from the east that would be expected if the Nemaha ridge and the Cambridge arch-Central Kansas uplift experienced post-Morrowan uplift.

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Precipitation of Sulfates and Chlorides by Mixing Seawater Brines

Experiments using artificial and seawater brines indicate that gypsum, halite, and sylvite can be precipitated by mixing brines at differing stages of evaporation, as well as by the previously recognized mechanisms of direct evaporative crystallization and crystallization by temperature changes. A modification of existing geologic models is proposed to show how brine mixing might work in an evaporite basin. Conclusions based on the experiments and their relations to the geologic model are as follows:

1. Precipitation of salts can occur in a marine evaporite basin by mixing brines of different composition and specific gravity.
2. Precipitation occurs without further water loss by evaporation.
3. Precipitation can occur from brines that were undersaturated before mixing.
4. Brine mixing could cause different salts to be deposited in different parts of a basin depending on the stage of the evaporite cycle.
5. Sylvite could be precipitated as a primary mineral.
6. Hopper crystals (cubic and tabular) of sodium chloride can form as a result of brine mixing in water of any depth.

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Shallow-Marine Environments in Late Precambrian of Finnmark, Northern Norway

Processes operating in present shallow seas suggest that shallow-marine clastic sediments are the result of 4 types of current: (1) tidal, (2) waves, (3) semipermanent, and (4) river. Usually one or two current types dominate. However, the effect of each type of current depends on whether it is operating under normal (fair weather) or catastrophic (storm or flood) conditions and the grade of sediment available. The Skalnes Sandstone shows the effect of alternating fair weather and storm conditions on a combination of semipermanent and wave currents. Other parts of the late Precambrian sediments of Finnmark show the dominance of river, tidal, and wave currents.

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Geologic Analysis of Remote Sensor Data, Bonanza Project

The NASA-supported Bonanza Project of the Colorado School of Mines and Martin Marietta Corporation has as its principal objectives (1) education in the geologic applications of remote sensing, (2) development of techniques for the geologic interpretation of remote sensor data, and (3) specification of the most useful parts of the electromagnetic spectrum for geologic remote sensing. The ultimate goal is to provide a test site over which to calibrate spaceborne remote sensors and from which to extrapolate interpretations of remote sensor data into surrounding areas. Research to accomplish these objectives is carried out in the field in the Bonanza test site (an area of approximately 10,000 sq mi in west-central Colorado) and in laboratories at CSM and MMC. Airborne remote sensor data, including aerial photography, infrared imagery and radiometric data, microwave radiometric data, and radar imagery and scatterometric data are acquired (by NASA) and interpreted. Detailed ground measurements are made during overflights, and extensive ground investigations to assist in the interpretation of the airborne data have been carried out. Measurements include surface and subsurface temperatures, soil moisture, atmospheric characteristics, and incoming solar radiation. Ground investigations include detailed geologic mapping, studies of physical properties of rocks and soils, spectral reflectances of natural materials, and relation of vegetation to geology. To date, the research has added to structural and stratigraphic knowledge of the Sangre de Cristo and Sawatch Ranges and San Luis and upper Arkansas valleys, and to knowledge of structure, rocks, and geologic history of the Bonanza volcanic field.

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Mineralogy of Deep-Sea Sediments from Cretaceous te Holocene

The mineralogy of the Cretaceous to Holocene sediments of the Pacific and Atlantic basins has close affinities to present sedimentation patterns. Carbonate sediments dominate equatorial and shallow oceanic areas. Turbidites are common close to continental margins. Siliceous radiolarian and diatomaceous sediments are abundant in zones close to the carbonate compensation depth.

One of the more striking features of the deep sea is the common occurrence of an amorphous metal-oxide basal facies. Many areas of both the Atlantic and Pacific show high iron- and manganese-content sediment facies at, or close to, the contact with basement basalt. This basal facies grades upward into the biogenous and detrital lithogenous overlying sediments. Some areas of the basal facies have high copper and zinc contents, and in other places manganese is prominent. In a few places, this facies is essentially hematitic. The carbonates present in the deep sea include, in addition to calcite and aragonite, dolomite, siderite, rhodochrosite, and ankeritic dolomite. An unusual palygorskite and sepiolite and bentonite associated with dolomite is well developed in the vicinity of the Cape Verde Islands in the eastern Atlantic. Basaltic volcanic glass usually alters to montmorillonite plus a zeolite which is usually phillipsite or clinoptilolite. Erionite has been discovered in the western Pacific for the first time in the deep sea. Biogenous opaline silica dissolves and reprecipitates to form crystobalite cherts. These in turn are recrystallized to form quartz cherts in pre-Cenozoic sediments.

The range of mineral facies available suggests that clay mineral diagenesis is slight but the *in situ* formation of zeolites and clays from recrystallization of volcanic ash is important.

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Variability of Geotechnical Properties of Lutite in Wilkinson Basin, Gulf of Maine, as Measured in Place from Submersible *Alvin*