The following hypothesis is proposed to explain these facts: during orogenesis, the miogeosynclinal carbonates were detached from the underlying evaporites, crushed between the median welt and platform, and overridden locally by the eugeosyncline. After middle Eocene time, the diapirs intruded along deep faults and reached the surface with fragments from the overridden facies belts. The latest diapiric movements are post-Miocene. The small number of diapirs probably is related to the great competence of the thick, overlying post-evaporite carbonate section.

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Density Currents Experiments

An extensive series of experiments on density currents of salt water, or muddy water flowing under fresh water, have been performed by engineers. The author has verified some of the results reported by earlier workers. Some new results have been obtained, using the small flume described by Bell (1942). A "specific law of saline fronts" was described by Keulegan (1958) who found that the movement of the head of a density current "surge" across a flat bottom could be described (for high Reynolds Numbers) by the equation

$$v = C\sqrt{\frac{\Delta_p d g}{\rho}}$$

where v is the velocity of advance of the head, C is a constant, Δ_p is the density difference between the two fluids, ρ is the mean density of the two fluids, d is the thickness of the current behind the head of the current, and g is the acceleration due to gravity. The author's experiments reveal a similar law for density currents flowing down a slope, with the exception that C depends on the slope. It is found that the ratio v/u, where u is the average velocity of uniform flow down the same slope (after the passage of the head), also depends on the slope, and is close to unity only for very low slopes. These results may have considerable significance for interpreting the behavior of turbidity currents.

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Deposition Accompanying Laramide Tectonics, Red Desert (Great Divide) Basin, Wyoming

The last major invasion of the sea in the northern Rocky Mountains is known from the distribution of the Upper Cretaceous Lewis Shale. Electric log correlation of key marine beds within the Lewis Shale provides reference horizons that facilitate the measurement of the subsequent structural deformation and accompanying terrestrial deposition during the Laramide orogeny.

Structural subsidence of the basin was contemporaneous with the accumulation of paludal, lacustrine, and fluvial deposits observed in 4,000 feet of the Upper Cretaceous Lance Formation. Post-Cretaceous erosion leveled the margins of the basin. Isopachous maps of the Lance interval, from the unconformity to the key beds, reveal areas of local uplift that are coincident in several places with hydrocarbon accumulations in the underlying Mesaverde Formation along the east flank of the Rock Springs uplift.

Periodic subsidence continued during the Paleocene and was accompanied by large scale normal and reverse faulting along the northern margin. Fort Union arkosic conglomerate, sandstone, and silty mudstone, derived from adjacent source areas, accumulated in and around the embryonic basin. Three lithologic facies that define the detritus related to each period of structural change are recognized. Lateral expansion of the basin is revealed by the onlapping relationship of the "basal" conglomerate and the distribution of the associated basin facies. The stratigraphy of the "basal" conglomerate is poorly understood from fossil evidence.

More than 6,000 feet of Paleocene Fort Union, and Eocene Battle Springs, Wasatch, and Green River strata in the subsurface have been correlated with the surface section recently described by George Pipiringos of the United States Geological Survey.

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Crustal Shear Patterns and Orogenesis

Major crustal shears of North America, Europe, and Africa are shown and analyzed, and it is concluded that two orthogonal primary compressional shear sets, which are essentially wrench fault zones, exist world-wide. These sets are thought to have been generated by meridional and equatorial compressive stresses; the meridional and equatorial shear systems for the world are shown.

Major fault zones of the earth's regmatic shear pattern are considered to exercise fundamental control on orogenesis. These major fault zones probably extend downward to a discontinuity which may be the Mohorovicic discontinuity at the base of the crust, or may be deeper. It is thought that "continental drift" occurs by translation (with very little, if any, rotation) of the polygonal crustal blocks, which derive from the regmatic shear pattern, moving above this discontinuity. Ultimate driving forces are to be sought in relation to the earth's translation and rotation in space, and in sub-crustal (sub-Moho) convection currents; the result of these forces is omnipresent lateral compression in the crust.

Orogenesis results from the interaction of the crustal blocks as they move and yield in response to the lateral-compression stress field and the earth's gravitational field. On this basis, tectonic mountains are classified into: (a) linear uplifts with longitudinal wrench fault zones and related thrusting, (b) autochthonous fold belts, (c) vertically uplifted or tilted fault blocks, (d) domal uplifts, and (e) volcanic chains. Secondary effects of orogenesis include metamorphism and magmatic activity related to frictional heat from movement in major shear zones; and erosion, glaciation, and gravity sliding resulting from vertical components of movement along major faults.

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Continuous Reflection Studies of Marginal Basin Sedimentation

Marginal basins include those within the body of the continental terrace (shelf and slope basins) and those flanking the terrace where it is separated from the deep sea by intervening topographic highs. Geographically widespread investigations with continuous reflection profilers suggest that continental slope basins are more common than previously suspected, particularly in tectonically active regions. Because of well-known topography and surface-sediment distributions, selected California continental borderland basins can be used as natural laboratories to study details of internal structures of basin deposits. These are compared with records of normal open shelf and slope deposits from other regions. Early results suggest that basin plains are underlain predominantly by ponded turbidites with internal reflecting horizons of near horizontal initial attitude which conform to their flat featureless surface. Lateral continuity of these reflectors appears to be large compared to those within the gently sloping aprons and sea fans of the basins. Reflection profiles of the peripheral regions of the Tyrrhenian Sea show horizontally-bedded, probably ponded turbidites in closed slope-basins and hemipelagic sediments blanketing and conforming to underlying topography in open-slope areas. Similar features are recorded in profiles from the continental terrace and marginal basin of the East China Sea and other regions. Filled marginal basins are believed to be quantitatively important in retaining terrigenous sediments within the continental framework.

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Mudlumps: Diapiric Structures in Mississippi Delta Sediments

Mudlump islands are surface manifestations of intrusive clay masses that result from depositional processes at the mouths of major Mississippi River distributaries. The stratigraphy and structure of mudlumps at the South Pass mouth have recently been studied through a drilling and coring program which included holes to depths of 700 feet. Subsurface information obtained establishes the interrelationship between older shelf and prodeltaic river deposits and younger, progradational delta front and river mouth bar sediments.

Mudlumps are interpreted as being near-surface expressions of older shelf and prodelta clays diapirically intruded into and through overlying bar deposits. The intrusion culminates in shallow-angle thrust faulting which has resulted in vertical displacement of older clays as much as 350 to 400 feet. New mudlumps, revealed during the period of study, display surface exposures of shelf deposits uplifted and thrust from depths in excess of 350 feet. Between diapiric clay masses are synclinal troughs filled with as much as 400 feet of rapidly accumulated, near-strandline bar sands, silts, clays, and organic material.

Rapid deposition of thick, localized masses of heavier bar sediments directly upon lighter, plastic clays leads to an unstable situation which is relieved by diapiric intrusion of the clays with the resulting formation of mudlumps.

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A Depositional Model for the Jackfork (Mississippian) Group of Arkansas

Two linear, isolated belts of Jackfork clastics in the Arkansas Ouachita Mountains exhibit differences in sand-shale percentages, sedimentary structures, composition, and thickness, permitting one to make assumptions concerning the depositional model. Along the Frontals, the 5,400-foot-thick section is 70 per cent shale, generally lacking fissility and siliceous marker beds and is often contorted, containing irregular sandstone blocks. Medium bedded, fine grained arenites contain laminations, cross-stratification, ripple marks, and scattered tool marks oriented 255°, whereas massive, ridge-forming arenites are almost structureless. The 6,000-foot-thick southern section is approximately 70 per cent fine grained, poorly sorted arenites, containing schist fragments and feldspar. The remaining wackes, siltstones, and mudstones show little evidence of strong currents or steep slopes.

Petrographic and paleocurrent studies suggest the derivation of the clastics from a large, well-drained provenance to the east, consisting predominantly of quartzites and mature sandstones. Some clastics may have bypassed the Illinois Basin, the resulting laminated and cross-stratified arenites having formed from southwest flowing traction currents. Rubble bedding, possibly initiated by faulting, resulted when subaqueous mudflows disrupted the non-lithified arenites to form rounded exotic blocks. Structureless, generally massive arenites may have entered the basin by mass sediment flow from a more eastern or southeastern direction, possibly being swept off the Appalachian land mass by westward flowing currents.

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Conodonts from the Wabamun Group (Upper Devonian) from the Canadian Subsurface

The Upper Devonian Wabamun Formation was named for 562 feet of limestone and dolomite in Anglo-Canadian's Wabamun Lake well, south of Edmonton, Alberta. Subsequently, the formation was elevated to group status in the Stettler area where it was divided into the upper, thin, Big Valley Limestone and the lower, predominantly evaporitic and dolomitic, Stettler Formation. These latter units are not generally recognizable outside the Stettler area, where these strata are termed "Wabamun Group undivided" or simply "Wabamun Formation."

According to previous studies (Wonfor and Andrichuk, 1956), Wabamun rocks in the Stettler area attained a pre-Mississippian thickness, ranging from less than 500 feet in the east to over 800 feet in the west. The general structural setting is on the regional southwesterly dip of the Alberta basin. The Wabamun strata are part of the basin's lower Paleozoic sequence of carbonates, shales, siltstones, and evaporites of Cambrian through Mississippian ages, overlying a crystalline Precambrian basement.

Wabamun conodonts have been recovered from cores from three wells near the towns of Edmonton, Westerose, and Calgary. The conodont fauna thus far revealed has been abundant and diverse. Named and unnamed species of the platform genera *Palmatolepis* and especially *Polygnathus* are abundant, as are the bars and blades of the species representing the genera *Spathognathodus*, *Apatognathus*, *Hindeodella*, *Pelekysgnathus*, *Trichonodella*, and *Angulodus;* the cones of *Acodina* and *Drepanodus* also characterize the Wabamun fauna. Two species are believed to represent a genus of bar-type conodont never before described; another species of a cone-type unit represents a hitherto unnamed genus.

Previously published studies of conodont faunas have not, with a very few exceptions, generally included the conodonts from subsurface or exposed rocks in western Canada. For this reason, comparison of new material with similar Canadian conodonts is impossible or impractical for the most part. Comparison of the Wabamun conodonts is therefore made with the better-known Devonian faunas of the United States and western Europe.

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Internal Structure and Growth of Salt Domes