plastic mud and silt. Asymmetric ball-and-pillow structures and overturned flamelike structures suggest that movement was toward the southeast. Deformation probably was initiated by earthquake shock.

The deformational structures are restricted to the basal member of the Bouse Formation 13 km northeast of Vidal, California. The basal member is divided into a lower unit of mudstone that grades upward to siltstone. The lower unit is conformably overlain by a well-bedded calcareous sandstone.

Ball-and-pillow structures, 5 cm to 4.5 m across, consist of mudstone, siltstone, and sandstone. The curvilinear long axes of these structures trend at oblique angles to tectonic strike and plunge at angles steeper than the dip. Overturned flamelike structures of mudstone and siltstone separate the ball-and-pillow structures.

Sandstone bedding planes conform to the outline of the ball-and-pillow structures but are undeformed a few centimeters above these structures; hence the ball-and-pillow structures are contemporaneous with deposition of the overlying sandstone. Saclike load casts and elliptical sandstone balls formed concurrently with the ball-and-pillow structures. Sandstone beds are buckled but not displaced by faults that stop within the sandstone unit.

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Comparison of Carbonate Chemistry of Brines from Orca Basin and Dead Sea

The Orca basin is an anoxic, brine-filled intraslope depression (2,250 m deep) located on the Louisiana continental slope in the Gulf of Mexico. The Dead Sea, also brine filled, is only 40 m deep. Both pH (6.83) and ΣCO_2 (5.04 mM) in the Orca brine are higher than in the Dead Sea brine (pH = 5.9–6.5, ΣCO_2 = 2.53 to 2.59 mM). These comparisons and our laboratory experiments on carbonate dissociation constants indicate that Orca basin brine and Dead Sea brine have quite different carbonate chemistries. Carbonate interactions in the Dead Sea brine are strongly influenced by its bulk ion composition, especially the magnesium and calcium enrichments, which are 2.8 and 3.7 times, respectively, relative to normal seawater. These enrichments cause a decrease in the second dissociation constant of carbonic acid. The Orca basin is depleted in magnesium and calcium and has a carbonate system that resembles a NaCl-saturated seawater.

Sass and Ben-Yaakov have attributed the low pH in the Dead Sea to ion pairing of Mg CO_3^o. Carbonate interactions in the Orca basin can be explained by the increased NaCl effect on the dissociation constants, with pH being largely controlled by an input of biogenic CO_2 from the sediments. This addition of CO_2 is significant and accounts for the higher ΣCO_2 levels that were found. These differences in the carbonate system between these two hypersaline bodies may result from differences in their origin.

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Geologic Distribution of Oil

A model for the worldwide distribution of oil can be constructed using only geologic variables. Three joint probabilities are required to explain the known distribution of giant oil fields in time. These probability functions are (1) that an adequate source has been deposited, (2) that oil has been generated and entrapped, and (3) that accumulations have not been destroyed nor the accumulation process aborted. The tectonic setting strongly affects the probability values.

For cratonic areas, the probability of adequate source can be modeled by the published curves for changes in sea level, because times of maximum transgression are most favorable for deposition of source sequences. Adequate thermal maturation varies with the geothermal gradient and is, therefore, extremely dependent on tectonic setting. Generally, Tertiary fields are in tectonically active areas whereas pre-Tertiary fields are in more passive areas. Oil fields in tectonically active areas are destroyed rapidly, whereas older fields which are in generally passive areas are destroyed more slowly.

This model predicts the large concentration of Cretaceous and Jurassic oil as the result of (1) maximum source availability because of extensive transgression, (2) adequate thermal maturity, and (3) very little destruction.

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Organic Acid Anions in Oil-Field Waters and Origin of Natural Gas

The concentrations of short-chain aliphatic acid anions (acetate, propionate, butyrate, and valerate) in 120 formation-water samples from 25 oil and gas fields in Alaska, California, Louisiana, and Texas were determined to study the formation of natural gas from decarboxylation of these anions. The reservoir rocks consist of sandstones ranging in age from Triassic through Miocene.

The samples from Tertiary rocks depict three temperature zones. The aliphatic acid anions of formation waters in zone 1 (subsurface temperatures $<80°C$) are characterized by concentrations less than 60 mg/L and consist predominantly of propionate. The concentrations of acid anions in zone 2 (temperatures 80 to 200°C) are much higher (up to 4,900 mg/L) than in zone 1 and decrease with increasing subsurface temperatures and age of their reservoir rocks; acetate forms more than 90% of the total anions. No acid anions are present in zone 3 (temperatures $<200°C$) or in formation waters from Triassic rocks. Microbiologic degradation of acetate and dilution by mixing with meteoric water most likely explains the composition and concentration of acid anions in zone 1. The trend in zone 2 and the absence of acid anions in zone 3 and Triassic rocks are explained by thermal decarboxylation of these anions as in the reaction: $CH_3COO^- + H_2O \rightarrow CH_4 + HCO_3^-$.

The aliphatic acid anions mainly result from the thermocatalytic degradation of kerogen. We believe that these anions, which are highly soluble, are produced