In Canyonlands National Park, the Ceder Mesa Sandstone consists of 700 ft (213 m) of large-scale trough, cross-bedded, well-sorted sandstone. It conformably overlies 1,100 ft (335 m) of interbedded sandstone, limestone, and shale of the Elephant Canyon Formation. Sandstones of both formations, formerly interpreted as shallow marine, are here interpreted as eolian due to occurrence of: (1) subcritically climbing translatent strata produced by migrating wind ripples; (2) unimodal southeasterly dips; (3) rare vertebrate fossils and trackways; (4) gypsum sand crystal pseudomorphs; and (5) abundant calcified plant roots. In contrast, limestones, conglomeratic sandstones, and shales of the Elephant Canyon contain diverse marine body and trace fossil faunas, and dip directions are widely dispersed.

Roots occur along twelve major bedding planes in the Cedar Mesa, several of which can be traced at least 16 mi (26 km). These planes are not channeled by overlying trough cross-beds. Planes do not climb downwind and are thus unrelated to migrating bedforms. Roots also occur along the planar tops of 15 eolian sandstone bodies in the Elephant Canyon, but are there overlain by fossiliferous marine carbonates. The planes are interpreted as eolian deflation surfaces resulting from decreased sand supply to a coastal dune field. A modern analogy is the Sabkha Matti south of the Persian gulf. Colonization by plants and growth of gypsum sand crystals was followed by transgression (Elephant Canyon) or by renewal of erg conditions (Cedar Mesa). Eustatic control of both sand supply and deflation is a strong possibility.

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Basin Evolution and Present Faulting Patterns Within Isthmus of Panama Volcanic Arc

The present foundation of Panama consists of a raised block of Upper Cretaceous or older oceanic crust within a plate convergence zone. The trend of the Panamanian volcanic arc is east-west. Although broken laterally, the structural pattern from the Pacific to the Caribbean includes a subduction complex crested by a coastal range, a fore-arc basin, followed by a volcanic arc, and a back-arc fold-thrust belt and retro-arc basin along the Caribbean margin. Plate interactions have been a prime mechanism in causing trans-isthmian faulting. The present boundary between Nazca (Panama basin) and Cocos plates is the Panama fracture zone. Faulting within this fracture zone partly cuts the fore-arc basin. Due north, in the Gulf of Mosquitos, there is morphologic evidence of faulting along the continental margin. The southeastward trend of eastern Panama is contrary to the convexity, relative to the underthrusting plates, of volcanic island arcs; thus, eastern Panama should trend toward the northeast and all of eastern Panama may have rotated up to 90°, from northeast to southeast. The Darien-Atrato basin is a fore-arc basin. East-west compression in eastern Panama is suggested by fault patterns lying perpendicular to the trend of the San Blas-Darien cordillera. There, inferred faults change trend from roughly north-south in the west to northeast-southwest in the east. Extension of these faults into adjacent basins is not known. Thus, one consideration in hydrocarbon exploration in Panama is the locating of faults.

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Seismic Stratigraphic Identification of Submarine Fans—Espirito Santo Basin, Offshore Brazil

Seismic stratigraphic analysis of the Upper Cretaceous/middle Eocene sedimentary section of the Espirito Santo basin reveals two distinctive, seismic supersequences which were deposited in open-marine conditions. Several submarine fan-forming episodes are identified. The lower supersequence of Late Cretaceous to Paleocene is a sedimentary wedge onlapping a tilted Albian/Cenomanian carbonate shelf. The upper supersequence, deposited from early to middle Eocene, displays a progradational pattern. Within this thick and well-defined Tertiary section, several depositional sequences are recognized, some closely related to global relative sea level changes.

The integration of data from 16 wells with seismic lines led to the identification and mapping of several seismic features which are interpreted as turbidite fans.

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Geologic and Geophysical Study of Cerro Prieto Geothermal Field, Mexico

The Cerro Prieto geothermal field is near the southwestern margin of the Colorado River delta, Baja California. The subsurface stratigraphy at Cerro Prieto is characterized by complex vertical and lateral variations in lithofacies, which is typical of deltaic deposits. The geothermal production zone is not a uniform reservoir layer overlain by a laterally continuous top seal of low-permeability strata.

The top of the geothermal-related hydrothermal alteration zone has a dome-like configuration which cuts across the sedimentary strata. Shales in the altered zone exhibit high densities and high resistivities on the well logs relative to those outside the zone. The geothermal producing intervals generally straddle or underlie the top of the altered shale zone.

Sandstones in the hydrothermal alteration zone commonly have fair to good porosities (15 to 35% or higher), which have resulted from the removal of unstable grains and carbonate cement by solution. Open fractures are unusual in the altered zone, based on core description. While fractures may be an important contributor to local reservoir permeability, secondary matrix porosity and permeability are considered to be more important volumetrically in the Cerro Prieto reservoirs.

Detection of geothermal anomalies in the Cerro Prieto region may be difficult from resistivity, magnetic, or gravity data. However, the occurrence of a reflection-poor zone coincident with the hydrothermal alteration zone suggests that the seismic reflection method may be a good approach to detecting these anomalies. Other types of geophysical data are necessary to eliminate alternate causes of reflection-poor zones on seismic profiles.

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Subtle Traps in East China Oil-Bearing Basins

Some oil-producing basins in eastern China, such as Songliao basin, Bohai Gulf basin, and Nanyang basin are extensively explored regions. In these basins, reserves in structural traps account for 34% of the total proved plus prospective, and 21% of the total estimated; in subtle traps, 7.6% of