field. This understanding of facies-controlled porosity development has application both in regional exploration and in field development.

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Seismic Line Across Wind River Thrust Fault, Wyoming

A seismic line was acquired by ARCO Exploration Company in 1977 in southern Freemont County and extends northeast from the deepest part of the Green River basin across the Wind River thrust onto crystalline basement rocks of the Wind River Mountains. A COCORP line across the area has been discussed previously, but the ARCO line shows more detailed information beneath the thrust.

The seismic line is significant because it shows a strong reflection at the base of the Precambrian granite, which overlies sedimentary rocks of the northern Green River basin. It also illustrates an apparent anticline beneath the thrust fault which is the result of lateral velocity variation caused by a shallow wedge of low-velocity Miocene sediments superimposed on a velocity pull-up related to the high-velocity Precambrian granite. The effects of the velocity variations can be analyzed by ray tracing and by studying the near offset and far offset stacks of the seismic data. A post-thrusting normal fault, the Continental fault, appears to extend downward and causes diffraction energy and time offset on the seismic section. Proper field technique, appropriate processing, and ray tracing interpretation are all necessary in areas of granite overthrusts.

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Stratigraphic Reconstruction Using Digitized Well Logs: Lewis Shale, South-Central Wyoming

Advances in manipulating and displaying log data and improved methods of well-log digitizing have greatly enhanced explorationists' ability to incorporate large volumes of well data into basin-wide stratigraphic reconstructions. Computer manipulation of digital traces expedites construction of cross sections, generation of log-derived lithologic columns, normalization of log response, and updating of regional studies. The ease and speed with which cross sections can be changed and printed allow use of numerous datums to test correlations and permits construction of paleoslope configurations. Additionally, the ability to reduce a large cross section to a single field of view, without loss of definition, produces enhanced basin-side perspective and reveals stratigraphic relationships not apparent at larger scales.

The approach proved critical in depositional reconstruction of the Maestrichtian-aged Lewis Shale in the Washakie and Red Desert basins, Wyoming. Deep-water sandstones within the Lewis are hydrocarbon reservoirs at Wamsutter and Hay Reservoir fields. Core data, cross section thickness patterns, and lithology computed from logs show the Lewis to consist of a thin transgressive shale overlain by progradational sequences. Progradation occurred as deltas entered the basin initially from the northeast and later from the south. Correlation of log response indicative of volcanically derived clay-rich layers results in stratigraphic patterns on log cross sections similar to patterns on seismic sections. The transgressive shale onlaps the Almond Sandstone; progradational sequences are depicted as irregular, sigmoidal clinoforms. Patterns indicate high sediment input and very rapid basin subsidence.

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Anatomy of a Regional Play in Rio Grande Rift Basins of New Mexico and Colorado

The integration of regional Cretaceous stratigraphy, surface mapping of different structural styles, seismic data, and accumulating subsurface well control has blended over the past 16 years into a regional Cretaceous play encompassing many of the subbasins of the Rio Grande rift from Texas, north through New Mexico, and into the San Luis basin of southern Colorado.

Different structural styles, as well as changing stratigraphy, can make exploration in one of the subbasins a very different problem from exploration in another. Remnant structures of pre-rifting tectonics vary radically along the course of the rift from north to south, and are present and preserved beneath the subsequent rift-valley fill. Although the same basic tectonic causes for the rift are common throughout its length, this later Tertiary tensional event was imposed across all previous structural grains from Precambrian to Laramide.

In areas such as the northern Albuquerque basin, which was relatively undisturbed by Laramide thrusts, the predominant structural style is listric faulting caused by the rift. However, areas such as the Espanola basin show strong evidence of pre-rift thrusting during the Laramide orogeny. This structural style is still quite evident, and in places is the predominant style preserved beneath Tertiary valley fill.

In other areas, such as the San Luis basin, the rift has superimposed itself across earlier block faulting that occurred during the Precambrian and late Paleozoic and was modified by Laramide thrusts. The area was then covered by Oligocene-Miocene volcanics and rift-valley fill.

Such complex tectonic history makes exploration in the various subbasins of the rift extremely difficult. It also presents rare opportunities for hydrocarbon exploration in potential new provinces where abundant stratigraphic and structural trap potential is combined with adequate source rocks and a favorable maturation history.

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Hydrocarbons in Northern Basin and Range, Nevada and Utah

Occurrences of surface and subsurface hydrocarbons in the northern Basin and Range province indicate that oil and gas have been generated in several areas in this province. Documented surface occurrences include: (1) oil in ammonites found in Triassic shales in the Augusta Mountains northeast of Dixie Valley, (2) the Bruffey oil and gas seeps and asphaltite dikes in Pine Valley, (3) Diana's Punch Bowl (probable gas seep) in Monitor Valley, (4) droplets of oil in goniatites of the Mississippian Chainman Shale and oil staining at one locality of the Sheep Pass Formation in the ranges surrounding Railroad and White River valleys, (5) oil shale in the Tertiary Elko Formation near Elko and the Ordovician Vinini Formation in the Roberts Mountains, and (6) numerous outcrops with petroliferous odor and a few with oil staining.

Subsurface oil and gas shows are more widespread, but most have been found in the same general area as the surface shows. However, there are some important exceptions.

To date, all commercial and noncommercial oil and gas fields in the northern Basin and Range are located near the sites of the surface hydrocarbons. This relationship emphasizes the importance of source rock studies to exploration in this province. Prospective areas that lack surface hydrocarbons might be delineated by source rock studies.

Eleven oil and gas fields have been discovered in this province of which only three or four can be classified as commercial fields. All of these fields are located in Neogene basins--no fields have been found in an exposed mountain range. The significant fields have some additional common characteristics: (1) the traps are associated with a Tertiary unconformity, (2) the reservoirs have a relatively thick oil column, and (3) fractures usually enhance the reservoir quality. Fields in Railroad Valley and the Great Salt Lake illustrate these and other characteristics.

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Red Wing Creek Field, North Dakota: Growth-Faulted or Meteoritic-Impact Structure?

During the early stages of development at Red Wing Creek field, meteoritic impact was the accepted explanation for structure. Spectacular structure that apparently did not persist below the Mississippian Madison Group and the presence of shatter cones, which were thought to be indisputable proof of shock metamorphism from impact, were the primary points of evidence.

More subsurface information from new wells, and more careful correlation, subsurface mapping, and cross sections appear to indicate that there are two interpenetrating systems of fault slivers that persist down through the Ordovician Red River Formation. These fault slivers seem most likely to be torn from northeast- and northwest-trending, reactivated lineaments at their intersection. This deep structure, which is offset from the central high, supports the concept of at least 100 m.y. of progressive structural growth at Red Wing Creek field.