value of mineral commodities produced, and the magnitude of state and local taxes. The quantity and value of the flows of mineral materials into and out of the state are measured and their impact assessed in this study.

The study for the State of Colorado can be visualized as a prototype of a large-scale study of a region or the entire United States. The use of data obtained by a comprehensive study of mineral commodity flows will allow formulation of a systems approach to the mineral and energy policy.

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## NEW GEOPHYSICAL AND GEOLOGIC DATA ON NORTHWEST EUROPEAN SHELF AND THEIR BEARING ON SEA-FLOOR SPREADING AND OIL AND GAS EXPLORATION

Geologic and geophysical data acquired on the northwest European shelf, mainly resulting from the search for oil and gas, reveal a fundamental system of tensional rifts and horsts which form the framework controlling post-Paleozoic deposition. Deep grabens filled with Mesozoic and Tertiary strata can be traced from the northernmost North Sea through the North Netherlands trough into Holland, to link up with the Rhine and Rhone grabens. Another rift system, west of Britain includes the West Scotland, Hebridean, Irish Sea, Celtic Sea, and Western Approaches basins. Similar thick sedimentary basins occur in the Porcupine Seabight and Rockall troughs. Selected geophysical profiles illustrate the basic rift framework. The rift system is considered to be a response to crustal stresses in the northwest European plate, related to the opening of the southern part of the North Atlantic, which began in the Triassic. The Celtic Sea-Hebridean, Porcupine Seabight and Rockall basins represent abortive attempts to extend the spreading ridge northward.

The tensional rifting and faulting of the northwest European shelf control the distribution and facies of the infilling sediments and the location of several of the large oil and gas fields recently discovered in the northern North Sea.

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## STRATIGRAPHIC FRAMEWORK OF ATLANTIC CONTINENTAL MARGIN

No abstract available.

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## SUBSURFACE, TEMPERATURE-CONTROLLED ORIGIN OF SAN JOAQUIN VALLEY CRUDE OILS OF CALIFORNIA

Many Tertiary oil basins are convenient for studying the fundamentals of the oil generation process, because the full stratigraphic section from very young to mature source rock commonly is represented, and all stages of the oil generation process can be investigated, except advanced, postmature stages. A study was made of the origin of crude oils in the San Joaquin Valley. Shale cores ranging in age from upper Miocene to Upper Cretaceous were analyzed from depths of 1,000 ft to more than 15,000 ft. Crude oils were analyzed from producing reservoirs ranging in age from Plio-Pleistocene through Late Cretaceous. A gradual change in composition of the shale hydrocarbons was observed from unlike petroleum (immature) in shallow strata, to like petroleum (mature) in deep and warmer strata (diagenesis of the shale organic matter).

Lower Miocene and upper Eocene shales were identified as the major source rocks of the San Joaquin Valley on the basis of relatively high organic content of the shales, shale hydrocarbon maturity, and the great similarity of shale and crude oil hydrocarbons.

In the San Joaquin Valley, as in the Los Angeles and Ventura basins earlier studied, the bulk of petroleum was formed at subsurface temperatures above 100°C (212°F), where the shales are sterile to bacteria. In the San Joaquin Valley, as in the other two basins, petroleum was formed by a nonbiologic chemical process which is strongly temperature-dependent.

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## COAL—OUR MOST ABUNDANT ENERGY SOURCE

Coal is this nation's most abundant source of energy. It represents 88% of the proved national fuel reserves now and 74% of all we can ultimately hope to recover. Yet coal now accounts for only about 19% of the nation's energy production and use, whereas the much more limited oil and natural gas are carrying about 78% of the energy load. In the face of an accelerating national energy demand, that fuel mix simply cannot be maintained.

It is essential that the public recognize that trade-offs are necessary between our energy and our environmental goals. We need to strike a workable balance between reasonably environmental restrictions and the total well-being of an energy-based society. In our efforts to merge our energy and environmental goals, the nation must start thinking about coal not so much as part of the problem but as part of the solution.

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## YAKUTAT GROUP, AN UPPER MESOZOIC FLYSCH AND MÉLANGE SEQUENCE IN SOUTHERN ALASKA

The Yakutat Group, part of a belt of highly deformed late Mesozoic rocks deposited in deep water and extending for more than 1,600 km along the Gulf of Alaska margin, underlies an area 200 km long by 15-30 km wide of the Saint Elias Mountains foothills and adjacent coastal plain. Bedded rocks of the Yakutat Group are dominantly Cretaceous graywacke and pelite with local pebble-cobble conglomerate and sparse pods of oolitic chert-nodule limestone. Interspersed with the bedded rocks are mélanges composed of large blocks of competent rocks up to several kilometers in size engulfed in a pervasively sheared matrix of pelite or tuffaceous pelite. These clasts include externally derived or exotic greenstone, marble, metagraywacke, metachert, and diorite that are at least in part of Triassic(?) and Middle Jurassic age. Following deposition, the Yakutat was subjected to (1) pre-late Eocene compressive folding and thrusting, (2) regional zeolite to low greenschist-facies metamorphism with emplacement of early Tertiary granitic plutons, and (3) disruption by large-scale dextral shearing.

Available data suggest that the Yakutat was deposited in an oceanic trench associated with a volcano-plutonic arc. Large exotic clasts were presumably incorporated in the mélange by tectonic disruption and submarine sliding of older rocks exposed along the inner wall of the trench. A source for the sediments and exotic clasts does not exist in contiguous parts of the Saint Elias Mountains. The most probable provenance lies roughly 240 km southeast in the Chichagof-Baranof-Admiralty Islands area of southeastern Alaska. Large-scale post-middle Eocene dextral slip on the Fairweather fault is postulated to explain separation of the Yakutat Group from its source area.

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## FLYSCH DEPOSITS OF ANTLER FORELAND BASIN, WESTERN UNITED STATES

In Late Devonian and Mississippian times, well-bedded, shallow- to deep-water marine, flysch-like mudstone, siltstone, sandstone, conglomerate, and minor impure limestone were deposited in a subsiding, elongate, structural foreland basin (exogeosyncline) on the continental shelf (Cordilleran miogeo-