Mountain Tuff (35 m.y.) was ejected from the southern Sawatch Range and flowed up to 30 km east of the Front Range. The Oligocene Castle Rock Conglomerate forms an elongate, northwest-southeast, discontinuous band across the southern Denver basin. Cross-beds dip east and southeast. Thick tabular cross-beds and large granite boulders derived from the Front Range indicate torrential flood deposition. North to northwesterly dipping bedding, and up to 1,000-m vertical offsets between Front Range Wall Mountain Tuff outcrops and those in the Denver basin suggest significant post-Castle Rock uplifting of the Front Range.

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Sedimentology and Tectonic Implications of Oligocene Castle Rock Conglomerate, Southern Denver Basin, Colorado

The Oligocene Castle Rock Conglomerate, 70 m thick, trends northwest-southeast in an elongate discontinuous band (80 km long) across the central Denver basin from near Castle Rock to Calhan, Colorado. The conglomerate was studied to determine the depositional environment and any implications on the tectonic history of the southern Front Range. The Castle Rock Conglomerate is a nonmarine formation with large-scale cross-bedding. It contains angular slump blocks of Wall Mountain Tuff, some exceeding 2 m in length, as well as rounded boulders and cobbles of Front Range basement rocks. It fills valleys, up to 90 m deep, carved into the underlying Oligocene Wall Mountain Tuff and the early Tertiary Dawson Formation. The Castle Rock Conglomerate is interpreted as a deposit of a braided stream, possibly an ancestral South Platte River, which flowed in a broad valley toward the east then southeast.

Several tectonic implications were determined from this study: (1) the Front Range, after being eroded to a low plain in the Eocene, was regenerated after the middle Oligocene, as shown by structural offset of the Castle Rock at the edge of the Front Range, and by its interpretation as a restricted fluvial deposit rather than a broad fanglomerate; (2) the fluvial interpretation supports other suggestions that this formation resulted from the eastward diversion of the Rio Grande headwaters by the Thirtynine Mile volcanic field across the area which is presently the Front Range; and (3) north to northwesterly dipping beds, opposite to paleocurrents, indicate post-Castle Rock rotation of the Denver basin.

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Storm-Surge Ebb Deposits of Early Cambrian Shelf: Andrews Mountain Member, Campito Formation, Eastern California

The Andrews Mountain Member of the Campito Formation consists of complexly interbedded fine sands, siltstones, and mudstones that accumulated in an offshore, shallow-shelf setting. Deposition of these units was punctuated by short duration, high-energy flows that deposited crudely graded, hummocky cross-stratified sand beds. These flows are inferred to be the product of the ebb of large storm surges. The sedimentology of these units indicates a five-stage scenario for their formation. (1) Initial erosion and suspension of muddy fairweather substrates occur in response to long-period storm waves. (2) As an intense low-pressure system moves onshore, a sediment-charged return bottom flow is generated by a storm-surge ebb. This flow moves across the shelf and further erodes and entrains material. (3) As the competence and capacity of the flow are exceeded, fine sand is deposited as parallel laminated and hummocky cross-stratified units. (4) Rapid attenuation of the flow then leads to low-flow regime deposition of climbing ripples and small-current ripples. Where deposition occurs within storm wave base, upper parts of the beds are reworked into complex wave-current ripples and flaser bedding. (5) Soft-bodied, benthic communities recolonize muddy substrates with the resumption of fairweather conditions.

Rather than depositing sand sheets over extensive areas, multiple storm-surge flows are inferred to have incrementally moved sand across the shelf. In addition, thinning/fining-upward and thickening/coarsening-upward stratigraphic sequences may reflect changes in both the intensity of the flows and the proximity of a local sand source.

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Sedimentologic Aspects of Bioturbation in Abyssal Atlantic Ocean

Relations between bioturbation features and sedimentologic aspects of abyssal pelagic ooze and clay were investigated in 26 box cores collected in 1,400 to 5,700 m of water in the central and southern Atlantic Ocean. Sediment composition, texture, and core stratigraphy were compared with the occurrences of biogenic structures and other aspects of bioturbation to determine the sedimentologic factors that most affect burrow preservation and biologic mixing of abyssal sediment.

Box core surfaces typically exhibited a heterogeneous microtopography of mounds, lumps, trails, agglutinated tubes, and open holes. Benthic protists (foraminifera and xenophyophorids) and fecal strings of larger organisms were common. Remnants of shallow infaunal tunnel systems sometimes were evident on slightly washed box core surfaces. For example, *Paleodictyon* occurred in carbonate-rich ooze; *Cosmorhaphe* occurred in deposits containing 20 to 30% coarse fraction; and *Spirorhaphe* appeared to be cosmopolitan with respect to sediment type.

Sediments of the mixed layer (upper 5 to 8 cm) and underlying Holocene transition layer were compared with respect to carbonate, organic carbon, and coarse fraction ($>62\mu m$) percentages. Transition layer sediments, which contained the most visible burrows, were much more heterogeneous in terms of carbonate content than mixed layer deposits. However, the heterogeneity of organic carbon and coarse fraction concentrations were roughly equivalent in the two horizons.

Visibility of specific burrows was highest in cores with low carbonate contents ($<30\%$ $CaCO_3$) and also in cores from the Sierra Leone Rise, where sedimentation patterns appear to have changed following the last glacial stage. Burrow visibility was poorest in cores with high carbonate contents ($>70\%$ $CaCO_3$) throughout the entire core.

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Anatomy of Modern Open-Ocean Windward Carbonate Slope: Northern Little Bahama Bank

The modern carbonate slopes in the northern Bahamas are classified as windward or leeward types along open oceans, open seaways, or closed seaways.

Morphologically the open-ocean windward carbonate slope,