore seems doubtful if the amount of oil to be found below 9,000 ft will be equal to that found between 6,000 and 9,000 ft.

END PART 1

Michigan's oil map widens almost by the week

THE Niagaran play in Michigan's northern and southern counties is moving so fast that mapmakers are having a tough time keeping up with it.

Jacobson Map Co., 315 Mayo Building, Tulsa 74103, has an updated map of the region, highlighting the reef discoveries. Niagaran fields are shown in orange, other oil fields in green. Gas fields of other pays are shown in red. Official names, cities, towns, townships and ranges, township names, and gas storage fields are shown. Small insert gives a complete description of 1970 northern Niagaran discoveries. Size is 28 x 30 in. Scale is 1-in. = 12 mi.

NEW MEXICO

DUAL zone gas production is reported at a New Mexico discovery well.

The Eddy County strike is El Paso Natural Gas Co. 1 Sundance Federal, 30 miles southeast of Carlsbad in 4-24s-31e. Flow was 2,608 Mcfd from the Morrow Pennsylvanian through perforations at 14,264-14,379 ft. Flow from the Atoka Penn at 13,691-99 ft was 3,251 Mcfd. Location is 3 miles southwest of Morrow gas and 4 miles southwest of Atoka gas in the Delaware basin.

COMPLETION is reported at a field confirmation in Southeast New Mexico's Eddy County.

Midwest Oil Corp. completed 2 South Empire Deep Unit as the second well in the new Morrow Pennsylvanian gas area 7 miles southwest of Loco Hills. The well flowed 19,100 Mcfd plus 24 bbl condensate per million. Location is in 6-18s-29e, ¼ mile south of the field discovery well.

A NEW oil well is reported near Hobbs in Lea County, Southeast New Mexico.

Frank D. Graham, Jr., Pubco Petroleum Corp. head, says the 2 Shipp flowed 758 b/d, 45° gravity, on ⅜-in. choke from Strawn Pennsylvanian through perforations at 11,430-68 ft. Well is in 11-17s-37e.

This well confirms the discovery in NE¼ 11-17s-37e. That March 1972 discovery flowed 624 b/d.

OKLAHOMA

IN the Oklahoma Panhandle, Hickerson Oil Co. 1 Miles, S½ N½ NW 17-4n-24eCM, Beaver County, flowed 28,000 Mcfd on tests of the Morrow Pennsylvanian at 6,314-19 and 6,575-80 ft.

The Mocane District well lies in the eastern section of the Oklahoma Panhandle in the large Morrow gas producing region.

UTAH

A SOUTHERN Utah prospect flowed 200 b/d and 750,000 cu ft of gas on tests of the Salt Wash Morrison Jurassic.

New well is Toledo Mining Co.'s 2 Bull Canyon unit in NE NW 9-20s-21e, Grand County. Tests continue. This discovery is about 1 mile northwest of Cisco Dome field and about 1 mile south of the 1 Bull Canyon unit in NE NW 4-20s-21e, another Salt Wash oil indicated strike.

That well flowed 150 bbl oil and 1 MMcfd on tests. Production is from 3,645 to 3,674 ft.

SHELL Oil Co. has another big one in Utah's Altamont field, Duchesne County.

The 1-36-A4 Ute, NE NE 36-1s-4w, flowed 2,655 b/d on completion test. Pay was the Wasatch Eocene at 12,382 to 14,014 ft. Flow was on 26/64-in. choke.

Shell also has one at 1-7B-4 Shell-Gulf-Tenneco-Farnsworth in SE NE 7-2s-4w. Flow was 1,860 b/d and 1,753 Mcfd from Wasatch through perforations at 12,022 to 13,124 ft on 35/64-in. choke.

BOOKS

JAPAN CHEMICAL DIRECTORY, 1972. Published by Japan Chemical Week, 19-16, Shibaura 3-chome, Minato-ku, Tokyo. 1972. 448 pp. $25.00.

This directory lists all those in the chemical business in Japan. Equipment people, chemicals, traders, associations, buyers' guide-chemicals containing maker's addresses, alphabetical index, and advertiser index.

THE country's busiest exploratory play is in the Southeast where new Jurassic fields are being opened.

This busy area has been mapped by E. C. Jacobson Maps Co., 315 Mayo Bldg., Tulsa 74103. His May No. 43 (Jurassic fields of Southeast) has been updated to show all new fields. Jurassic fields are in orange, all others in red and green (gas and oil). Official field names are listed, cities, towns, townships, ranges, and counties. Structure contours on top of Jurassic Haynesville or Smackover are shown.

STRUCTURAL GEOLOGY OF SOUTHWESTERN ONTARIO AND SOUTHEASTERN MICHIGAN. By Robert J. Brigham. Published by Mines and Northern Affairs Petroleum Resources Section, Ontario. 1972. 110 pp.

The subtle but definite structure of Paleozoic sediments in southwestern Ontario has received little attention and, due to the low regional dip and scarcity of outcrops, most geologic information is available only from the records of wells drilled for oil and gas. Prior to the advent of the Ontario Well Data file, regional studies required time-consuming searches of the files maintained by the Ontario Department of Mines & Northern Affairs, the Geological Survey of Canada, and the various oil companies. The Ontario Well Data file and associated computer programs made possible both regional and detailed study of the structure of a selected area of southwestern Ontario. The study area was extended across the international boundary into southeastern Michigan by utilizing data from a comparable file made available by Petroleum Information of Denver.

Note: The Oil and Gas Journal maintains a book department. Write to the Book Department, PO Box 1260, Tulsa, Okla. 74101, for copies of the book list.