ment surfaces. The Tertiary depocenter, adjacent to this fault, shifted from west to east with continued slippage through time, the greatest movement occurring in Miocene and post-Miocene. In the strike direction, the valleys are separated into at least two subbasins by an east-west structurally high axis. The axis is postulated to be the result of a tear fault associated with movement along the listric normal fault.

Tertiary stratigraphy varies between valleys and between subbasins in a given valley. All the valleys contain Miocene and younger rocks; however, not all subbasins contain the pre-Miocene section suggesting a complex scheme of structural development.

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Trace Fossils and Stagnation of Deep-Sea Basins

The patterns and intensity of bioturbation of marine sediment are useful indicators of the response of benthic organisms to fluctuating oxygen levels in the bottom water. Trace fossil assemblages in mid-Cretaceous (Barremian-Albian) DSDP core sections from the central and southern Atlantic were examined to document the activities of burrowing infauna relative to episodes of stagnation in deep Atlantic basins during that time.

The mid-Cretaceous anoxic horizons in DSDP cores typically are dark, homogeneous or laminated, organic muds, which alternate with moderately to heavily burrowed facies containing less organic carbon. Bioturbation intensity and trace fossil diversity appear to correlate inversely with the amount of unoxidized carbon in the sediment, suggesting that the more organic-rich facies were deposited under conditions where oxygen was a limiting factor for benthic macro-organisms.

The ichnogenus *Chondrites* commonly occurs, sometimes to the exclusion of all other kinds of burrows, immediately above and/or below unburrowed, laminated mud. It also occurs in heavily burrowed limestones containing rich trace fossil faunas, including *Zoophycos*. Therefore, mid-Cretaceous *Chondrites* apparently were created by animals possessing broad oxygen tolerances; the presence of *Chondrites* alone in an organic-rich deposit probably indicates dysaerobic conditions.

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How do Thrust Belts Form?

Thrust belts form at converging plate margins and straddle both sides of a hinterland occupied by a calc-alkaline arc. There are two competing theories for thrust belts and each implies a distinctly different behavior at the plate margins. The two theories, stated in oversimplified form, claim that thrust belts are created by either a horizontal push, or by the gravity-driven spreading of an elevated hinterland. In response to modern geometrically based structural interpretations the two theories have changed and developed over the past decade. Thrust toes are clearly dominated by a compressive push from the rear, but for larger parts of a thrust the gravitational terms are more significant. However, on the scale of an entire thrust belt, are rocks sufficiently weak for the gravitational terms to dominate? One of the principal differences between the two theories boils down to the question of rock strength. Certain simple structures provide a key to this impasse. One is listric normal and growth faults which develop without any push from the rear. Because of their high degree of symmetry, opposed-dip thrust complexes, such as triangle zones and pop-ups, also provide information. By working on these structures with limit analysis, a method recently developed in soil mechanics, we can estimate upper and lower bounds which bracket rock strengths under long term geological conditions. These bounds to rock strength can be directly applied to the two theories for the formation of thrust belts.

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A Test of the Melanoidin Hypothesis

Marine and terrestrial humic acids are thought to differ in structural composition owing to differences in precursors and formation pathways. It has been proposed that marine humic acids are formed by the polymerization of sugars and amino acids (the melanoidin pathway) while terrestrial humic acids result primarily from the condensation of lignin-derived phenols and amino acids. In this study, four marine and three terrestrial humic acids have been isolated, and a series of polymers have been made by the reaction of either glucose or catechol with alanine or ammonia. Chemical and spectroscopic measurements of the natural and synthetic polymers have been made, including elemental analysis, carbon isotope ratios and IR, UV-visible, UV-fluorescence, and ESR scans. In addition, degradative analyses of marine and terrestrial humic acids together with the synthetic polymers have been performed to determine (1) if characteristic structural differences exist between marine and terrestrial humic acids and (2) if similarities between the degradative products of synthetic and natural polymers reflect biologic precursors and reaction pathways.

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Carbon Flux from Ocean to Biosphere—Chemical Evidence from Deep-Sea Cores

The ocean is the major carbon reservoir in the ocean-atmosphere-biosphere system. Depending upon the demands of the biosphere, the ocean alternately acts as a source or sink of carbon. Because organic carbon has a δC^{13} composition of approximately -25 ppm (PDB), a 15% variation in the size of our modern biosphere (living and humus) would result in a 0.2 ppm δC^{13} variation in the CO_2 of the world ocean. A -0.4 ppm δC^{13} variation in modern surface water has been measured in a 200-year-old coral. Carbon-14 measurements in the same coral confirm that the cause of the δC^{13} variation