tiary to Devonian) and have a wide range in gravity (45 to 65° API). The highest gravity oils typically are in Tertiary units. Geochemical analyses show systematic compositional trends in the C^5 to C^{10} molecular weight range of these oils. Isoparaffins and cycloparaffins tend to increase in relative abundance, whereas normal paraffins and aromatics tend to decrease with increasing gravity.

It is proposed that these compositional trends result from fractionation during migration by accommodation in water. This origin requires that normal paraffins essentially be excluded at the onset of the migration event while aromatics are "swept" through the reservoir site. The enhanced isoparaffin and cycloparaffin content of the most fractionated oils is attributed to their intermediate solubilities. Exsolution of these hydrocarbons is attributed to solubility reduction caused by temperature and pressure decreases and the probable presence of a gas cap. Processes such as thermal fractionation and biodegradation fail to account satisfactorily for observed compositional trends of these oils.

The wide range in reservoir ages and gravities of the oils in the Santa Cruz basin, coupled with the likelihood that the oils were derived from a single source, provide a natural laboratory in which the chemical effects of migration-fractionation can be studied.

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Oil Geochemistry As Exploration Tool

Oils represent a final product of physical and chemical processes within a basin. As such, they contain compositional attributes that can be utilized to describe the conditions through which they evolved. Data obtained from high-resolution gas-liquid chromatographic and mass-spectrometric analyses of whole oils substantially reduce exploration risk by providing information concerning fluid characteristics. Some of the information that can be deduced from the analysis of oils is: the number of sources, alteration during migration or after accumulation, and mixing of oils derived from one or more sources. Oil geochemistry assists in evaluating the probable numbers of potential reservoir zones, the possibility of encountering "cross-stratigraphically" migrated oils, and the probable value of potentially exploitable reservoirs.

The effective use of oil geochemistry depends on the availability of accurate and precise analytic data. Some significant applications involve whole-oil, gas-liquid chromatography, distribution of sulfur-bearing organics, distillation curves, and mass-spectral data. The efficient treatment of data obtained from oil analyses is central to the problem of producing a succinct interpretive statement meaningful to management. Data reduction and manipulation techniques are also important.

The occurrence of oils within a region is the ultimate demonstration of the presence of source beds and the dynamics of migration and accumulation. Oils should be exploited to obtain a view of the potential of a region because, in nonfrontier areas, samples are often available before major exploration commitments are required.

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Dolomitization of Offshore Carbonate Deposits in Hammett Shale, Lower Cretaceous, Texas

The Hammett Shale (Lower Cretaceous) represents the offshore marine equivalent of overlying carbonate beach (Cow Creek Limestone) and alluvial (Hensel Sandstone) deposits of Aptian age which prograded shelfward off the southeast margin of the Llano uplift in central Texas. Interbedded and intermixed dolomites and limestones compose most of the upper part of the Hammett Shale and, within this section, dolomites decrease in abundance upward. Dolomites are primarily echinoid-oyster wackestones with clay-rich, medium crystalline dolospar matrix. Limestones are mollusk packstones-wackestones with clay-poor microspar and pseudospar matrix. The dolomites were most likely deposited on a grass or algally stabilized seafloor, whereas the limestones represent units deposited in higher energy environments.

Dolomitization probably took place during shallow burial as the beach sequence prograded eastward, and the regional, fresh-groundwater flow system invaded the marine sediments. Carbonate packstones resisted dolomitization because of original differences in mineralogic composition, and because they were semilithified. They were fractured prior to dolomitization, and have sharp contacts with dolomite. Carbonate wackestones underwent dolomitization because they initially contained more magnesium (high-magnesian calcite, mixed-layer illites, and chlorite), and fine detrital dolomite which acted as seed crystals. Dolomites often display flow-aligned bioclasts parallel with their contacts with limestones, indicating that they were somewhat fluid at the time of limestone lithification, thus allowing the dolomitizing waters to pass through more effectively. Although the marine interstitial water, the fresh water draining Llano uplift Paleozoic dolomites, and the hydrodynamics of the zone of water-mixing provided the means of dolomitization, original sedimentologic differences were a key factor as well.

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Geochemistry of South Texas Uranium Deposits

During the past several years attempts have been made to unravel the geochemistry of south Texas uranium deposits by analyzing core samples obtained from several localities within the mineralized province and from various prospective mines.

The core samples were taken from three different sections of the geochemical cell—the oxidation, ore, and protore zones. All samples selected for analysis belong to the same stratigraphic interval as the ore zone.

Measurements of pH and Eh taken in the field range as follows: oxidation zone, pH 7.2 to 5.6 and Eh −60 mv to +50 mv; ore zone, pH 4.1 to 3.6 and Eh +210 mv to +155 mv; protore zone, pH 2.6 to 4.2 and Eh +210 mv to +180 mv.

Analyses of total organic carbon, pyritic sulfur, and uranium have also been conducted. The total organic

carbon content is generally low, but increases toward the protore to approximately 0.273%. Although the occurrence of pyritic sulfur is low in the oxidation zone, it increases from 0.015 to 0.696% in the protore. Evidence also indicates an increase with proximity to the roll front. Uranium is most prevalent in the ore zone, with a maximum value of approximately 290 ppm for the samples studied. In the protore, it ranges from 37 to 44 ppm.

Adsorbed hydrocarbon analysis shows little evidence of petroleum migration from the downdip section of the deposits thus far analyzed.

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Correlation of Continental-Margin and Deep-Sea Sequences—Neogene Examples from Pacific

The Deep Sea Drilling Project (DSDP) has produced fundamental advances in Cenozoic planktonic biostratigraphy and our understanding of the Cenozoic paleooceanographic and paleoclimatic history of the world ocean. These new insights and data serve to increase the precision and resolution of provincial biostratigraphies and correlations commonly applied to continental-margin sequences, and thus result in more accurate reconstructions of margin histories. DSDP-IPOD Legs 18, 19, 31, 57, and 63 included drill sites close to tectonically active continental margins surrounding the North Pacific. They provide clear examples of correlation of deep-sea and epicontinental marine deposits in Mexico, California, Japan, and Korea. In particular, DSDP Site 173 off northern California has yielded an important lower Miocene through Pleistocene (N4-N22) reference section, demonstrating the usefulness of DSDP data for interpretation of margin biostratigraphic, sedimentologic, and tectonic events on a regional scale. Multiple siliceous and calcareous plankton zones within this sequence provide an average biostratigraphic resolution of 0.5 m.y. with paleo-oceanographically induced biofacies trends marking zones of special value for interbasin correlation across latitude. Many of the planktonic datums and biofacies trends clearly defined in the thin (320 m), but nearly complete, Neogene column at DSDP Site 173 can be readily recognized in the thick paleoenvironmentally diverse and structurally disordered, continental-margin deposits now exposed along the Pacific Coast of North America. These correlations provide a framework for calibrating provincial biostratigraphic units; estimating rates of sediment accumulation, subsidence, and uplift in margin sequences; and hindcasting periods of increased primary productivity, variations in the oxygen-minimum layer, and deposition of sediments favorable for hydrocarbon generation.

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United States Petroleum in World Energy Perspective

The recent exponential growth in the numerate handling of energy resource data has not been matched by increased knowledge of basic concepts and adequate gain in hard facts. Constant reiteration of those concepts and of the softness of most "facts" is necessary in order to avoid the dangers of pseudo-precision. This is true for both potential supply and potential demand. Consumption will be dictated increasingly by available supply. This is the reverse situation from that of the past 30 years. Increasing scarcity will not only enhance the importance of discovery forecasting but will emphasize the interdependence of all factors affecting the worldwide supply and demand balance. No one energy source and no one country can be considered in isolation. Petroleum and the United States are no exceptions.

Petroleum must be considered in the context both of other energy sources worldwide and in its optimum end-use future. The United States is only one unit in what may well be an energy-hungry world. Its own needs and the success of its petroleum industry, both in domestic and foreign fields are important, but their relevance, both locally and globally, depend on both discoveries and demand in many other countries.

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Lateral Diagenesis in Monterey Shale, Santa Barbara Coast, California

Lateral differences in Monterey strata along the Santa Barbara coast indicate increased diagenesis toward the west. Westward, silica alters from biogenic amorphous opal (in diatom frustules) to diagenetic opal-CT, and then to diagenetic quartz. Continuous exposure for 50 km, simple homoclinal structure, paleogeographic setting, and detailed analysis of 14 stratigraphic sections together show that sediments were laterally equivalent, as originally deposited. Distinctive stratigraphic differences in sediment composition, informally divided into five members, are also laterally age-constant.

Because silica phases differ in rocks of the same age, same depositional environment, and with identical bulk chemical composition, the differences must reflect post-depositional conditions. Overburden thicknesses and thermal changes in organic matter indicate that diagenesis increased westward owing to greater burial temperature.

Study of sample sets taken laterally shows that both silica phase changes occurred by rapid solution-precipitation accompanied by significant compaction, and by little movement of silica between beds. Distinctive field characteristics (hardness, brittleness, bulk density, and luster) changed mainly during opal-CT formation.

Although these changes affected rocks of nearly all compositions, details varied—even in carbonate-rich rocks—with the proportion of detrital material to biogenic or diagenetic silica. As this proportion increased, opal-CT formation was retarded, accompanying compaction decreased, "ordering" of opal-CT increased, and quartz formation was promoted. Nearly identical timing relation in associated calcareous, dolomitic, and carbonate-free rocks show that silica diagenesis was unaffected by carbonate except in rocks containing at least 10 times more silica than detrital material.