$\delta^{13}C$ values (PDB)—of dolomites in the Monterey Formation, California, and in recent sediments in the Gulf of California, controlled by the CH_4/CO_2 ratio; and (3) the often observed similar oxygen isotope values of coexisting calcites and dolomites in limestones which were dolomitized by seawater mixed with large volumes of fresh water.

Thus, in low or sulfate-free environments, dolomitization of $CaCO_3$ and the formation of primary dolomite are limited by supply of alkalinity, calcite or aragonite, or dissolved Ca^{2+} or Mg^{2+}. Even in the absence of sulfate, dolomitization may be retarded or inhibited by the transformation of opal-A to opal-CT, a reaction which can compete with dolomite for available Mg^{2+}.

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Use of Vertical and Surface Seismic Profiles to Investigate Distribution of Aquifers in Madison Group and Red River Formation, Powder River Basin, Wyoming-Montana

Intensive energy development activity in the Powder River basin area of eastern Wyoming has placed heavy demands on the limited water resources of the state. Water cannot be obtained from streams, rivers, or shallow wells to support coal-slurry pipelines, coal gasification, shale retorting, or even in many places enlarged municipal water systems. The U.S. Geological Survey is, therefore, promoting the water resource potential of the Madison Group and Red River Formation. Such water is to be produced from depths of 2,500 to 7,500 ft (762 to 2,286 m) to supply some of the needs cited.

Because deep water wells are expensive, and Madison-Red River productivity varies drastically throughout the area, it is highly desirable to select drilling sites with a high probability of good water production. The exploration seismograph is a promising tool to aid in site selection. The object of the investigation was to determine under what conditions the exploration seismograph can be used to detect porosity development at depth in the horizons of interest, an application which also has obvious significance to the petroleum industry.

In-situ measurements of the acoustic properties of the Madison-Red River interval have been made using vertical seismic profiles in several wells. Surface seismic profiles were then run over the wells in which vertical seismic profiles had been made. The combination of these results, together with well log data and regional geologic subsurface studies, give one considerable insight into the problem of exploring for commercial quantities of water at depth.

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Multichannel Measurements Over a Possible Gas-Bearing Structure Near Cay Sal, Bahamas

Multichannel reflection measurements in water depths of 500 m reveal an asymmetric anticline 70 km southeast of Cay Sal Bank. This fold has an apparent width of 10 km. The northern flank has a maximum relief of 1 km, and the southern flank's maximum relief is 400 m. North of this structure, in Santaren Channel, coherent reflections occur throughout our 5-sec record. Depth at 5 sec is approximately 10 km. South of the anticline, reflections are discontinuous below 1 sec, and no coherent reflections can be seen below 2 sec. A strong reflection at 2.3 sec in Santaren Channel (approximately 3 km depth) probably marks a middle Cretaceous unconformity. Seismic units inferred to be youngest Cretaceous and Paleogene show maximum thinning over this fold. The Upper Cretaceous sequence shows maximum structural relief here. Amplitude anomalies occur on the crest. Reflections from the uppermost Cretaceous to Paleogene section are dim above reflections from inferred Upper Cretaceous units that contain several bright spots. Some flat reflections on the structure may stem from gas-liquid contacts.

Ten kilometers south of the asymmetric anticline, a tilted block that may be composed of platform carbonate rocks rises to within 0.3 sec of the sea floor. This block has an east-west dimension of more than 20 km and a maximum relief of 1.3 km. A Lower Cretaceous carbonate platform edge underlies 800 m of water and 1.5 km of sediment at the junction of Nicholas Channel and Florida Straits. In Florida Straits, a strong reflection correlates with the middle Cretaceous unconformity.

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Organic Geochemistry as a Geologic Tool

Recent advances in techniques for analyzing organic matter, together with improved understanding of compositional changes with changing physical conditions, have led to the development of methods with considerable potential for providing insight into geologic processes. The physical character and chemical composition of organic matter change with temperature and can be used like a thermometer that is still reading its maximum value. As organic matter is extremely sensitive to past thermal effects, it responds at temperatures much lower than those needed to produce the mineral changes characteristic of the lowest grade of metamorphism. If values for geothermal gradient are known the actual depths of burial can be estimated from values for vitrinite reflectance and elemental composition. Faults or unconformities commonly show clearly in vitrinite reflectance plots and it is possible to use this information to calculate the displacement of the fault or the amount of overburden removed. Vitrinite reflectance and electron spin resonance have the potential for showing past geothermal gradients. The amount and type of organic matter in a rock are strongly influenced by the depositional environment. An obvious example is the presence of wood indicating input from terrestrial sources. A variety of characteristic organic compounds (biological markers) have potential as environmental indicators. The role of organic matter in controlling conditions, especially Eh, is well known but often poorly documented, while the significance of organic matter in complexing and transporting trace elements in the subsurface is just starting to be investigated. Organic matter may also have an important role in recrystallization and diagenesis because of its adsorption on crystal surfaces. The wide range of compounds present in organic matter is controlled by depositional environment but subsequently modified by changes in temperature, pressure, Eh, and pH, and thus provide enormous potential for studying geologic processes.

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Geochemistry of a Marine Gas Hydrate Associated with a Bottom Simulating Reflector