marine sediments collected from the Atlantic and Pacific oceans and from other areas. The equation is

$$\gamma = 2.232 - 0.0129w + 0.000064w^2.$$

The range of water contents covered by the measurements is from 30 to 240% by dry weight, and the range of bulk densities from 1.25 g/cm^3 to 1.95 g/cm^3. Using this equation, the water content can be calculated, with a standard deviation of 2.3, from a measured bulk density.

It also is possible to calculate specific gravity of solids (G) and void ratio (e) directly from water content and bulk density for water-saturated sediments. The relationships are:

$$G = \frac{100\gamma}{(100 + w - w\gamma)\rho_t}$$

and

$$e = \frac{w\gamma}{(100 + w - w\gamma)\rho_t^2},$$

where ρ_t is the density of pore water at temperature t. The use of these relations may save appreciable time by eliminating or reducing the quantity of laboratory measurements made on sediment cores by geologists and soils engineers. The study of consolidation by the use of sedimentation-compression (e log p') diagrams may also be greatly facilitated when using nuclear methods of measuring bulk density and deriving water content from these measurements.

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ENVIRONMENTAL QUALITY CONTROL AND MINERALS

In the past several years protection of the environment has become a major factor affecting the production, transportation, and utilization of all types of mineral commodities. Examples of its effects are found throughout the minerals industry. Zoning restrictions and public pressures are barring the production of industrial minerals from some of the most favorable sites; proposals have been made to prohibit further offshore drilling for oil and gas; and strip mining of coal has been prohibited in steep terrain. Concern for environmental damage is delaying construction of the Trans-Alaska Pipeline System and the availability of an important new source of crude oil. Air quality controls that have been proposed or placed in effect are of such a nature as to eliminate the use of much of the coal and residual oil now being consumed and ban the use of lead in gasoline as an antiknock additive.

The steady increase in the number and scope of environmental regulations will have widespread effects. They will affect the availability of resources and change the methods and sources of mineral production, which will result in shifts in the patterns of mineral consumption and, inevitably, increased costs to the consumer.

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STRATIGRAPHIC TRAP CLASSIFICATION

A trap for hydrocarbons requires the simultaneous existence of (a) a reservoir, (b) an isolated region of low potential in the reservoir, and (c) a barrier (or seal) having high enough entry pressure to retain a commercially producible volume of hydrocarbons. Three kinds of traps may exist—structural, stratigraphic, and hydrodynamic. All 3 kinds have a reservoir bounded by a barrier, but differ in the cause of the isolated area of low potential. In classifying hydrocarbon accumulations, the conditions that determined the present location of the accumulation should be used where these conditions can be determined.

In the stratigraphic trap classification suggested here, primary emphasis is placed on usability; i.e., will the groupings help in searching for new hydrocarbon accumulations and is the suggested terminology simple and descriptive enough to be accepted? A classification using the time relations between barrier and reservoir was considered but rejected.

The suggested classification begins with the simple concept that stratigraphic traps are adjacent to unconformities or they are not. For traps that are not adjacent to unconformities, the reservoir and barrier may either be (I) primary (depositional, and usually facies related) or (II) wholly or in part secondary (diagenetic). Those traps in contact with unconformities may either be (III) below the unconformity surface or (IV) above it. This approach uses some but not all of Levorsen's ideas and eliminates some inconsistencies in his classification. These 4 major classes (facies, diagenetic, below unconformities, and above unconformities) can be subdivided with appropriate terminology to identify the different types.

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ORIGIN OF COLORATION IN UPPER DEVONIAN CATSKILL FACIES, NEW YORK

Mineralogic and chemical studies of interbedded red and greenish-gray sandstone, siltstone, and mudstone from the Upper Devonian Catskill facies in New York indicate that the red coloration is a result of the presence of diagenetic red hematite pigment. Thin sections of red sandstones show hematite partly replacing rock fragments composed of fine-grained mica and chlorite, as well as coating sand grains and forming patchy interstitial matrix material. Hematite is absent at many sand-grain contacts in red rocks.

X-ray diffraction studies of powdered rock samples and oriented clay aggregates show that the greenish-gray rocks are illite poor and chlorite rich relative to interbedded red rocks. X-ray diffraction intensity data indicate that chlorite is more iron rich in green or drab rocks. There is no significant difference in the total iron content of interbedded red and greenish-gray rocks; however, small green patches in otherwise red rocks have significantly lower amounts of total iron than do the surrounding redbeds.

Iron-bearing opaque minerals are present in very small amounts in both red and greenish-gray rocks suggesting that iron precipitated as hematite was not derived from these minerals.

These results suggest that hematite in these redbeds has formed diagenetically under near-surface oxidizing conditions, largely controlled by the level of the groundwater table. Chlorite is believed to be the major source of the iron that has been precipitated as hematite. Except for localized green patches where reducing conditions prevailed because of the presence of organic matter, the greenish gray rocks are believed to be composed of detrital sediments that have undergone little alteration.