GEOLOGY AND PETROLEUM POTENTIAL, COLORADO PARK BASIN PROVINCE, NORTH-CENTRAL COLORADO

By Edwin K. Maughan

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A summary of structural, stratigraphic
and related geological elements that
have influenced oil and gas occurrences
in the intermontane Colorado Parks.

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This report is preliminary and has not been edited or reviewed for
conformity with U.S. Geological Survey standards and nomenclature.

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INTRODUCTION

The major Colorado Parks, composed of North, Middle, and South Park (Plate 1), comprise three similar intermontane basins in north-central Colorado. These parks occur within the Park Basin Province as defined for petroleum resource appraisal, which incorporates Clear Creek, Gilpin, Grand, Jackson, Park, and Summit counties, an area of 17,765 km^2 (6,859 mi^2). This report summarizes the geology relative to oil and gas production in the province. Roughly one-half of the surface area, which includes all of Clear Creek and Gilpin counties, comprises crystalline Precambrian rocks where petroleum is not likely to occur. Sedimentary rocks, from which oil and gas have been produced in Jackson County, occur in the remaining half of the province in Grand, Jackson, Park, and Summit Counties. The oil in Jackson County has been discovered and produced from structural traps in Upper Jurassic and Lower Cretaceous strata, and the most viable play for additional discoveries in the region would seem to be via similar methods.

Structure

The Colorado Parks and the narrow valley of the Blue River between Middle and South Parks form a complex structural province that is essentially a north-south elongate, assymetrical syncline or eastward tilted graben. This Colorado Parks syncline comprises a complex of structures bounded by westward thrusted uplifts that bring Precambrian rocks to the surface to the east and the west of the syncline. The Colorado Front Range, composed of segments of the Medicine Bow and Never Summer Mountains to the north, and of the Tarryall Mountains and Puma Hills to the south, bound the synclinal complex on the east. The Park, Gore, and Mosquito Ranges bound the complex on the west. The Colorado Parks is divided by northeast-southwest-trending mountainous terrain of Precambrian rocks that separates South Park into a distinct structural basin from the other valleys and parks. Independence Mountain lies athwart the Colorado Parks syncline on the north, and volcanic rocks of the Thirty-nine Mile Mountain interrupt the syncline at the south.

Middle Park and South Park are structurally separated by Precambrian crystalline rocks and Tertiary intrusive rocks in the Williams Fork and Vasquez Mountains that form a complex of ranges between the two basins. In contrast, North Park and Middle Park comprise a single structural basin separated by Tertiary volcaniclastic and flow rocks of the east-west-trending Rabbit Ears Range. Whether igneous rocks form most of the core of the Rabbit Ears Range or whether Mesozoic sedimentary rocks underlie most of the Tertiary volcanic rocks of this range is unknown. High-angle reverse faults with as much as 10,000 feet of displacement occur along the east and north margins of the Colorado Parks and other high angle normal and reverse faults and fault complexes occur along other margins of the basins.

Structures that developed in the region of the Colorado Parks since the onset of the Laramide orogeny are exceedingly complex. Epochs of compressional and extensional tectonics have been interpersed with intrusive and extrusive events so that there are many cross-cutting faults, overthrusts and other features that interfere with clear and unequivical interpretations of the tectonic history. However, the time of formation and the style of these structures are important factors in the generation, migration, and entrapment of the hydrocarbons in these north-central Colorado basins, and they provide clues to explain the oil and gas occurrences in North Park and the apparent absence of recoverable oil and gas farther south in these intermontane basins.

Source Rocks

Hydrocarbon source rocks within the Cretaceous rocks of the parks seem adequate, although the time available for burial, generation, migration and entrapment was short. Hydrocarbon generation in the Paleozoic rocks southwest of the Hayden lineament could have occurred as early as Late Permian or Triassic. In the Jurassic and oldest Cretaceous rocks hydrocarbon generation probably occurred no earlier than Maestrichtian (early Laramide) time. Hycrocarbon generation probably continued into the early Tertiary and likely ended during middle to late Eocene (late Laramide) time. High heat flow associated with the Laramide and later intrusion of igneous rocks may have locally accelerated oil generation penecontemporaneously with the major structural movements during Paleocene and could have occurred as recently as the Miocene. Asphaltic material referrable to grahamite, a mineral that is a probable petroleum derivative, has been mined from veins in the Middle Park Formation near Willow Creek Pass at the eastern end of the Rabbit Ears Range (Vine, 1957). The occurrence of grahamite suggests that source rocks and hydrocarbons could occur elsewhere within this mountanous area that dissects the North Park-Middle Park basin.

Hydrocarbon Occurrence

Oil and gas have been produced only in North Park where they occur in structural traps. Structural plays have been the basis for most exploratory drilling. Most of the structures that are evident at the surface have been explored; but owing to the tectonic complexities some of these structural reservoirs may have been incorrectly interpreted and missed. Most reservoirs are interpreted (Wellborn, 1977) to be associated with detachment thrusts or folds formed by out-of-the-basin thrusting related to the tight basin folding during the Laramide orogeny. Similar intrabasin thrusts are the most likely trapping structures elsewhere in the region. The regional relations, especially the tightly-folded basin, suggest that many additional Laramide structures occur but that they are buried by Tertiary sediments and require geophysical studies for their location.

Stratigraphic traps formed by interfingering of Cretaceous sandstone and mudstone, which have been successful plays in Cretaceous rocks elsewhere in Colorado and Wyoming, are an important element in determining oil occurrences here also. However, the limited and fragmentary areal extent of the strata within these small basins prohibit or severely restrict a regional prediction of lithofacies trends. The preservation of reservoir integrity within these highly faulted basins poses an additional problem for the entrapment of hydrocarbons. On the other hand, fracture porosity, which has been interpreted for the producing reservoir in the Coalmont area, is likely to occur at other places within the basins, considering the intensity of Laramide tectonic forces evidenced by the structural complexities.

Hydrocarbon discoveries and production, thus far, occur only in Jackson County and mostly in the northeastern part of North Park. The first discovery was in 1926 by Continental Oil Co. in the North McCallum field. Gas, composed of 96 percent CO_2 and 4 percent hydrocarbons was produced initially from the

Cretaceous Dakota Sandstone. There were no further new fields discovered in North Park until 1952 when a new field was discovered in the Coalmont area. In that venture oil flowed on drill-stem test from fractured shales in the Dakota and indicated that CO_2 wasn't ubiquitous. Within Jackson County in 1986 there were 112 producing wells from which 248,262 barrels (bbl) of oil and 1,239,925 thousand cubic feet (mcf) of gas (193,116 mcf hydrocarbon and 1,046,809 mcf CO_2) were recovered (table 1). Cummulative production through 1986 amounted to 14,728,669 bbl of oil and 675,116,645 mcf of gas (9,398,610 mcf HC and 665,717,995 mcf CO_2).

REGIONAL GEOLOGY

The sedimentary rock strata in north-central Colorado and adjacent areas record the geological history of a region of recurring tectonic uplift. During a large part of the Phanerozoic, this region was slightly positive and was repeatedly elevated with respect to sea level to the extent that many strata are thin and separated by erosional unconformities compared to equivalent strata in nearby regions. Many of the Phanerozoic stratigraphic units exhibit either depositional or erosional thinning, or both, throughout the Colorado region. Some stratigraphic units are absent across much of north-central Colorado owing to non-deposition or truncation that is the result of repeated uplift. On the other hand, Cretaceous and Early Tertiary depositional sequences are thick, and comparable to equivalently thick strata in adjacent areas.

The northeast-trending Transcontinental arch (fig. 1) has been the principal positive structural feature that has affected the Phanerozoic depositional patterns. The Transcontinental arch, a long enduring prong of the North American craton, extended southwest from the central Canadian Shield across southeastern Colorado into New Mexico and possibly beyond. The position and the influence of the Transcontinental arch on the lower Phanerozoic (Cambrian to Devonian) sedimentary units is yet difficult to determine owing to the paucity of data for these rocks, especially the sparse data relative to their distribution in the central Rocky Mountain and adjacent plains region. For example, at several places in the Colorado-Wyoming area a sandstone that lies unconformably upon Precambrian crystalline rocks has been long identified as the Cambrian Sawatch Sandstone because of its stratigraphic position. However, this sandstone significantly differs lithologically from unequivocal Sawatch Sandstone strata elsewhere in south-central Wyoming and north-central Colorado, and it is known to be paleontologically and depositionally related to Upper Devonian and Lower Mississippian strata (Lageson, 1977; Maughan, 1963, and unpublished data). Isopach maps that have incorporated the equivocal data and show a widespread distribution of the Cambrian rocks in the central Rocky Mountain region, such as those of Lochman-Balk (1972) are unreliable for interpreting early stages of Phanerozoic history in the central Colorado and Wyoming area. The distribution of Cambrian strata is reliable only where these sandy beds have yielded fossiliferous evidence for their Cambrian age or are overlain by fossiliferous Ordovician rocks. Figure 2 shows the generalized distribution of Cambrian and Ordovician strata in the region.

Table 1. Oil and gas production in the Colorado Parks. CO_2 gas production given in footnotes. Data from State of Colorado Oil and Gas Conservation Commission, 1986 oil and gas statistics.

Field	Producing Formation	1986 Production Oil (Bbls)	1986 Production Gas (Mcf)	Cummulative (Bbls) oil	Prod. (Mcf) gas
Alkali Lake	Dakota	0	0	3,978	0
Battleship	Dakota	2,071	0	286,163	0
Frontier	584	0	9,706	1,390	
Lakota	8,851	0	2,562,063	0	
Butler Creek	Frontier	281	0	20,900	14,871
Canadian River	Dakota-Lakota	3,437	106,455	456,771	4,103,871
Lakota	13	35,026	13	3,425,742	
Muddy	0	0	0	247,667	
Niobrara	1,092	0	27,114	176	
Carlstrom	Niobrara	0	0	7,741	4,194
Coalmont	Niobrara	2,796	0	123,442	76,235
Delaney Butte	Dakota	0	0	2,691	0
Frontier	0	0	2,331	358	
Niobrara	0	0	7,037	1,373	
Grizzly Creek	Niobrara	0	0	1,112	0
Shannon Sandstone		0	0	1,342	0
Johnny Moore Mtn.	Niobrara	336	597	35,880	64,143
Lone Pine	Dakota-Lakota	92,211	16,101	2,007,513	557,423
Lakota	676	101	70,287	39,291	
McCallum	Dakota-Lakota	24,129	0[4/]	4,754,471	176[4/]
Lakota	453	24,220	23,872	269,915	
Muddy	95	0[1/]	47,304	0[1/]	
Morrison	405	0[2/]	2,040,315	0[2/]	
Niobrara	0	0[3/]	231	0[3/]	
Pierre B	104,692	10,520	1,339,822	316,399	
McCallum South	Lakota-Dakota-Muddy	0	0[5/]	708,159	0[5/]
Niobrara	85	0	1,855	0	
Pierre	2,193	0	22,805	0	
Pierre B	0	0	38,191	119,958	
Michigan River	Dakota	139	96	9,164	7,286
Lakota	3,718	0	121,942	148,500	
Niobrara	0	0	588	0	
Total Oil and Gas Production		248,262	193,116[6/]	14,728,669	9,398,610[6/]

	CO_2 Production 1986	CO_2 Production Cummulative
1/	10	274,603
2/	11,760	153,206,713
3/	59,589	904,706
4/	975,450	356,535,975
5/	0	154,795,998
6/	1,046,809	665,717,995

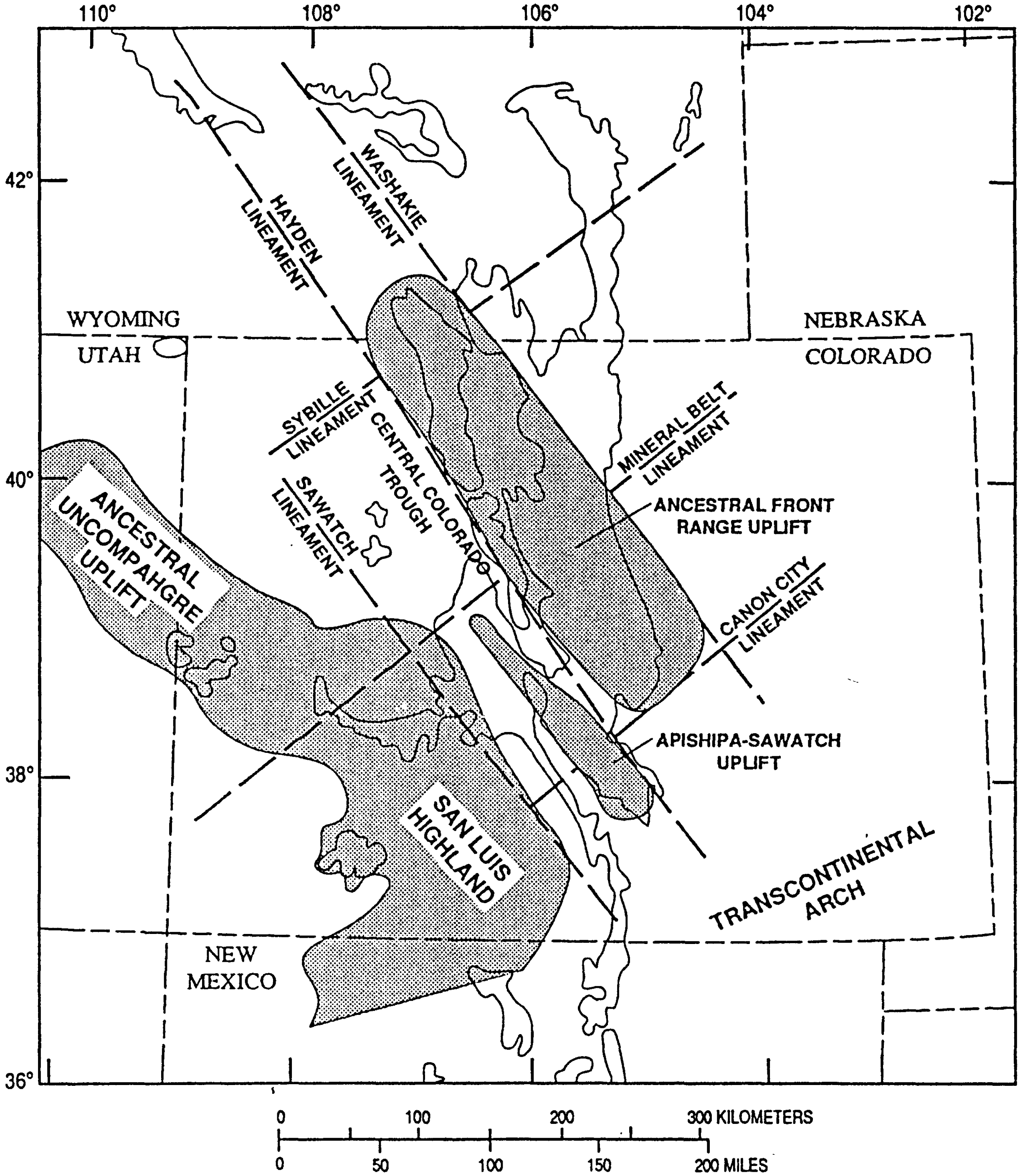

Figure 1. Principal paleogeographic and structural elements in Colorado and adjacent areas.

The regional distribution and remnants of the lower Paleozoic rocks have been summarized and their history interpreted by Ross and Tweto (1980). The axis of the Transcontinental arch crossed through north-central Colorado during the Ordovician according to the analysis by Ross (1976). Xenolithic Cambrian, Ordovician, and Silurian sediments have been identified in diatremes that lie to the east of North Park (Chronic and Ferris, 1963), along that proposed axis, and these relicts indicate that the lower Paleozoic seas may have blanketed the region. As suggested by Ross and Tweto (1980, p. 54), scattered islands along the arch may account for the areas where Cambrian and Ordovician rocks seem to be absent by non-deposition. One such possible island occurs in southwestern Colorado in the vicinity of the Gunnison Plateau and northern edge of the San Juan Mountains. Upper Cambrian and Lower Ordovician sedimentary rocks are absent there, but igneous dikes of these ages intrude older crystalline rocks in a west-northwest-trending belt extending from the Wet Mountains to the Black Canyon of the Gunnison River (Ross and Tweto, 1980, p. 54). Another postulated island area was in north-central Colorado.

Lower Paleozoic rocks do not occur across most of north-central Colorado and are absent in the Colorado Parks. If this area had been an elevated island area during early Paleozoic, the data are equivocal. The lower Paleozoic xenoliths indicate that early Paleozoic seas inundated at least some parts of this area; and, except for Cambrian sandstone that occurs in adjacent areas, the evidence for the dominance of carbonate rocks in the lower Paleozoic sediments suggest regional, albeit shallow, epicontinental seas across all of north-central Colorado. The area seems to have been elevated during the Devonian into a broad northwest-trending arch where lower Paleozoic rocks were removed by erosion and Precambrian crystalline rocks were uncovered. This elevated terrain provided the source for arkosic and orthoquartzitic sandstone sediments deposited marginal to the transgressing shore of the Late Devonian and Early Mississippian epicontinental sea (Maughan, 1963). The uplift in this area occurred approximately in the same area as the ancestral Front Range uplift and seems to represent proemial arching on this part of the continental shelf coincident with the early part of the Antler orogeny along the western margin of the continent.

Upper Paleozoic rocks (Devonian to Permian) are represented by Upper Devonian(?) through Permian strata in the southwestern part of South Park, but only Permian strata are present in the northeastern part of North Park. These rocks occur on the slopes that dip into the basins along the flanks of the Mosquito Range and the Medicine Bow Mountains, respectively. Upper Paleozoic rocks are unknown in the Park basins between the Hayden and the Washakie lineaments (fig. 1), which are coincident, respectively, with the southwest and northeast boundaries of the ancestral Front Range uplift. In general, the upper Paleozoic strata are composed of increasingly coarser sediments toward the flanks of the uplift, the younger strata successively overlap the older onto the uplift, and overall composition consists of finer grained sediments in the successively younger units. These relationships and lesser features of these rocks record the episodic uplift of the northwest-southeast trending ancestral Front Range during the Pennsylvanian Period, and the burial of that uplift by sediments deposited during episodes of diminishing orogenic tectonic movements and regional subsidence through the Permian Period.

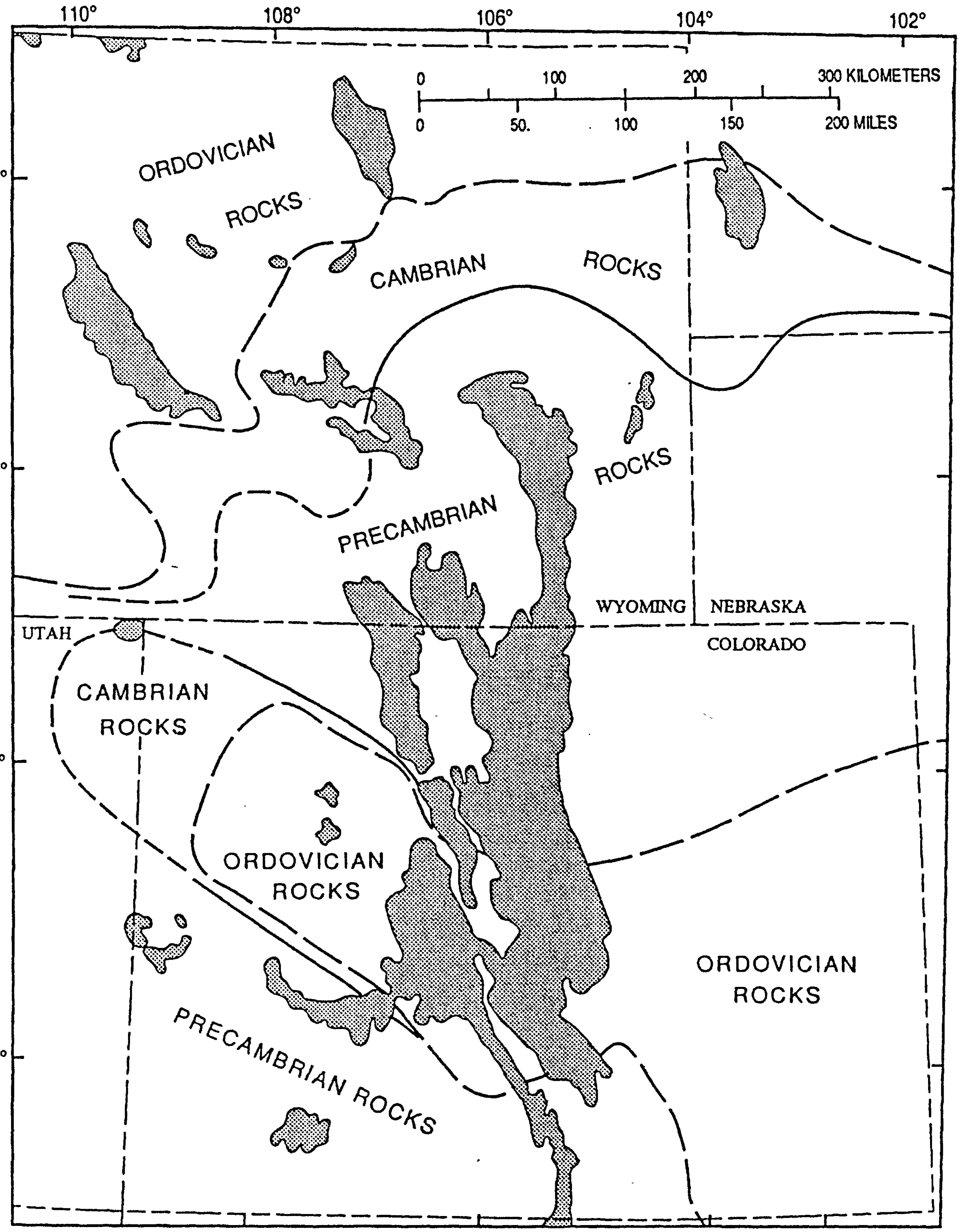

Figure 2. Generalized paleogeologic map showing approximate distribution of Precambrian, Cambrian, and Ordovician rocks beneath Devonian or younger rocks in vicinity of North, Middle, and South Parks, Colorado, and parts of adjacent States. Stippled areas indicate exposures of Precambrian rocks. Limits of Cambrian rocks in Wyoming from D.L. Macke (oral and written communs., 1987), and in Colorado from Ogden Tweto (1979) and Maughan (unpublished data).

The Permian rocks that occur on the flank of the Medicine Bow Mountains in northeastern North Park are thin red mudstone, carbonate rocks, and some gypsum beds that represent an onlapping tongue of the Permian and Lower Triassic Goose Egg Formation where it lies unconformably upon Precambrian rocks. These rocks have low permeability and porosity, are remote from petroleum source rocks, are not in favorable structural locations for hydrocarbon entrapment and therefore are not expected to contain oil or gas accumulations.

The upper Paleozoic rocks in southwestern South Park and on its flank in the Mosquito Range occur southwest of the South Park and other closely related faults, which are structural elements of the Hayden lineament. Antecedent faulting along the Hayden lineament formed the principal structural boundary between the ancestral Front Range uplift and the central Colorado trough during late Paleozoic time. Details of the stratigraphy, especially the areal relationships and correlation of the strata in the upper Paleozoic rocks, are not well known in the South Park area owing to probable abrupt changes of facies in the late Paleozoic rocks, and owing to later (mostly Laramide and more recent) igneous intrusions. A diagrammatic southwest to northeast restoration of these Paleozoic strata (DeVoto, 1965b, fig. 2) illustrates their onlap onto the flank of the ancient positive terrain (fig. 3).

At the beginning of the Mesozoic Era north-central Colorado and adjacent areas were near sea-level and were part of a tectonically stable region. The terrain during the Mesozoic was locally elevated to lowlands. Increasing topographic and structural complexity resulted from the local effects of the Laramide orogeny toward the end of Cretacous time and during the Early Tertiary Period. Mesozoic sediments in the Park basin were part of the very broad and tectonically stable continental shelf of the North American craton; but, as in the late Paleozoic, Colorado tended slightly more positive than adjacent parts of the shelf and seems to have been somewhat less stable during the Mesozoic. Consequently many stratigraphic units identified in adjacent parts of the region are locally thin or absent.

The Triassic part of the Permian and Triassic State Bridge Formation, which is equivalent to the Goose Egg Formation and the Red Peak Formation (formerly Chugwater Formation) in North Park, lies without apparent unconformity upon the Permian part of the Goose Egg within a paraconformable sequence (Newell, 1967) in northeastern North Park. The Triassic beds of the Red Peak overlap the Permian strata and are unconformable upon Precambrian rocks in northwestern North Park (Hail, 1965; Maughan, unpublished data), but are absent farther south in Middle and in South Park. Southwestward thinning is indicated by depositional wedging against Precambrian rocks of the ancestral Front Range (Hail, 1968, p. 10), but Triassic rocks seem to be absent in Middle Park chiefly due to erosional bevelling in those areas where the Jurassic Morrison Formation is unconformable on Precambrian rocks (Tweto, 1957, p. 20). Triassic rocks thin northeastward toward Middle Park in the McCoy area on the west flank of the Gore Range (Donner, 1948, p. 1228-1229) and rocks as young as the Late Jurassic Morrison Formation are locally arkosic and lie unconformably upon crystalline Precambrian rocks about 8 km west-southwest of Gore Pass. The Triassic distribution is suggestive of onlap onto a relict of the Paleozoic ancestral Front Range uplift and also of probable rejuvenated uplift during Late Triassic and Early and Middle Jurassic time.

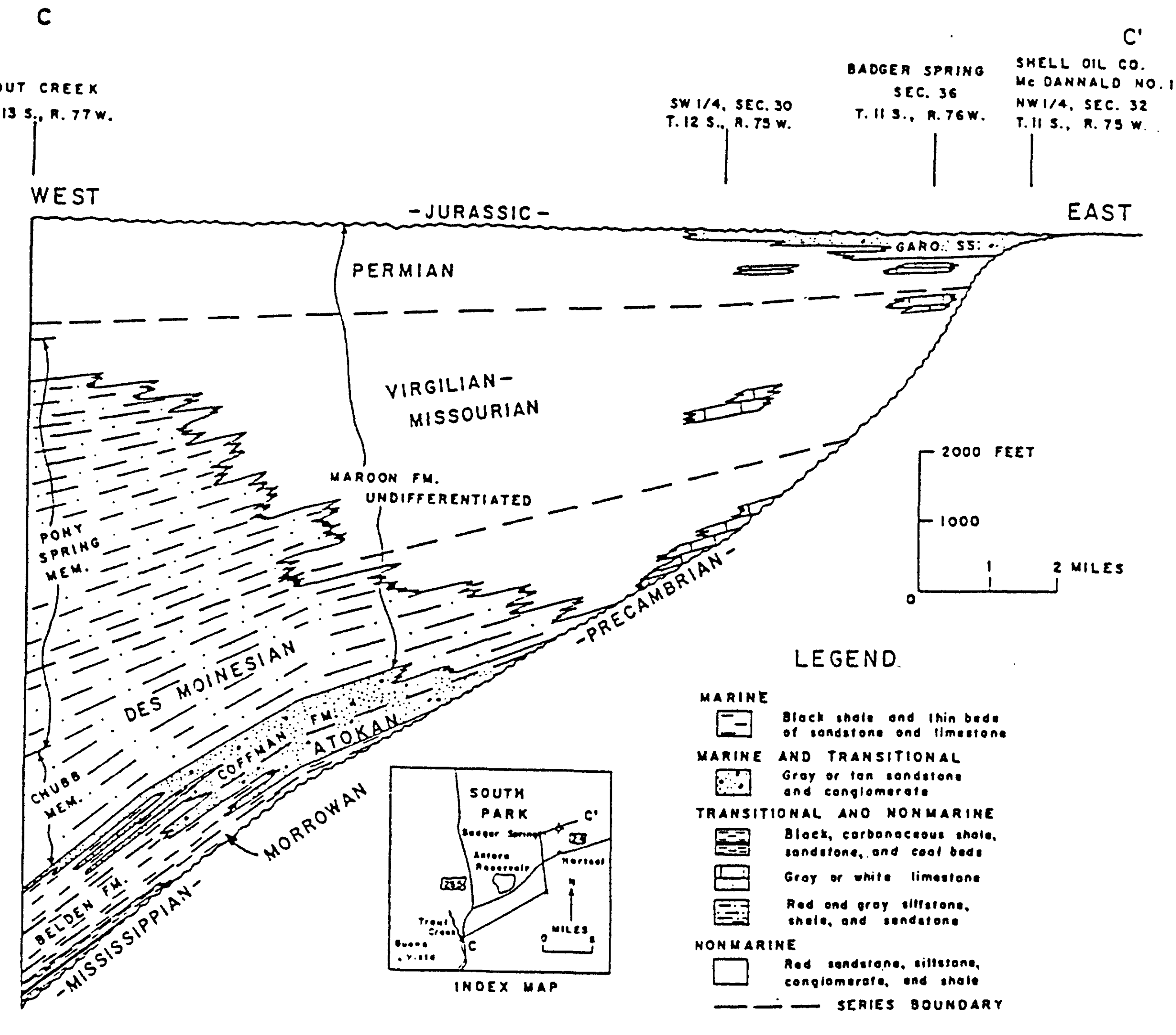

Figure 3. Diagrammatic restored section of Pennsylvanian and Permian rocks in southern South Park (DeVoto, 1965b, fig. 2, p. 211) showing onlap of strata in central Colorado trough onto flank of ancestral Front Range. The Garo Sandstone probably is Jurassic rather than Permian as shown in this illustration.

Lower into Upper Jurassic rocks are absent in most of central Colorado except for the Sundance Formation, which includes an upper member equivalent to the Curtis Formation and a lower member that is probably equivalent to the Entrada Sandstone of northwestern Colorado, in northwestern North Park (Hail, 1965, p. 20-25; 1968, p 11-14). The Garo Sandstone in southwestern South Park is of equivocal Jurassic age (Stark and others, 1949, p. 47-48), and it may be of Permian age (DeVoto, 1965a, p. 460-462; 1965b, p. 218). The Garo is here considered most likely to be an equivalent of the Jurassic Entrada Sandstone based on regional paleogeographic relations and on lithologic and depositional similarities to the Entrada. This interpretation is dependent on whether the Garo is unconformable upon the Maroon Formation as described by Stark and others (1949) or whether it intertongues into the Permian strata as indicated by DeVoto (1965a; 1965b). In any case, this dominantly eolianite sand seems to have been deposited on the flank of lowlands that were succesor uplifts or relicts of the late Paleozoic ancestral Front Range.

The late Late Jurassic Morrison Formation overlaps older Jurassic and Triassic rocks and is unconformable upon Precambrian rocks. The Morrison evidently blanketed the Parks Basins as part of the vast coastal plain deposits that covered most of the Rocky Mountain region toward the end of the Jurrasic. The episodic uplifts that had occurred in this region since Middle to Late Devonian and that had culminated during Middle Pennsylvanian seem to have terminated by latest Jurassic time. The distribution and relationships of the fragmented exposures of the older middle Phanerozoic strata suggest that a principal center of recurring uplift was in the vicinity of the intersection of the northwest-trending Hayden and the northeast-trending Front Range Mineral Belt lineaments. Regional, epeirogenic subsidence became dominant toward the close of the Jurassic Period and continued during the Cretaceous as the coastal plain deposits were succeeded by the epicontinental sea as it transgressed from the northwest toward the crest of the Transcontinental arch.

Cretaceous deposits in the Parks Basins record combinations of a transgressing sea, prograding terrigenous-derived sediments, and eustatic sea-level changes. The base of the Cretaceous sequence is unconformable upon the Morrison Formation, but the unconformable relationship is locally obscured by basal Cretacous fluvial sediments that are like those in the Morrison and are commonly mapped with them. Cretaceous sediments are more typically the onlapping sandy shore sequence of the Dakota Sandstone. The Dakota Sandstone in the Colorado Parks is correlated in part with the Lakota Sandstone and the Fall River Sandstone of the Dakota Group in northeastern Colorado (fig. 4), but in north-central Colorado these rocks are no older than late Albian in North Park and even younger, Cenomanian age in South Park, significantly younger than in the type areas to the northeast. Thin Skull Creek Shale (Thermopolis Shale) and the Muddy Sandstone are also mapped as part of the Dakota in the Colorado Parks. Equivalents of the Dakota Sandstone also include the Lower Cretaceous Purgatoire and Lytle Formations exposed on the east flank of the Front Range in the Denver to Colorado Springs, Canon City, and Pueblo areas. The lower part of these Cretaceous beds east of the Front Range are also of fluvial origin and have been locally included with the similar Morrison Formation and explains observations there (Hail, 1968, p. 17; Haun, 1959) of absence of unconformity and intertonguing.

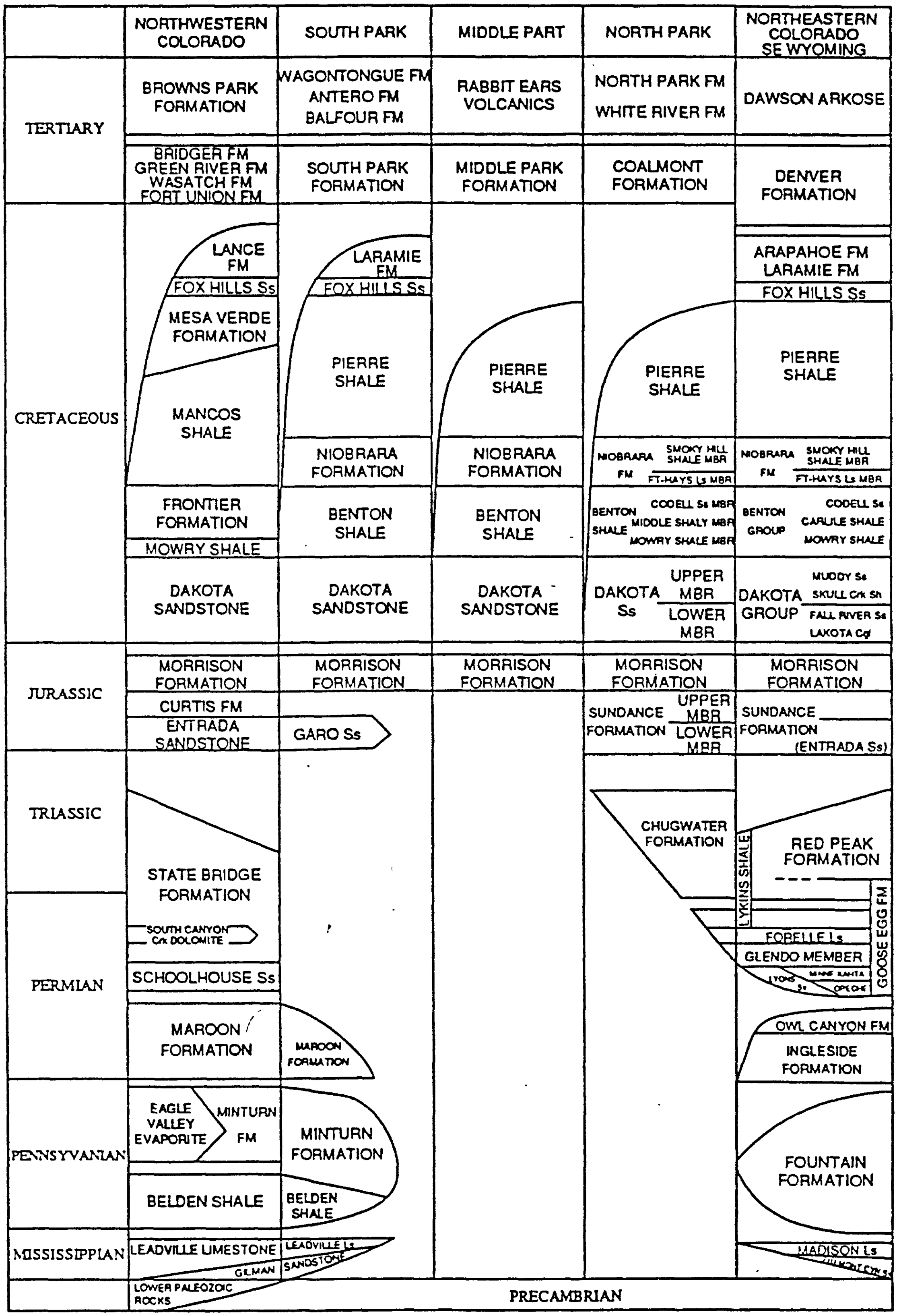

Figure 4. Nomenclature and correlation of sedimentary rocks in the Colorado Parks and some adjacent areas of northern Colorado

Dakota Sandstone grades abruptly upward into a sequence of thick carbonaceous mudstone, thin sandstone beds, and a few limestone beds deposited in a shallow, epeiric sea during regional Cretaceous subsidence. At least 2,000 m (6,500 ft) of Cretaceous sediments accumulated in North Park and 1,800 m (6,000 ft) accumulated in South Park. Total thickness of Cretaceous rocks in North Park are estimated to have been about 3,200 m (10,000 ft). About 2,000 m (6,500 ft) of Dakota Sandstone, Benton Shale, Niobrara Formation, and Pierre Shale have been described in North Park (Hail, 1965, 1968); and an additional approximately 1,000 m (3,500 ft), an estimate of the thickness of Pierre Shale, Fox Hills Sandstone, and Lance, Lewis, and Laramie Formations in the adjacent Laramie and the Denver basins were probably deposited and subsequently removed by erosion from North Park.

Aggregate thickness of Cretaceous rocks preserved in South Park is about the same as those that are preserved in North Park, but the total thickness of originally deposited Cretaceous in the south was probably somewhat less than in the north. Cretaceous rocks have been measured and estimated to total approximately 2,000 m (6,600 ft) (Ettinger, 1964; Stark and others, 1949); but the original total Cretaceous thickness in South Park likely was at least 2,200m (7,200 ft) thick. Initial basin-filling sediments in north-central Colorado were derived chiefly from erosion along the Transcontinental arch; but most subsequent sediments reflect the eastward progradation of dominantly muds and some sand-sized clastics derived mostly from erosion and volcanic sources in the Sevier orogenic belt in Utah. During Maestrichtian time, sedimentation and regional uplift displaced the epeiric sea and the depositional environment shifted from that of the marine Pierre Shale through the shore facies of the Fox Hills Sandstone into the dominantly paralic and fluvial facies of the Laramie Formation.

STRATIGRAPHY

The correlation of nomenclature in the Park basins and adjacent areas is provided in figure 4. Lower Paleozoic rocks older than the Leadville Limestone are not described in detail in this report because they are known to occur only beneath the upper Paleozoic rocks along the western flank of the Mosquito Range, and they are unlikely to extend farther than the southwesternmost part of South Park nor to have significant amounts of hydrocarbons in that limited area. The Paleozoic strata are exposed in the vicinity of Trout Creek Pass and dip eastward from the Mosquito Range into the southwestern edge of the South Park Basin. It is unlikely that the older Paleozoic strata extend as far into the basin as the Hayden lineament; but the Leadville Limestone overlaps the older Paleozoic rocks and it may extend to the vicinity of that lineament. Descriptions of the lower Paleozoic strata, the Cambrian Sawatch Sandstone and Peerless Shale, the Ordovician Manitou Limestone, and the Devonian Parting Quartzite and Dyer Dolomite, are given by Stark and others (1949, p. 32-38). Descriptions of the Leadville Limestone and younger strata are given by them and by DeVoto (1971).

Mississippian

Leadville Limestone. The Leadville Limestone, of Lower Mississippian age, is mostly dolomite and dolomitic limestone that is dominantly medium and dark grey. It is irregularly bedded and includes nodular chert, especially in the upper part, and it is sandy at the base. Sand content seems to increase northeastward into the vicinity of the Hayden lineament. Karst with many solution features and collapse breccias is common. The Leadville is erosionally bevelled beneath Pennsylvanian rocks and is not present northeast of the Hayden lineament in South Park nor farther north in the Colorado Parks.

Pennsylvanian and Permian

Pennsylvanian and Permian rocks exposed on the slopes that dip northeastward along the Gore Range into South Park include the Belden, Minturn, and Maroon Formations. The younger State Bridge Formation of Permian and Triassic age, which occurs in areas west of the Gore Range, and equivalent rocks of the Lyons Sandstone and most of the Lykins Formation, which occur in areas east of the Medicine Bow Mountains and the Front Range, do not occur in the North, Middle, and South Park area. Because the members of the Lykins Formation, which also comprise parts of the Goose Egg Formation in Wyoming, occur within such a limited area in northeastern North Park and becuase they are inconsequential in regards to hydrocarbons, they are not described here.

Belden Formation. The oldest Pennsylvanian rocks are included in the Belden Formation and comprise mostly dark grey and very dark grey carbonaceous mudstone. Intertongued beds of arkosic and subarkosic sandstone and conglomerate increase upward and are dominant in the upper part and interbedded limestone and sandy mudstone dominate as accessory beds in the lower part. Deposition occurred in a marine to para-marine environment in the central Colorado trough adjacent to the southwest flank of the ancestral Front Range uplift. Prograded terrigenous sediments increase in thickness and are more abundant shoreward onto the flank of the uplift, and the Belden grades laterally and upward into the Maroon Formation and sand and conglomerate displace the carbonaceous mudstone beds. An abundant flora has been noted in some beds where they are exposed near the crest and western slopes of the Mosquito Range (Read, 1934; Johnson, 1932, 1934). The Belden does not occur in North Park nor south of there at least to Vail Pass, but the Belden does occur as a northeastward thinning sequence farther south along the Mosquito Range and in the southeasternmost part of South Park, southwest of the Hayden lineament.

Minturn Formation. Mostly yellowish grey to pale greyish red arkosic sandstone and conglomerate with common micaceous mudstone and some limestone characterize the Minturn Formation. The sequence includes pale greyish red and some greyish red-purple and light greenish grey beds in some strata in some areas. The Minturn was deposited in a fan-delta complex in marine to shore and alluvial to paludal settings on the southwest flank of the ancestral Front Range and is unknown in the Colorado Parks northwest of the Hayden lineament. Redbeds seem to dominate the strata that comprise the equivalent sequence adjacent to the ancestral Front Range uplift, which lay northeast of the lineament, and separation of Minturn and Maroon Formations is controversial in the South Park area. A boundary defined by the Jacque Mountain Limestone near Hoosier Pass (Tweto, 1949) is used west of the Gore and Mosquito Ranges, but that limestone unit has not been positively identified in South Park and the extension of this boundary southward to the east flank of the Mosquito Range and southwestern South Park by Brill (1952, p. 836) has been questioned by DeVoto (1965b, p. 215).

Maroon Formation. Dominantly red arkosic sandstone, conglomerate, and mudstone comprise the Maroon Formation, but differentiation of the Maroon from the lithologically similar Minturn Formation is based primarily on difference in color. Deposition occurred principally in fan-deltas and related braided stream deposits on the southwest flank of the ancestral Front Range southwest of the Hayden lineament. The Maroon Formation is not known to occur northwest of the lineament in South Park and farther north in the Park basins. The Maroon is unconformably overlain by Jurassic rocks.

Triassic

Chugwater Formation. Reddish-colored mudstone and argillaceous sandstone and siltstone in mostly thin and medium beds comprise the Chugwater Formation in North Park. The Triassic part of the Lykins Shale and of the Goose Egg Formation are equivalent strata, as are the beds that comprise the Red Peak Formation in nearby areas of Wyoming. The Triassic strata thin southward and are not known to occur in Middle Park and South Park. Deposition likely occurred whithin the intertidal zone, and may represent both storm-tide (sabkha) and diurnal-tide (littoral) mudstone sediments (Maughan, 1980, p. 109). Thinning is in part owing to depositional onlap, but most thinning seems to have been erosional bevelling and truncation that occurred prior to Late Jurassic deposition.

Jurassic

Jurassic rocks in the region include the Entrada Sandstone in the north and the equivalent Garo Sandstone in the south, and the overlying Morrison Formation. The Entrada and Garo seem to occur only locally within their respective areas, whereas the Morrison occurs throughout north-central Colorado.

Entrada (Garo) Sandstone. An apparently widely distributed sandstone of Jurassic age occurs across most of the Park basins. This sandstone, which is correlated to the Entrada Sandstone in northwestern Colorado, has been named the Garo Sandstone in South Park (Stark and others, 1949, p. 47-48). Equivalent rocks, also correlated to the Entrada, are identified as the lower member of the Sundance Formation in North Park (Hail, 1965; 1968). Inasmuch as similar sandstone with the same stratigraphic relations is identified as Entrada at places on the east flank of the Front Range, Entrada is used in this report for this formation throughout the North, Middle, and South Parks.

The Entrada comprises mostly fine- and medium-grained, well-sorted sandstone that is generally coarse grained and locally conglomeratic at the base. Mostly the sandstone is white to light grey, but commonly it is yellowish or stained moderate reddish orange to pale red. Generally high-angle cross beds occur and are indicative of eolian and possibly shoreface deposition. The Entrada is mostly lithified by calcareous cement, but it is very friable at many places. Thickness ranges from 19 to 52 m (63 to 166 ft) in North Park (Hail, 1965; 1968). The Entrada is locally absent, but its thickness ranges up to 125 m (409 ft) in South Park (Stark and others, 1949, p. 48). Thickness differences are attributed to unconformable deposition upon an irregular erosion surface above Triassic and older rocks.

The Entrada seems to thin southward in North Park, it is thin or absent in Middle park, and seems to be not present in the Blue River Valley between Middle Park and South Park. No more than 8 m (25 ft) of probable Entrada is indicated by Tweto (1957, p. 20) in Middle Park, and none occurs in the Hot Sulphur Springs area (Izett, 1968, p. 13-14).

The Entrada is overlain by the upper member of the Sundance Formation, which comprises marine mudstone, sandstone, and carbonate rocks similar to the Lak Member of the Sundance Formation (Pipiringos and O'Sullivan, 1978). The contact with the underlying Entrada is abrupt and probably represents conformable deposition between the underlying dune and foreshore sands and the overlying shallow marine sediments. The upper member thins southward beneath the Morrison Formation and is not present in the southern part of North Park nor farther south.

Morrison Formation. The Morrison Formation comprises broad floodplain deposits that consist dominantly of fluvial and lacustrine sediments and include mostly claystone and mudstone, and commonly includes limestone, siltstone, sandstone, and local lenses of conglomerate. The Morrison is varicolored with common mottled red, purplish, and green beds, but it is dominantly green. Sandstone beds, which are mostly light grey and light greenish grey, usually weather yellowish to rusty brown. The Morrison ranges in thickness from 77 to 110 m (250 to 360 ft) in South Park (Stark and others, 1949, p. 50). In Middle Park, the Morrison ranges between 46 and 92 m (150 and 300 ft), but it is as thin as 7.5 and 15 m (25 and 50 ft) at some localities in southeastern South Park (Tweto, 1957, p. 20). As much as 150 m (500 ft) of Morrison Formation has been noted in North Park (Hail, 1968, p. 14).

Cretaceous

Dakota Sandstone. The Dakota Sandstone consists mostly of intertongued beds of sandstone and conglomeratic sandstone and some generally carbonaceous siltstone and claystone beds. Thin coal lenses and carbonized plant fragments occur locally in the middle and lower parts of the Dakota. In most areas the initial deposits are conglomeratic and lenticular and deposition in the lower Dakota was in non-marine fluvial environments. In the upper part, where sandstone is mostly well-sorted, fine- and medium-grains, and quartzose, deposition was in shore and shallow-water marine settings. Cross-bedding is common. Cementation is calcitic and the sandstone commonly is very friable, but ranges to silicified and very strongly indurated in some areas. Shaly beds near the middle of the formation occur throughout most of the region and crudely divide the dominantly fluvial lower part from the dominantly marine influenced upper part. Thickness of the Dakota averages about 70 m (230 ft) in South Park (Stark and others, 1949, p. 51), it ranges between 30 and 72 m (100 and 235 ft) in western North Park (Hail, 1965; 1968), and it ranges from as little as 30 m (100 ft) in southern North Park (Hail, 1968, p. 17) to as much as 150 m (500 ft) in northeastern North Park (Gorton, 1953, p. 89).

Benton Shale. Very dark grey to black fissile claystone and mudstone comprise most of the Benton Shale. Thin limestone beds and nodules, bentonite, and sandstone, esspecially near the top, occur throughout the formation. Stark and others (1949, p. 52) note that certain beds, especially of sandstone, are fetid or have a petroliferous odor. The Benton is conformable upon the Dakota Sandstone with a transitional sequence through several meters of interbedded sandstone and shale. Deposition was in an epicontinental sea.

The Benton is divided into three members, in ascending order, the Mowry Shale Member, a middle shaly member, and the Codell Sandstone Member. The Codell in South Park is 3.4 to 6 m (11 to 20 ft) thick of calcareous sandstone. The Codell thickens northward to 19 m (63 ft) in North Park (Hail, 1965, p. 44) where it is more calcareous and includes interbedded limestone.

Niobrara Formation. The Niobrara Formation consists dominantly of fissile to thin-bedded dark grey calcareous claystone. Dark grey, fetid limestone at the base, which is equivalent to the Fort Hays Limestone Member of the Niobrara in eastern Colorado, ranges from 3 to 20 m ((10 to 70 ft) thick and is disconformable upon the Benton. Most of the Niobrara weathers light grey, which differentiates this unit in surface exposures from darker-weathering rocks above and below it. The upper boundary of the Niobrara with the overlying Pierre Shale is arbitrarily placed in a transitional sequence from the light-weathering calcareous shales of the Niobrara to darker grey and less calcareous claystone and sandy shales above. The Niobrara ranges in thickness from a minimum of about 150 m (500 ft) in South Park (Stark and others, 1949, p. 34) to as much as 245 m (800 ft) in North Park (Hail, 1968, p. 35).

Pierre Shale. The Pierre consists principally of dark-grey to brown or greenish-brown fissile claystone, but contains much mudstone, sandstone, and a few thin beds of sandy and argillaceous limestone. The sandstone is scattered throughout the section in beds or zones ranging from less than a meter to as much as 60 m (200 ft) in thickness. Locally, sandstone beds are arkosic and some mudstone is micaceous. Thin bentonite beds less than 1 m in thickness are common throughout much of the Pierre Shale. The Pierre is conformable above the Niobrara and it is conformably overlain by the Fox Hills Sandstone. Calcareous concretions are abundant in some zones. Thickness of the Pierre Shale where it is depositionally complete between the Niobrara and Fox Hills is about 1,500 m (5,000 ft) in the north, but evidently the formation is somewhat thinner in South Park where its thickness is estimated by Stark and others (1949, p. 55) to range from about 700 to 830 m (2,300 to 2,700 ft). The Pierre is greatly reduced in thickness in most areas of the Colorado Parks owing to erosional bevelling in the region prior to deposition of Tertiary age sediments.

Fox Hills Sandstone. Fine-grained, quartzose sandstone that is generally poorly cemented and quite friable comprises the Fox Hills Sandstone. Color ranges from white and light grey through yellow and orange to various shades of brown. Shale occurs in planar beds in the lowermost part of the formation and sandstone, which occurs in the upper part, is conspicuously cross-bedded. The Fox Hills probably blanketed the Colorado Parks where it was deposited in littoral to shoreface environments; but it was eroded from most of the area prior to Tertiary deposition except in South Park. The Fox Hills is about 110 m (350 ft) thick where it has not been erosionally thinned beneath the pre-Tertiary unconformity, it is absent at most places in South Park (Stark and others, 1949, p. 55-56), and it is preserved only near the axis of the South Park syncline (Clement and Dolton, 1970, p. 209).

Laramie Formation. Coal and carbonaceous beds in massive lenses and beds of sandstone, mudstone, and volcanic tuff comprise the Laramie Formation. Most sandstone is quartzose but some beds are very arkosic. Mudstone beds are generally shaly but commonly range to poorly fissile silty and sandy beds.

Cross-bedding is conspicuous in many exposures and some planar beds occur. Deposition was chiefly in fluvial and in some lacustrine settings. The Laramie Formation lies conformably above the Fox Hills Sandstone along an abrupt depositional transition from dominantly lutitic to dominantly arenaceous sediments. The Laramie occurs only in a small area in South Park where the maximum thickness of the formation is about 115 m (375 ft) (Stark and others, 1949, p. 57), and it is unconformably overlain by the Tertiary (Paleocene) South Park Formation.

Tertiary

Volcanic and terrigenous clastic sediments that were derived from the erosion of nearby sedimentary and crystalline rock terrains characterize the content of the thick Tertiary rock sequences in the Colorado Parks area. Strata in these sequences, which are essentially equivalent to the Denver Formation that lies east of the Front Range, are the Coalmont Formation in North Park and the Middle Park and the South Park Formations in their respective basins. These formations and younger Tertiary rocks are lumped and described in only a general way in this report. They lie unconformably upon Cretaceous and older strata in the region. The pre-Tertiary rocks were subjected to considerable tectonic movements and were erosionally bevelled across the region prior to the accumulation of the thick Tertiary sequence. About 2,750 m (9,000 ft) of Tertiary rocks are estimated to have accumulated in Middle Park (Izett, 1968, p. 6), about 3,400 m (11,000 ft) in South Park (Stark and others, 1949, p. 34), and about 3,700 m (12,000 ft) in North Park (Hail, 1968, p. 8). Most of the accumulation occurred during the principal epoch of Laramide mountain uplift and basin development in the central Rocky Mountain region prior to the Oligocene. Paleocene sediments in the lower members of the Coalmont Formation accumulated 900 to 1,200 m (3,000 to 4,000 ft) thick in North Park prior to deposition of the Middle Park Formation in Middle Park to the south (Tweto, 1957, p. 29). The Lower Tertiary sediments seem to have been initially deposited even later farther south in South Park where the South Park Formation is partly Paleocene, but is mostly of Eocene age.

Later Tertiary (Neogene) sediment accumulations are relatively neglible by comparison to the earlier Tertiary accumulation. Erosion in the region during the Late Tertiary, and especially in Oligocene and Recent time, has been far more efficient at removing rocks in the region than the episodic periods of deposition have been at adding sedimentary layers in the parks.

STRUCTURE

The Colorado Parks basins lie obliquely across the axis of the northwest-southeast-trending ancestral Front Range uplift. Paleozoic rocks are absent from this paleo highland by erosion or non-deposition except in the extreme northeast part of North Park and along the southwestern margin of South Park. Thin Permian red mudstone and evaporite beds lap southwesterly in North Park onto the flank of the ancestral Front Range in northeastern North Park. The areal extent of the Permian beds in the park is confined to a very small area. Their limited occurrence and unfavorable lithology make them inconsequential in regards to oil and gas. In South Park, a nearly complete Paleozoic section for this part of Colorado occurs southwest of the the South Park fault in the adjacent easterly dipping slope of the Mosquito Range on the flank of the basin. The South Park fault is coincident with the Hayden lineament along which the major bounding fault(s) between the ancestral Front Range uplift and the Central Colorado trough had been localized in late Paleozoic time. The Paleozoic rocks are preserved there in a part of the late Paleozoic central Colorado trough that bordered the anestral Front Range highland on the southwest. These Paleozoic rocks include hydrocarbon source rocks and likely reservoir rocks in both carbonate and sandstone sequences. The complex structure and numerous intrusives in the area militate against the possibility that they may contain large oil and gas accumulations.

Mesozoic rocks overlapped the ancestral Front Range uplift but did not bury it entirely until Middle Jurassic. Lower Triassic rocks are mostly mudstones, but Upper Triassic and Lower Jurassic rocks include beach and dune sand deposits that could have trapped oil, which had migrated from outside the basin or which could have been generated by deep burial within the basins during the Laramide orogeny. Cretaceous carbonaceous mudstone and sandstone beds, like those deposited elsewhere in the Rocky Mountain region along the Western Interior seaway, occur in the Parks basins. Oil and many shows of oil in the region occur chiefly in sandstone reservoirs in the older Cretaceous sequence, which is quite similar to oil occurrences in Cretaceous rocks of adjacent areas in Wyoming and the Denver basin. Hydrocarbon occurrences in fractured shale beds are also known. Upper Cretaceous and Tertiary rocks are chiefly poorly sorted arkosic sandstone and they commonly comprise igneous intrusives, volcanic flows, and volcaniclastic sediments mostly unfavorable for oil and gas accumulations.

The relationships of many of the complex structures attributed to the Laramide orogeny within the Colorado Parks basins superficially resemble those of a transpressional tectonic fabric. However, when individual faults and faults of similar orientation and style are carefully analyzed for clues leading to the timing of deformation that they represent, it is evident, at least in a general way, that several distinct tectonic events comprise the structural fabric in this region. The structures do not seem to logically relate to a single transpressional regime. Much of the overall fabric seems to have an origin inherited from ancient orthogonal blocks defined along two systems: one by approximately northwest and northeast lineaments, and the others by approximately east-west and north-south lineaments (Maughan and Perry, 1986). Deposition of the Mesozoic sediments was influenced in only minor ways by tectonic disturbances until late Late Cretaceous (Maestrichtian) time when stresses along the western North American continental plate, attributed to subduction of the Farallon plate, were directed into the Western Interior of the continent with significant tectonic disturbance as far east as central Colorado.

The North-central Colorado region, since Late Cretaceous time, has been subjected to several epochs of compressional and extensional tectonics as well as magmatic intrusive and extrusive events. The Laramide orogeny, between about 70 m.y. ago (Maestrichtian) and 40 m.y. ago (Eocene), comprises two major compressional events. The early Laramide compression was along a northeast-southwest axis and resulted in northwest-southeast folds and faults. The late Laramide compression was directed east-west and resulted in north-south folds and faults. Subsequent tectonics, principally during Oliogocene and Miocene, have been primarily north-south compression and complimentary east-west extension resulting in faulting that includes some thrusting and folding along approximately east-west trends, and graben and horst formation by normal faulting along approximately north-south trends.

The Mesozoic rocks were deformed and severely eroded at an early stage of the Laramide orogeny (Tweto, 1980, p. 133). The Late Cretaceous and older strata were folded and possibly faulted in North Park along northwest-southeast axes prior to erosional bevelling and deposition of early Paleocene sediments (Blackstone, 1977, p. 6). Most early Laramide structures in the Hot Sulphur Springs area also trend west-northwest (Izett, 1968, p. 61-64). The Williams Range thrust fault, which has placed Precambrian rocks above Cretaceous Pierre Shale along a north-northwest trend, probably is of early Laramide origin.

In contrast to the northwest-southeast oriented compressional structures, those overthrust faults that trend approximately north-south, such as the Sheep Mountain and related faults in northwestern North Park, the Never Summer fault in southeastern North Park and the Elkhorn fault in eastern South Park, seem to be of later Laramide origin. Most of these north-south trending overthrust faults have placed Precambrian rocks above Paleogene strata and indicate their genesis during the late Laramide stage. In contrast to the northwest-southeast oriented structures in North Park, those in South Park involve younger Paleocene and possibly Eocene rocks indicating that the northwest-southeast compressional structures formed later in South Park than similarly oriented structures in North Park. However, the orientation of the structural axes in South Park differ slightly and trend more toward north-south directions than the more northwesterly structural axes in the northern part of the Colorado Parks, a relationship suggestive of east-west compressional forces active during the development of these later structures.

Tertiary strata, the Coalmont Formation in North Park, the Middle Park Formation and the South Park Formation in their respective basins, were deposited with slight to marked angular unconformity upon the older rocks. The sediments consist largely of volcanic rocks in the lower parts and of Precambrian lithic material derived from erosion of the developing Front Range in the upper parts of these formations. Up to 3,000 m (10,000 ft) of Paleogene volcaniclastic and arkosic sediments may have accumulated in the Park basins.

Structural evolution of the Colorado Parks to their present north-south, trough-like configuration began during the Paleogene, contemporaneous with deposition of later stages of sedimentation in the Coalmont, Middle Park, and South Park Formations. Precambrian cored mountain blocks that comprise the Colorado Front Range, and the Medicine Bow Mountains, the principal structural uplifts along the east flank of the basins, were elevated and thrusted westward over Phanerozoic rocks at least as young as Eocene. The Elkhorn thrust along the eastern flank of South Park is probably late Eocene or early Oligocene (Sawatzky, 1964, p. 139).

The Independence Mountain overthrust at the north edge of North Park trends approximately N. 75° W., a direction quite different from most other structures in north-central Colorado. Precambrian rocks there are thrust southward over the Paleocene and Eocene Coalmont Formation (Hail, 1965, p. 103) and the north-south-trending late Laramide Delaney Butte, Sheep

Mountain and related structures indicate development of this overthrust during the later events of the Laramide orogeny or even later.

The northwesterly oriented folds and thrusts extend diagonally across the north-south synclinal trough of the Parks Basins, and many of these thrusts bring Precambrian crystalline rocks over the Phanerozoic strata along listric surfaces. Partially exhumed ridges of Precambrian rocks are notable, especially in South Park and Middle Park, and the major thrusts in some areas resolve upward into anticlinal structures and high-angle faults (Wellborn, 1977; Osterwald and Dean, 1957, p. 14; Sawatzky, 1964; Clement and Dolton, 1970, p. 209-212). Stratigraphic displacement of up to 3,000 m (10,000 ft) is estimated for faults along the northern and eastern flank of North Park (Wellborn, 1977, p. 42), and along the eastern flank of South Park (Sawatzky, 1964, p. 136). A comparable displacement probably occurs at the eastern edge of Middle Park.

Laramide compressional forces in the Colorado Parks are related to distant, external orogeny. Northeast-southwest compression resulted during the early Laramide when westward spreading of the Atlantic forced the North American continent obliquely over the subducting Farallon plate to the west. Compression was intensified within the Western Interior as the North American plate encountered greater bouyancy and subduction was flattened as it began to obliquely override an aseismic ridge on the Farallon plate about 65 m.y. ago during the Maestrichtian (Jurdy, 1984; Henderson and others, 1984; Chapin and Cather, 1983). Those increased compressional stresses spread southward within the interior as the zone of subduction of the ridge migrated southward along the western margin of North America during Paleocene and early Eocene. The plate motion also changed to approximately east-west during late Maestrichtian and continued east-west during later phases of the Laramide orogeny (Jurdy, 1984, p. 109; Engebretson and others, 1984, fig. 2, p. 117). Structural telescoping and overthrusting along approximately north-south faults in the Rocky Mountain region occurred during the later stages of the Laramide orogeny as indicated by the westward movement of crystalline basement rocks over basin-filling sediments of Eocene age. The low-angle subduction and bouyancy of the subducted Farallon plate may account for the elevation of the Western Interior that displaced the epicontinental sea and also brought many of the upthrusted crystalline blocks to elevations above sea level where they were eroded and their detritus accumulated in the developing early Tertiary basins.

Synorogenic sediments in the Paleocene rocks lie unconformably upon the folded Cretaceous beds, and crystalline rock components in the Paleogene sediments indicate that by early Paleocene time the Precambrian rocks were exposed to erosion in some nearby uplifts. The late Laramide, north-south structures were even more strongly elevated than the earlier northwest-southeast structures. The basement crystalline rocks were thrust to high elevations and with later Neogene uplift they comprise the crystalline rock-cored ranges that are the conspicuous elements of the present Rocky Mountain topography.

The time of development of the Independence Mountain thrust is uncertain, but it occurred later than deposition of the early Paleocene sediments that comprise the youngest rocks beneath this fault (Blackstone, 1977). The probable age of thrusting is Oligocene or Miocene. Certainly, the Independence Mountain overthrust was subsequent to the north-south, late

Eocene (?) thrust faults and folds of the Delaney Butte-Sheep Mountain system, which it overrode. The Independence Mountain overthrust likely formed in response to southward directed compression created by Neogene opening of the Rio Grande rift and the clockwise rotation of the Colorado Plateaus plate (Hamilton, 1981, p. 91). The Archean terrain exposed in the Sierra Madre and northern Medicine Bow Mountains, immediately north of Independence Mountain, probably provided a relatively immobile buttress that broke the adjacent crust along fractures related to the Sybille lineament and forced the crystalline rocks over the North Park Basin sedimentary rocks.

EXPLORATION SUMMARY

Petroleum exploration began in the Colorado Parks with drilling in 1912 on the prominent South McCallum anticline in North Park. First discovery of oil occurred in 1926 by Continental Oil Co. on the North McCallum anticline where the Sherman A-1 was completed in the Dakota Sandstone for 30 mcf of carbon dioxide and 500 bbls of condensate a day. Subsequent drilling, summarized by R.C. Oburn (1968), has led to oil and gas production in 13 fields, all in North Park (Plate 1). Drilling frequency, the number of wells completed each year in the Colorado Parks, through 1986, is summarized in figure 5. Production of oil and gas from the fields in North Park during 1986 and cummulative production from these fields are shown in table 1.

PLAY DESCRIPTIONS

The principal successful oil and gas exploration play in the Park basins thus far has been the one related to structural entrapment of oil and gas in Lower Cretaceous rocks. Stratigraphic or compound structural and stratigraphic entrapment in these Cretaceous rocks may occur, but the structural complexities limit the understanding of facies changes and are not separately included in this analysis. A second, but untested play, is here considered for possible entrapment in the Pennsylvanian to Jurassic rocks in structures in southwestern South Park adjacent on the southwest to the South Park fault. In addition, a hydrocarbon subthrust play may exist.

Upper Jurassic and Lower Cretaceous Structural Plays

All of the existing oil and gas discoveries and producing fields in North Park serve to define the principal exploration play in the Park basins. Oil production data and field names are listed in table 1; field locations are shown on plate 1. These fields are developed in reservoir rocks in which closure and entrapment occur adjacent to northwest-southeast trending faults and in anticlinal folds related to early Laramide compressional events. The complexities of these structural traps are illustrated in the Lone Pine field in Jackson County (Wellborn, 1977 p. 43-46). A structure map and cross-sections of the Lone Pine field, which are characteristic of the complex structures in North Park, are reproduced in figure 6. Descriptions of Butler Creek, Delaney Butte and Lone Pine fields (Wellborn, 1983a,b,c) show similar reservoirs that are also representative of the structural traps in North Park. Structures in Middle Park (Wellborn, 1977, p. 46-58) seem equally complex, but those in South Park (Sawatzky, 1964; 1972) seem to reflect less involvement in tectonic action until the later Laramide events, and the southern part of the Colorado Parks syncline may have experienced less intense compressional forces and the development of early Laramide structural traps.

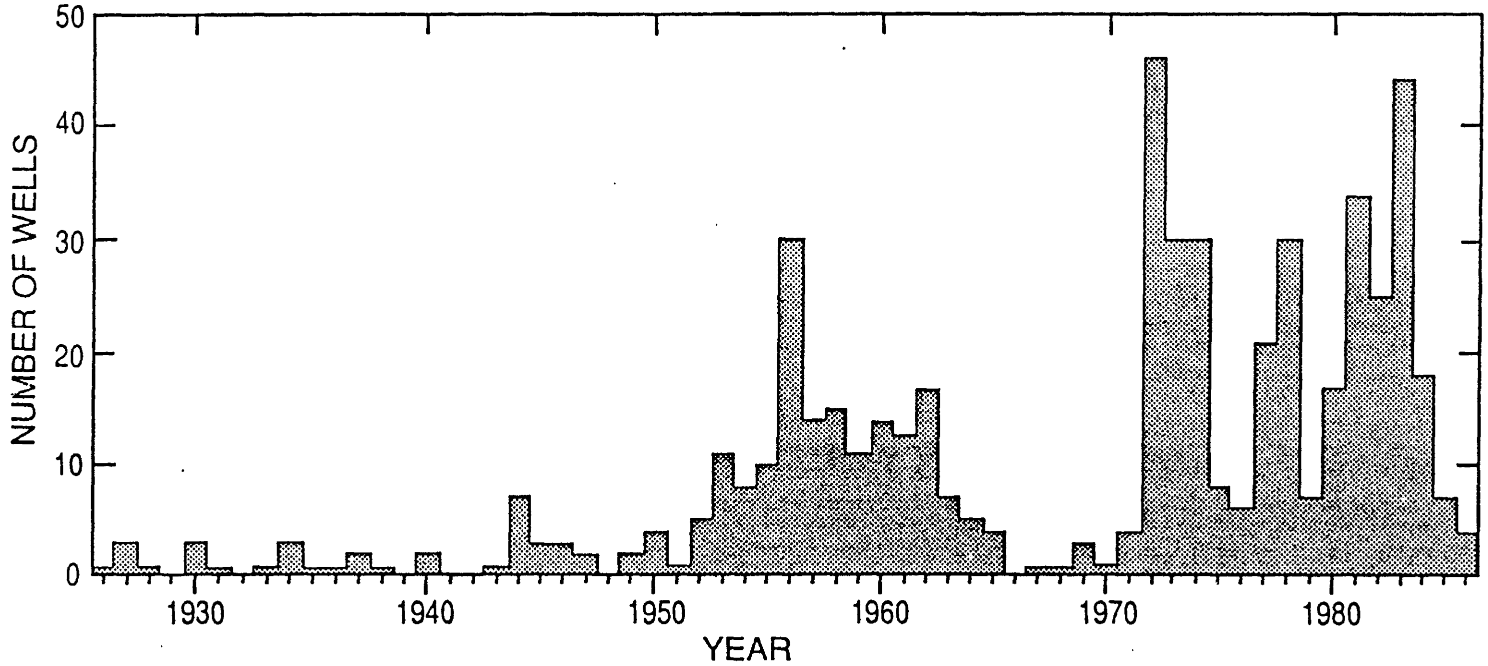

Figure 5. Bar graph showing number of wells drilled per year in the Colorado Parks, 1926-1986. Data from the Well History Control System file, Petroleum Information Corporation, 1986.

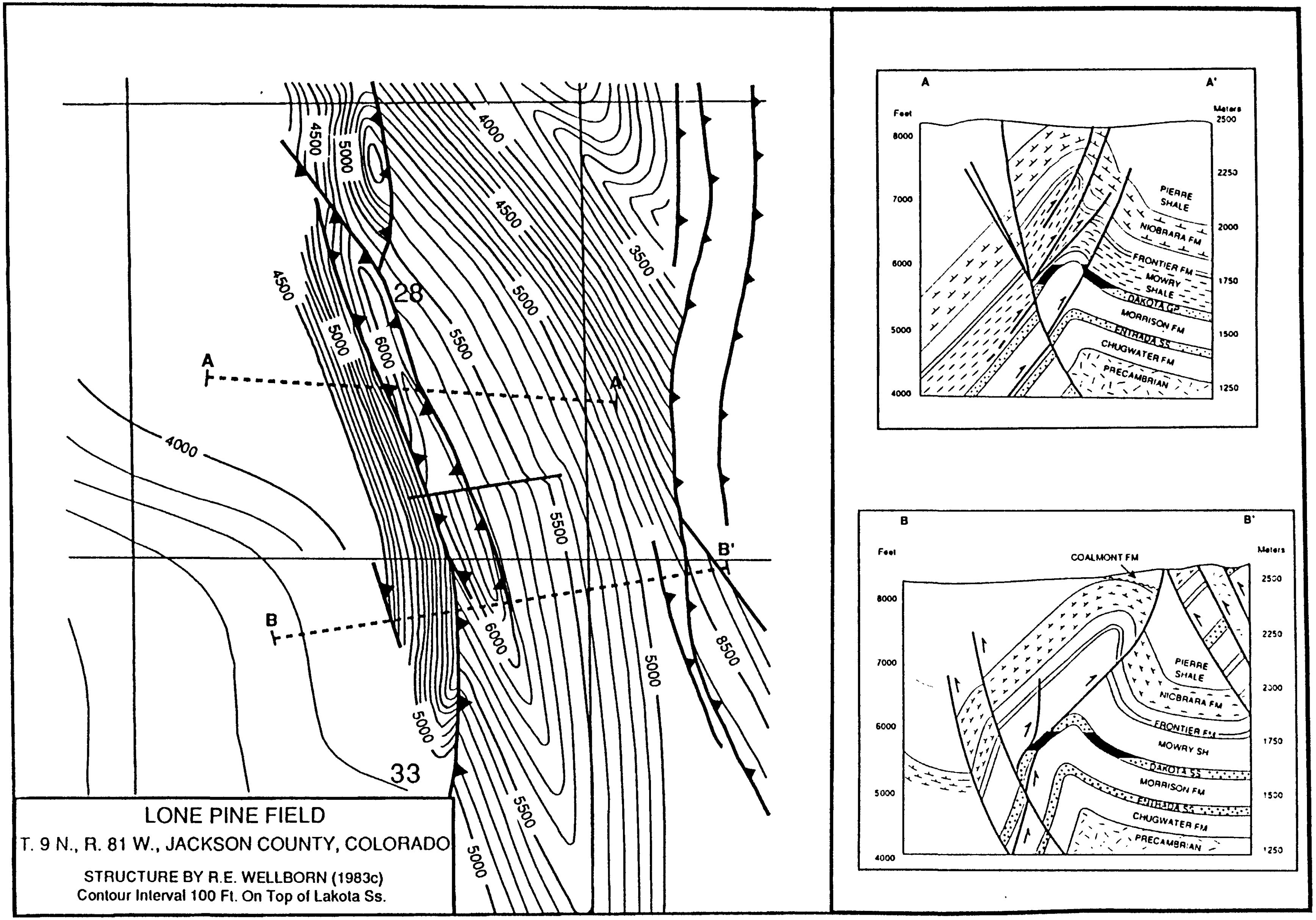

Figure 6. Structure contours and cross sections of Lone Pine field, Jackson County, Colorado, adapted from R.E. Wellborn (1983c) illustrating complex structures characteristic of the North and Middle Park Basin.

Oil and gas production in North Park fields is primarily from porous sandstone of the Entrada Sandstone, Morrison Formation, Dakota Sandstone (Lakota, Dakota, and possible Muddy Sandstone equivalents), Codell Sandstone Member of the the Benton Shale, and a sandstone in the Pierre Shale referred to as the Pierre B, which probably is the equivalent of the Shannon Sandstone in the Great Plains region east of the Front Range. Oil and gas are also produced in some fields from highly fractured beds in the Niobrara Formation.

The organic carbon-rich claystone and mudstone beds in the Cretaceous sequence are sources of the hydrocarbons. Burial sufficient to achieve thermal maturation and oil generation from the kerogen in the carbonaceous shales of these older Cretaceous sediments is assumed to have been reached around the end of Cretaceous time when the overlying sediments had accumulated to a thickness of about 2 km (6,500 ft). Burial deeper than 2 km and most catagenesis occurred during the Paleocene and continued into Eocene time. Comparison of the accumulated thicknesses shown in figure 7 indicate that the assumed critical depth for onset of catagensis of about 2 km occurred during Maestrichtian time in North Park and probably was slightly later, during early Paleocene time, in South Park, assuming uniform thermal gradients and heat-flow regimes. Vitrinite reflectence values indicate that maturation and migration occurred in South Park prior to the development of trapping structures (Harry Terbest, Jr., personal commun., 1987).

The northwest-southeast oriented structural traps in North Park were formed during the early stages of the Laramide orogeny in latest Cretaceous time and prior to deposition of the unconformably overlying Paleocene Coalmont Formation. Most of the structural development farther south in Middle Park and South Park occurred at succesive later stages of the Laramide orogeny and any traps that were formed were subsequent to the peak of oil expulsion in the more southerly parts of the region.

Folding with southwest vergence of folds and high-angle reverse faults comprised the dominant structural style during the early stage of the Laramide orogeny. These early Laramide structures are evident in the Upper Cretaceous and older strata in the region; and their development preceded erosional bevelling and deposition of Paleocene strata. These early Laramide structures were most strongly developed in North Park. Westward verging folds and faults formed in the sedimentary rocks during the late stage of the Laramide orogeny, penecontemporaneously with the north-south-trending thrust faults. These north-south structures probably formed too late relative to the time of oil generation to entrap hydrocarbons.

Neogene sediments may have added up to 600 m (2,000 ft) of basin fill and further increased the depths of petroleum source rock burial, at least locally in the vicinity of the Rabbit Ears Range. Regional uplift during the Neogene, however, would have led to accelerated erosion in most parts of the Colorado Parks, and it is likely that there has been a net decrease in the thickness of the overburden and an accompanying cooling in the basins.

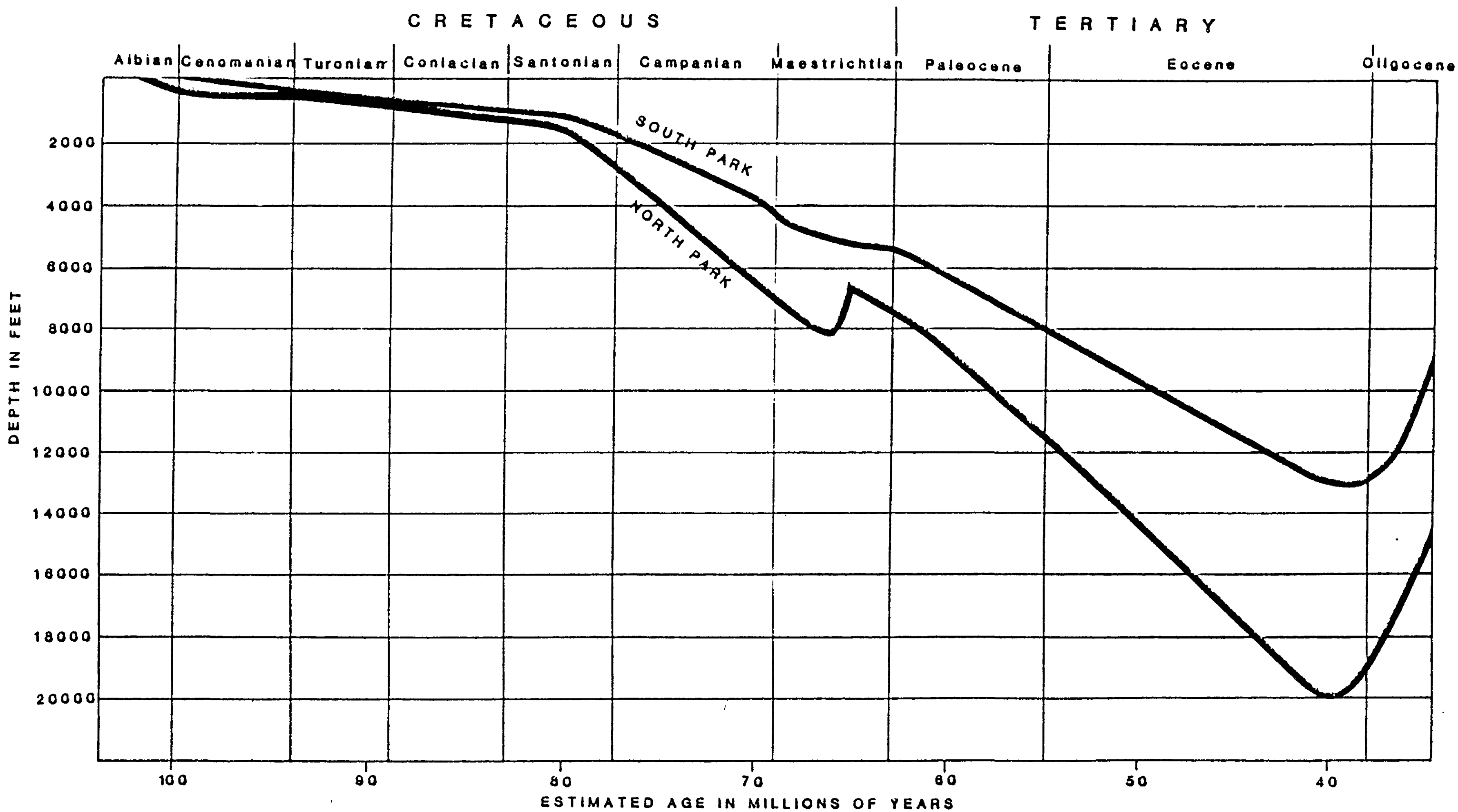

Figure 7. Burial history curves of the base of Cretaceous rocks in North Park and South Park, Colorado. Upward directed parts of the curves represent an estimate of erosional decrease in the depth of the covering sediments.

Chemical analyses of coal beds in North Park (Hatch, Madden, and Affolter, 1981) show minor differences in rank ranging from sub-bituminous A through C. The differences could be attributed to local differences of heat flow. The various factors that affect coal rank were not investigated in that study nor evaluated sufficiently to determine the thermal effects.

Vitrinite reflectance values from the Pierre Shale in central Colorado (Bostick and Pawlewicz, 1984) indicate anomalously high temperature having affected only an area near Cameron Pass on the east flank of North Park. Reflectance values determined by them from the Pierre in other parts of the Colorado Parks region indicate comparatively low temperatures. The apparent low temperature regime my be explained in several ways: 1) the temperature gradient may have been low, 2) the uppermost Cretaceous and some of the younger sediments may never have been deposited or were much thinner, as speculated by Bostick and Pawlewicz (1984, p. 397), or 3) the time of burial was short. It is most likely that erosional thinning occurred relatively quickly following deposition and that effective burial of the Pierre was too brief for the heat flow to have reached its potential and establish a full temperature gradient. Older rocks that were more deeply buried and buried for a longer time than the Pierre have generated oil that is produced in the North Park area and probably are the sources of oil traces that are known to occur throughout the Colorado Parks syncline.

Not addressed in this study are the likely, but complex, effects of heating of these rocks in areas of magmatic and hydrothermal intrusions, which Bostick and Pawlewicz (1984, p. 395) attribute for the Cameron Pass high heat anomaly. Evidence for high heat flow during the Late Tertiary occurs locally throughout the area as evidenced especially by the mineralization in the Front Range mineral belt and its southwesterly extension into the Mosquito Range. The effect of high heat on argillaceous sediments and other rocks in the Breckenridge area were noted by Ransome (1911). Thermal springs provide further evidence of local, high subsurface temperatures; and it is likely that the large volume of CO_2 gas, more than 1 million mcf, that has been produced in the McCallum field (table 1) is the result of local heating and the natural calcining of carbonate rocks in that area.

Subthrust Play

Several overthrusts on the flanks of the Colorado Parks provide oil exploration objectives, but none have been tested. The Independence Mountain block at the north of North Park, with up to 20 km (12 mi) of overhang, is the most obvious of the areas for a subthrust play. The oil potential in the Mesozoic rocks beneath the overthrust crystalline Precambrian rocks of the Independence Mountain block is summarized by Park (1977). The sedimentary rocks and the Laramide structures of North Park extend beneath the Independence Mountain overthrust from the oil-producing areas that characterize the North Park oil play. The oil play potential in this area, therefore, is the same as the principal North Park play. Overhang of Precambrian rocks above sedimentary rocks on other thrusts along the eastern edge of the Colorado Parks syncline, such as the Vasquez thrust and the Elkhorn thrust, as well as the Williams Range thrust along the eastern edge of the Blue River Valley, are areally limited in comparison to the Independence Mountain overthrust; but they are geologically similar.

Southwest Paleozoic Play

A speculative play southwest of the South Park fault (plate 1) involves the upper Paleozoic rocks there. The Belden Shale as a source rock, an early deep burial history in Pennsylavanian and Permian time, and a later burial history somewhat similar to nearby areas where the Mesozoic rocks have been preserved provide both favorable factors for oil generation, and unfavorable factors for hydrocarbon preservation. Reservoir rock conditions are less favorable than in the Mesozoic rocks. Porosity may be restricted to grainstones or to paleoweathered horizons in carbonate rocks of the Leadville Limestone. Poorly sorted arkosic sandstone units, chiefly in the Minturn Formation, are mostly unfavorable for preservation of good porosity and permeability because of an abundance of clays and clay-forming minerals.

The carbonaceous rocks of the Belden are overlain by 2,500 to 3,000 m (8,000 to 10,000 ft) of Pennsylvanian and Permian rocks. Mesozoic sediments added an additional 2,000 m (6,600 ft) minimum above the upper Paleozoic rocks. Further post-Cretaceous burial of the Paleozoic rocks southwest of the Hayden lineament probably did not occur because that terrain seems to have been involved in uplift during the Laramide and was an area of erosion and a source terrain for some of the Paleogene sediments in South Park. This burial history certainly was adequate for the generation of oil in the Belden during the Permian and later time; but overheating during the Late Cretaceous brought much of the Belden to temperatures beyond the oil generation window. Hydrocarbons that have been reported in the Leadville Limestone within mines on the western flank of the Mosquito Range (Ogden Tweto, oral commun., 1977) indicate that oil generation has occurred in that area.

Structures in the upper Paleozoic rocks that may have provided hydrocarbon traps were formed chiefly penecontemporaneously with upper Paleozoic sediments deposition in association with the faulting along the Hayden lineament that differentiated the ancestral Front Range and the central Colorado trough. Compressional tectonics during the Laramide orogeny was pervasive in the Mosquito Range and most strata there have been so severely fractured that most hydrocarbons in older structural and stratigraphic traps of that area could have escaped.

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APPENDIX

Table 2. Boreholes and their locations in the Colorado Parks, Grand, Jackson, Park, and Summit Counties, Colorado. Data extracted from the Petroleum Information Well History Control System, 1986.

Well Identification		Location	Total Depth	Formation at TD	Completion Date
UNKNOWN PERSONS	1	SEC 29 T 11N R 81W	TD 606	LAKOTA	19
CONSOLIDATED SMELT-MET	1 JACKSON	SEC 18 T 9N R 78W	TD 2250	PIERRE	19
CONTINENTAL OIL	1 GOVT	SEC 12 T 9N R 79W	TD 5110	DAKOTA	1926
CONTINENTAL OIL	1 SHERMAN	SEC 12 T 9N R 79W	TD 5110	DAKOTA	1927
CONTINENTAL OIL	1 POLLOCK	SEC 2 T 9N R 79W	TD 4900	BENTON	1927
CONTINENTAL OIL	2 POLLOCK	SEC 2 T 9N R 79W	TD 1230		1927
SEWARD OIL	1 HUNTER	SEC 31 T 11N R 79W	TD 4717	MUDDY	1928
MIDWEST OIL	214 RICH	SEC 9 T 6N R 80W	TD 4500		1930
PRODUCERS & REFINERS	1 HENDERSHOT	SEC 2 T 6N R 81W	TD 4258		1930
MIDWEST OIL	21 RICH	SEC 8 T 6N R 80W	TD 4500		1930
OIL-MINERALS LANDS INC	1 MCELROY	SEC 14 T 2N R 81W	TD 545		1931
WALDEN OIL	1 MESMAN	SEC 33 T 9N R 78W	TD 325	COALMONT	1933
SOUTH PARK O & G	1 ESCHE	SEC 5 T 9S R 76W	TD 7725		1934
SO PARK OIL AND GAS	1 ESCHE	SEC 5 T 9S R 76W	TD 2465	DAKOTA	1934
SOUTH PARK OIL CO	1 MILLIGAN	SEC 13 T 8S R 76W	TD 3228	MUDDY	1934
CONTINENTAL OIL	3 ROSAMONDE HOYE	SEC 34 T 9N R 78W	TD 5258		1935
SO PARK OIL	1 LEBERT	SEC 21 T 11S R 75W	TD 705		1936
CARTER OIL	1 ABBOTT	SEC 27 T 9N R 78W	TD 3950		1937
SOUTH PARK OIL	1 STATE	SEC 16 T 11S R 75W	TD 5705		1937
INTERSTATE OIL & REFIN	1 HINMAN	SEC 11 T 2N R 81W	TD 3920	TIMPAS	1938
SOUTH PARK OIL	1 LEMARR	SEC 16 T 11S R 75W	TD 7234		1940
COLORADO OIL REFINING	1 NORTH PARK COAL	SEC 18 T 9N R 78W	TD 4350		1940
CONTINENTAL OIL	5-A POLLOCK	SEC 2 T 9N R 79W	TD 5129	DAKOTA	1943
CONTINENTAL OIL	4-A HOYE	SEC 27 T 9N R 78W	TD 5708	DAKOTA	1944
CONTINENTAL OIL	2-A SHERMAN	SEC 12 T 9N R 79W	TD 5845	LAKOTA	1944
CONTINENTAL OIL	1-B POLLOCK	SEC 11 T 9N R 76W	TD 5388	DAKOTA	1944
CONTINENTAL OIL	1-B POLLOCK	SEC 11 T 9N R 79W	TD 5388	MORRISON	1944
CONTINENTAL OIL	1 WEBSTER	SEC 18 T 9N R 78W	TD 5414	MORRISON	1944
CONTINENTAL OIL	2 POLLACK /B/	SEC 3 T 9N R 79W	TD 5085	LAKOTA	1944
CONTINENTAL OIL	2-A PETERSON	SEC 2 T 9N R 79W	TD 5416	DAKOTA	1944
CONTINENTAL OIL	3-A SHERMAN	SEC 12 T 9N R 79W	TD 5696	LAKOTA	1945
CONTINENTAL OIL	3-B POLLOCK	SEC 2 T 9N R 79W	TD 5578	DAKOTA	1945

CONTINENTAL OIL	2 -A	MORRIS	SEC	34	T	10N	R	79W	TD	5880	DAKOTA	1945
FARRELL WM L	1	HILL	SEC	21	T	11N	R	81W	TD	1462		1946
FARRELLY WM L	2	HILL	SEC	33	T	11N	R	81W	TD	1248		1946
FARRELLY	3	HILL	SEC	33	T	11N	R	81W	TD	729	MUDDY	1946
LYNCHETAL P D	1	FEE	SEC	9	T	2N	R	81W	TD	1230		1947
STRINGER ET AL	1	GOVT	SEC	8	T	10N	R	79W	TD	1236		1947
MCDANNALD OIL	1	GOVT	SEC	1	T	12S	R	75W	TD	7098	NIOBRARA	1949
MCDANNALD OIL CO	1	STATE	SEC	20	T	12S	R	74W	TD	6182	MAROON	1949
WYCOMO OIL	1	STATE	SEC	16	T	11S	R	75W	TD	5485	NIOBRARA	1950
NEEDHAM JOE	1	BOND	SEC	7	T	8N	R	81W	TD	481	MORRISON	1950
MCDONNALD OIL	1	FEE	SEC	28	T	11S	R	73W	TD	2087	GRANITE	1950
FADGE OIL	1	EDWARD	SEC	6	T	8N	R	81W	TD	1150		1950
CONTINENTAL OIL	1	HARWOOD	SEC	3	T	9N	R	79W	TD	5961	MORRISON	1951
DEBARARD CATTLE	1	STATE	SEC	27	T	4N	R	81W	TD	4705	CAMBRIAN	1952
CONTINENTAL OIL	A-6	POLLACK	SEC	2	T	9N	R	79W	TD	6180	GRANITE	1952
FIFTY-ONE OIL	1	GOVT	SEC	1	T	12S	R	75W	TD	424		1952
BENEDUM & TREES	1	STATE	SEC	36	T	7N	R	81W	TD	6920	FRONTIER	1952
CONTINENTAL OIL	1	M J OGARA	SEC	4	T	9N	R	79W	TD	7007	RED BEDS	1952
CONTINENTAL OIL	3	HOYE	SEC	34	T	9N	R	78W	TD	6358	GRANITE	1953
RYAN OIL	1	GOVT	SEC	19	T	10N	R	78W	TD	4837	MORRISON	1953
BRITISH AMERICAN OIL	1	C LAZY U	SEC	3	T	2N	R	77W	TD	4629	GRANITE	1953
EDWARDS E M	1	ANDERSON RANCH	SEC	2	T	4N	R	82W	TD	800		1953
LOCKHART L M	1	FULLER	SEC	35	T	7N	R	81W	TD	8116	JURASSIC	1953
HIAWATHA OIL & GAS	1-25	GOVT	SEC	25	T	7N	R	81W	TD	8244	GRANITE	1953
JOHNSON F KIRK ETAL	1	BIG HORN RANCH	SEC	27	T	10N	R	81W	TD	2381	RED PEAK	1953
GREAT LAKES NATURAL GAS	53-31	UNDERWOOD-B	SEC	31	T	2N	R	76W	TD	5077	RED BEDS	1953
CONTINENTAL OIL	2	HARWOOD	SEC	10	T	9N	R	79W	TD	7454	JURASSIC	1953
GLASSCOCK G C	1	HORN	SEC	31	T	2N	R	76W	TD	5606	MORRISON	1953
PLACID OIL	1	CARL D JOHNSON	SEC	22	T	8N	R	78W	TD	8115	CRETACEOUS	1953
MACK LEWIS	1-A	C LAZY U	SEC	2	T	2N	R	77W	TD	3114	MORRISON	1954
HORTON I D	1	GOVT	SEC	31	T	9N	R	81W	TD	100		1954
MONOLITH PORTLAND MIDWS	1	GOVT	SEC	32	T	8N	R	78W	TD	10264	TRIASSIC	1954
LOCKHART	1	GOVERNMENT	SEC	11	T	6N	R	81W	TD	7841	MORRISON	1954
LION OIL	1	HACKLEMAN	SEC	23	T	10N	R	79W	TD	5265	MORRISON	1954
HORTON I D	2	BRAND	SEC	31	T	9N	R	81W	TD	880	MORRISON	1954
BOSCO F M	1	GOVERNMENT	SEC	17	T	3N	R	77W	TD	430		1954
LION OIL	1	DWINNELL	SEC	23	T	10N	R	79W	TD	4673	LAKOTA	1954
WOODS WALTER	1	JOHNSON-GOVERNMENT	SEC	18	T	6N	R	79W	TD	948	RED PEAK	1955
LION OIL	1	EVA	SEC	20	T	10N	R	79W	TD	6350	RED PEAK	1955
MACK PETROLEUM	1	S M MORRIS	SEC	6	T	1N	R	76W	TD	1770	MORRISON	1955

LION OIL	3	DWINNEL	SEC	23	T	10N	R	79W	TD	5494		1955
KAMPHAUSEN DAN	1	KNIGHT	SEC	4	T	10N	R	79W	TD	1835	MORRISON	1955
LION OIL	2	DWINELL	SEC	23	T	10N	R	79W	TD	4949	LAKOTA	1955
WYCOMO OIL	1	STATE	SEC	16	T	11S	R	75W	TD	5924	NIOBRARA	1955
LION OIL	4	DWINELL	SEC	23	T	10N	R	79W	TD	4716	LAKOTA	1955
KAMPHAUSEN DAN	1	GOVT	SEC	9	T	10N	R	79W	TD	3529	ENTRADA	1955
LION OIL	1	CODY	SEC	22	T	10N	R	79W	TD	4830	MORRISON	1955
LION OIL	2	CODY	SEC	22	T	10N	R	79W	TD	5100	MORRISON	1956
NATIONAL COOP REF ASSN	1	STATE	SEC	36	T	7N	R	82W	TD	4480	MORRISON	1956
SHELL OIL	1-4343	STATE	SEC	36	T	11S	R	75W	TD	5349	CAMBRIAN	1956
SHELL OIL	1	STATE	SEC	17	T	12S	R	74W	TD	3905	MORRISON	1956
CABEEN EXPL	1 B	BLEVINS	SEC	3	T	9N	R	78W	TD	2253	LAKOTA	1956
LION OIL	1	CRYSTAL	SEC	8	T	10N	R	79W	TD	4070	MORRISON	1956
CABEEN EXPL	2-A	BLEVINS-A	SEC	3	T	9N	R	78W	TD	2707	TRIASSIC	1956
CABEEN EXPL	3-B	BLEVINS	SEC	3	T	9N	R	78W	TD	2165	MORRISON	1956
CONTINENTAL OIL	5-B	POLLOCK	SEC	3	T	9N	R	79W	TD	6261	ENTRADA	1956
LION OIL	1	COCHRAN	SEC	20	T	10N	R	79W	TD	5756	MORRISON	1956
LION OIL	3	CODY - 03534-A	SEC	22	T	10N	R	79W	TD	4950	MORRISON	1956
LION OIL	1	PERKINS	SEC	22	T	10N	R	79W	TD	5116	LAKOTA	1956
CABEEN EXPL	5-A	BLEVINS	SEC	11	T	9N	R	78W	TD	2170	LAKOTA	1956
CABEEN EXPL	4-B	BLEVINS	SEC	3	T	9N	R	78W	TD	2278	LAKOTA	1956
CABEEN EXPL	4-A	BLEVINS	SEC	11	T	9N	R	78W	TD	2135	MORRISON	1956
MURFIN & SUTTON	1	GOVT	SEC	14	T	9N	R	78W	TD	1821		1956
VICTOR DRILLING	1	BUFFALO CREEK	SEC	8	T	6N	R	80W	TD	8486	MORRISON	1956
CABEEN EXPL	2-B	BLEVINS	SEC	3	T	9N	R	78W	TD	2134	MORRISON	1956
SHELL OIL	1	A T MCDANNALD	SEC	32	T	11S	R	75W	TD	3560	CAMBRIAN	1956
CABEEN EXPL	3-A	BLEVINS	SEC	10	T	9N	R	78W	TD	2128	MORRISON	1956
CABEEN EXPL	5-B	BLEVINS	SEC	3	T	9N	R	78W	TD	2150	MORRISON	1956
CABEEN EXPL	5-B	BLEVINS	SEC	10	T	9N	R	78W	TD	2148	LAKOTA	1956
CONTINENTAL OIL	B-1	MORRIS	SEC	34	T	10N	R	79W	TD	7485	MORRISON	1956
CARTER OIL	1	GOVT-MCDANNALD	SEC	4	T	10N	R	80W	TD	7536	JELM	1956
SHELL OIL	1	FEDERAL 4337	SEC	4	T	12S	R	74W	TD	571		1956
SHAMROCK DRILLING	1	BLEVINS-STATE	SEC	27	T	10N	R	78W	TD	2177	LAKOTA	1956
SHELL	1	GOVT	SEC	34	T	12S	R	74W	TD	4444	MORRISON	1956
CONTINENTAL OIL	2 A	PETERSON	SEC	2	T	9N	R	79W	TD	5925	MORRISON	1956
SHELL OIL	1-4285	FEDERAL	SEC	28	T	11S	R	75W	TD	8490	MORRISON	1956
CABEEN EXPL	1-A	BLEVINS	SEC	11	T	9N	R	78W	TD	1593	MUDDY	1956
HEWITT WILLIAM J	1	GOVERNMENT	SEC	21	T	6N	R	79W	TD	2755	GRANITE	1956
CONTINENTAL OIL	4-B	POLLOCK	SEC	11	T	9N	R	79W	TD	6180	MORRISON	1956
CABEEN EXPL	1	TEXAS STATE	SEC	11	T	9N	R	78W	TD	2300	LAKOTA	1957

CABEEN EXPL	6-B	BLEVINS	SEC	3	T	9N	R	78W	TD	2130	DAKOTA	1957
LION OIL /MONSANTO/	1	LINKE-STATE	SEC	16	T	1N	R	77W	TD	5366	LAKOTA	1957
CABEEN EXPL	7	BLEVINS A	SEC	3	T	9N	R	78W	TD	1605	MUDDY	1957
CABEEN EXPL	1	TEXAS-GOVT	SEC	10	T	9N	R	78W	TD	2160	LAKOTA	1957
CONTINENTAL OIL	1	SHERMAN B	SEC	13	T	9N	R	79W	TD	6845	JURASSIC	1957
TENNESSEE GAS TRANS	1	TETER	SEC	11	T	8S	R	76W	TD	7475		1957
CLAYTON OIL ETAL	1	STATE	SEC	16	T	2N	R	81W	TD	670	RED PEAK	1957
GULF OIL	1	MOORE-STATE	SEC	36	T	8N	R	78W	TD	9533	DAKOTA	1957
REPUBLIC NATURAL GAS	1	GADDIS GOVT	SEC	19	T	10N	R	78W	TD	4713	JELM	1957
MURPHY CORPORATION	1	UNIT	SEC	4	T	2N	R	78W	TD	7471	DAKOTA	1957
CONTINENTAL OIL	4	SHERMAN A	SEC	13	T	9N	R	79W	TD	6041	MORRISON	1957
PAN AMERICAN	1	DODGE	SEC	30	T	9N	R	77W	TD	3104	RED PEAK	1957
CABEEN EXPL	6-A	BLEVINS	SEC	11	T	9N	R	78W	TD	2199	MORRISON	1957
CONTINENTAL OIL	2	SHERMAN B	SEC	13	T	9N	R	79W	TD	6278	MORRISON	1958
AMERADA HESS CORP	1	MORRIS	SEC	14	T	6N	R	79W	TD	7623	GRANITE	1958
GULF OIL	1	BALLINGER	SEC	8	T	9N	R	78W	TD	5609	MORRISON	1958
KAMPHAUSEN DAN	4	GOVT	SEC	9	T	3N	R	81W	TD	1956	SUNDANCE	1958
GULF OIL	2-A	BALLINGER-FEDERAL	SEC	8	T	9N	R	78W	TD	5450	MORRISON	1958
KAMPHAUSEN DAN	2	GOVT	SEC	9	T	3N	R	81W	TD	1866	MORRISON	1958
COLORADO WESTERN DRLG	1	KAMPHAUSEN	SEC	22	T	10N	R	79W	TD	5342	MORRISON	1958
CABEEN EXPL	9-A	BLEVINS	SEC	11	T	9N	R	78W	TD	2470	ENTRADA	1958
TOMBERLIN BILL	1	HILLS LAND	SEC	32	T	6N	R	79W	TD	1497	ENTRADA	1958
KAMPHAUSEN DAN	1	BROWN	SEC	12	T	2N	R	81W	TD	2730	MORRISON	1958
TOMBERLIN BILL	2	HILLS LAND	SEC	32	T	6N	R	79W	TD	1245	LAKOTA	1958
KAMPHAUSEN DAN	3	GOVERNMENT	SEC	8	T	3N	R	81W	TD	1112	SUNDANCE	1958
KINGWOOD OIL	1	GOVT-COWDREY	SEC	11	T	10N	R	79W	TD	2437	RED PEAK	1958
KAMPHAUSEN DAN	1	GOVT	SEC	9	T	3N	R	81W	TD	1237	MORRISON	1958
GULF OIL	2	BALLINGER-FEDERAL	SEC	8	T	9N	R	78W	TD	5481		1958
GALLAGHER V R	3	GOVT	SEC	17	T	9N	R	78W	TD	5962	MORRISON	1959
GULF OIL	1-A	MCCALLUM	SEC	21	T	9N	R	78W	TD	5638	LAKOTA	1959
CLAYTON OIL	1	FEDERAL	SEC	4	T	5N	R	79W	TD	2512	MORRISON	1959
CONTINENTAL OIL	1	BOURG	SEC	7	T	9N	R	78W	TD	5929	MORRISON	1959
GALLAGHER V R	2	GOVT	SEC	20	T	9N	R	78W	TD	5707	LAKOTA	1959
REPUBLIC NATURAL GAS	1	GOVT B	SEC	24	T	10N	R	79W	TD	4525	MORRISON	1959
GULF OIL	1	SUDDITH-FEDERAL	SEC	22	T	9N	R	78W	TD	6760	MORRISON	1959
GALLAGHER V R	1	GOVT-HOYE	SEC	21	T	9N	R	78W	TD	5915	MORRISON	1959
GULF OIL	3	BALLINGER	SEC	17	T	9N	R	78W	TD	5538	MORRISON	1959
COX HOWARD JR	1	GOVT-NEWTON	SEC	10	T	9N	R	78W	TD	4583	LAKOTA	1959
CABEEN EXPL	8-A	BLEVINS	SEC	10	T	9N	R	78W	TD	2156	LAKOTA	1959
GULF OIL	1	MCCOLLUM FEDERAL	SEC	21	T	9N	R	78W	TD	5499		1959

SINCLAIR OIL & GAS	1	STATE-JACKSON	SEC	16	T	9N	R	78W	TD	5820	MORRISON	1960
KINGWOOD OIL	4	HOYE-GOVT	SEC	27	T	9N	R	78W	TD	5680		1960
HUMBLE OIL & REFINING	1	PERKINS	SEC	22	T	10N	R	79W	TD	5173	MORRISON	1960
GALLAGHER VICTOR R	1	GOVT-ROGERS	SEC	20	T	9N	R	78W	TD	6279	MORRISON	1960
CONTINENTAL OIL	21	GOVT	SEC	7	T	9N	R	78W	TD	6000	LAKOTA	1960
SHERWOOD OIL	1	GOVT	SEC	33	T	6N	R	79W	TD	1026	FRONTIER	1960
WALTERS DRLG	1	STATE-B	SEC	21	T	4N	R	81W	TD	3346	MORRISON	1960
GARY SAMUEL-ETAL	1	DWINELL RANCH	SEC	26	T	10N	R	79W	TD	5058	DAKOTA	1960
KINGWOOD OIL	5	HOYE-GOVT	SEC	27	T	9N	R	78W	TD	6160	MORRISON	1960
CABEEN EXPL	1	JOHNSON	SEC	25	T	9N	R	79W	TD	7553	PIERRE	1960
CONTINENTAL OIL	22	MCCALLUM UNIT	SEC	10	T	9N	R	79W	TD	6683	ENTRADA	1960
CABEEN EXPL	1	CARSTROM-STATE A	SEC	29	T	9N	R	81W	TD	4250	ENTRADA	1960
GULF OIL	1	DALY-FEDERAL	SEC	7	T	9N	R	78W	TD	6660	NIOBRARA	1960
KAMPHAUSEN DAN	1-C	LAZY-U-RANCH	SEC	2	T	2N	R	77W	TD	2068	PIERRE	1960
TEXACO INC	1	STATE C-NCT	SEC	11	T	9N	R	78W	TD	2138	MORRISON	1961
CONTINENTAL OIL	24	MCCALLUM-GOVT	SEC	10	T	9N	R	79W	TD	6223	MORRISON	1961
CABEEN EXPL	1	BROWNLEE	SEC	8	T	9N	R	79W	TD	9729	LAKOTA	1961
SHARPLES OIL	1	J H DICKENS	SEC	6	T	8N	R	77W	TD	3536	MORRISON	1961
HICKERSON-GREEN-LIDDELL	1	GOVT	SEC	9	T	1N	R	80W	TD	840	LEWIS	1961
GULF OIL	1	BUSH DRAW-GOVT	SEC	34	T	9N	R	78W	TD	6358	GRANITE	1961
B-JAY OIL	2	RINGSBY-STATE	SEC	16	T	9N	R	78W	TD	5995	DAKOTA	1961
CONTINENTAL OIL	23	MCCALLUM-GOVT	SEC	18	T	9N	R	78W	TD	6229	MORRISON	1961
SHARPLES OIL	1	H E DODGE	SEC	13	T	9N	R	78W	TD	363		1961
EASON OIL	1-A	GOVT	SEC	22	T	1S	R	77W	TD	2110	ENTRADA	1961
AMERADA PETROLEUM	1	THOMPSON	SEC	8	T	6N	R	79W	TD	2934	GRANITE	1961
SHARPLES OIL	1-X	DODGE	SEC	13	T	9N	R	78W	TD	3100	MORRISON	1961
CONTINENTAL OIL	25	MCCALLUM-GOVT	SEC	11	T	9N	R	79W	TD	6125	LAKOTA	1961
TEXACO INC	1	STATE-D	SEC	34	T	10N	R	78W	TD	3132	FRONTIER	1962
CONTINENTAL OIL	32	MCCALLUM UNIT-GOVT	SEC	4	T	9N	R	79W	TD	6015	MORRISON	1962
CONTINENTAL OIL	30	UNIT	SEC	3	T	9N	R	79W	TD	6090	MORRISON	1962
CONTINENTAL OIL	26	UNIT	SEC	10	T	9N	R	79W	TD	6040	MORRISON	1962
CONTINENTAL OIL	28	UNIT	SEC	3	T	9N	R	79W	TD	6129	MORRISON	1962
CONTINENTAL OIL	27	UNIT	SEC	11	T	9N	R	79W	TD	6070	MORRISON	1962
MIDWEST OIL	1	S MCCALLUM-FED	SEC	3	T	8N	R	78W	TD	7815	MORRISON	1962
CONTINENTAL OIL	29	MCCALLUM UNIT	SEC	11	T	9N	R	79W	TD	6388	MORRISON	1962
CONTINENTAL OIL	35	MCCALLUM UNIT	SEC	34	T	10N	R	79W	TD	6600	MORRISON	1962
CRESLENN OIL	1-A	DWINELL	SEC	26	T	10N	R	79W	TD	5305	LAKOTA	1962
CONTINENTAL OIL	20	UNIT	SEC	13	T	9N	R	79W	TD	6278	MORRISON	1962
CONTINENTAL OIL	31	MCCALLUM UNIT	SEC	11	T	9N	R	79W	TD	6165	MORRISON	1962
GALLAGHER R VICTOR	1	GOVT-BELTZ	SEC	1	T	9N	R	78W	TD	3097	LAKOTA	1962

CONTINENTAL OIL	28	UNIT	SEC	8	T	9N	R	79W	TD	6129	MORRISON	1962
CONTINENTAL OIL	33	MCCALLUM UNIT	SEC	4	T	9N	R	79W	TD	6210	MORRISON	1962
SUNRAY DX OIL	1-D	GOVT	SEC	14	T	4N	R	77W	TD	7882	MORRISON	1962
CONTINENTAL OIL	28	UNIT	SEC	3	T	9N	R	79W	TD	6129	MORRISON	1962
TEXACO INC	1-A	LANMON-GOVT	SEC	7	T	9N	R	80W	TD	6150	ENTRADA	1963
CONTINENTAL OIL	36	MCCALLUM UNIT-GOVT	SEC	11	T	9N	R	79W	TD	6545	MORRISON	1963
CONTINENTAL OIL	8	MCCALLM UNIT	SEC	12	T	9N	R	79W	TD	5696	LAKOTA	1963
SHARPLES PHILIP T	1	AUBREY-GOVT	SEC	1	T	8N	R	78W	TD	5582	PIERRE	1963
CONTINENTAL OIL	1	DELFERN-GOVT	SEC	33	T	10N	R	79W	TD	6028	LAKOTA	1963
AMERADA PETROLEUM	1	STATE-G	SEC	36	T	6N	R	79W	TD	6783	DAKOTA	1963
CONTINENTAL OIL	34	UNIT	SEC	4	T	9N	R	79W	TD	6268	MORRISON	1963
SOUTHLAND ROYALTY ETAL	1	GOVT	SEC	20	T	9N	R	78W	TD	6265	MORRISON	1964
PEASE WILLARD DRLG	1	GOVT	SEC	12	T	8N	R	82W	TD	602	ENTRADA	1964
PEASE WILLARD DRLG	1	IRVINE	SEC	7	T	8N	R	81W	TD	855		1964
COUPEY PAUL	2	TEXACO-STATE	SEC	2	T	9N	R	78W	TD	1120	CRETACEOUS	1964
HILL A G	1	C L DUNAWAY	SEC	21	T	10N	R	79W	TD	5605	NIOBRARA	1964
HILL A G	2	C L DUNAWAY	SEC	21	T	10N	R	79W	TD	6001	FRONTIER	1965
BUTTES G&O	1-25	MOTT-GOVT	SEC	25	T	10N	R	80W	TD	4042	PIERRE	1965
COUPEY PAUL S	1	STATE	SEC	27	T	10N	R	78W	TD	200		1965
LUFF-MARTINETS-ALPINE	1	RITSCHARD	SEC	28	T	4N	R	81W	TD	3019	DAKOTA	1965
GEARY WILLIAM J	1	STATE	SEC	11	T	13S	R	77W	TD	880	PENNSYLVANIAN	1967
PAN AMERICAN PETROLEUM	1	USA-WILLIAM HEWIT	SEC	5	T	2N	R	78W	TD	6811	GRANITE	1968
NATIONAL ASSOCIATED PET	1	CHEDSEY	SEC	14	T	7N	R	81W	TD	7505	GRANITE	1969
THE COLORADO CORP	1	KING	SEC	33	T	4N	R	78W	TD	2129	PALEOCENE	1969
UNION OIL OF CALIFORNIA	1-P19	E B SHAWVER	SEC	19	T	7N	R	79W	TD	7856	CRETACEOUS	1969
MCBRIDE W C INC	1	ALLARD	SEC	30	T	10N	R	79W	TD	7773	DAKOTA	1970
OCCIDENTAL PETROLEUM	1	PETERSON-GOVT	SEC	28	T	9N	R	78W	TD	7221	MORRISON	1971
CONTINENTAL OIL	37	MCCALLUM	SEC	3	T	9N	R	79W	TD	1266	PIERRE	1971
NIELSON ENTERPRISES	8-1	COWDREY-GOVT	SEC	8	T	10N	R	79W	TD	4082	LAKOTA	1971
BURTON-HAWKS EXPL	1	MARGARET SPAULDING	SEC	28	T	9N	R	81W	TD	2692	MORRISON	1971
MCBRIDE W C INC ETAL	1X	ALLARD	SEC	30	T	10N	R	79W	TD	7820	MORRISON	1972
CONTINENTAL OIL	60	MCCALLUM UNIT	SEC	12	T	9N	R	79W	TD	965	PIERRE	1972
CONTINENTAL OIL	52	MCCALLUM UNIT-GOVT	SEC	34	T	10N	R	79W	TD	1012	PIERRE	1972
BURTON-HAWKS EXPL	2	MARGARET SPAULDING	SEC	28	T	9N	R	81W	TD	2683	MORRISON	1972
CONTINENTAL OIL	43	MCCALLUM UNIT-GOVT	SEC	11	T	9N	R	79W	TD	1474	PIERRE	1972
CONTINENTAL OIL	69	MCCALLUM UNIT-GOVT	SEC	2	T	9N	R	79W	TD	4022	PIERRE	1972
BURTON-HAWKS EXPL	1	STATE	SEC	28	T	9N	R	81W	TD	2000	NIOBRARA	1972
AZTEC OIL & GAS	1	CARTER CREEK	SEC	7	T	3N	R	80W	TD	5900	RED PEAK	1972
CONTINENTAL OIL	50	MCCALLUM UNIT-GOVT	SEC	3	T	9N	R	79W	TD	955	PIERRE	1972
HISSONG JOHN R	1	STATE-DOLORES	SEC	16	T	10N	R	81W	TD	873	MORRISON	1972

CONTINENTAL OIL	40	MCCALLUM UNIT-GOVT	SEC	11	T	9N	R	79W	TD 1204	PIERRE	1972
CONTINENTAL OIL	67	MCCALLUM UNIT-GOVT	SEC	12	T	9N	R	79W	TD 1400	PIERRE	1972
CONTINENTAL OIL	70	MCCALLUM UNIT-GOVT	SEC	34	T	10N	R	79W	TD 1660	PIERRE	1972
CONTINENTAL OIL	66	MCCALLUM UNIT	SEC	12	T	9N	R	79W	TD 1120	PIERRE	1972
CONTINENTAL OIL	47	MCCALLUM UNIT-GOVT	SEC	2	T	9N	R	79W	TD 1205	PIERRE	1972
CONTINENTAL OIL	59	MCCALLUM UNIT	SEC	3	T	9N	R	79W	TD 1875	PIERRE	1972
CONTINENTAL OIL	51	MCCALLUM UNIT-GOVT	SEC	1	T	9N	R	79W	TD 835	PIERRE	1972
BASIN PETROLEUM ETAL	28-1	RIDGE-GOVT	SEC	28	T	6N	R	81W	TD 5083	DAKOTA	1972
CONTINENTAL OIL	74	MCCALLUM UNIT-GOVT	SEC	2	T	9N	R	79W	TD 1172	PIERRE	1972
CONTINENTAL OIL	42	MCCALLUM UNIT-GOVT	SEC	3	T	9N	R	79W	TD 1923	PIERRE	1972
CONTINENTAL OIL	39	MCCALLUM	SEC	3	T	9N	R	79W	TD 1530	PIERRE	1972
BURTON-HAWKS EXPL	2	MARGARET SPAULDING	SEC	28	T	9N	R	81W	TD 2884	MORRISON	1972
BURTON-HAWKS EXPL	6	MARGARET SPAULDING	SEC	33	T	9N	R	81W	TD 2995	LAKOTA	1972
BURTON-HAWKS EXPL	1	MEXICAN CREEK-GOVT	SEC	5	T	6N	R	81W	TD 5940	ENTRADA	1972
CONTINENTAL OIL	64	MCCALLUM UNIT-GOVT	SEC	11	T	9N	R	79W	TD 1571	PIERRE	1972
BURTON-HAWKS EXPL	4-B	MARGARET SPAULDING	SEC	28	T	9N	R	81W	TD 2553	LAKOTA	1972
BURTON-HAWKS EXPL	5	MARGARET SPAULDING	SEC	28	T	9N	R	81W	TD 2770	MORRISON	1972
CONTINENTAL OIL	49	MCCALLUM UNIT-GOVT	SEC	2	T	9N	R	79W	TD 936	PIERRE	1972
CONTINENTAL OIL	1-17	CONOCO-FEDERAL	SEC	17	T	9N	R	78W	TD 1381	PIERRE	1972
CONTINENTAL	46	MCCALLUM UNIT-GOVT	SEC	2	T	9N	R	79W	TD 681	PIERRE	1972
CONTINENTAL OIL	57	MCCALLUM UNIT-GOVT	SEC	2	T	9N	R	79W	TD 565	PIERRE	1972
BURTON-HAWKS EXPL	6	SPAULDING	SEC	21	T	9N	R	81W	TD 2640		1972
BURTON-HAWKS EXPL	4	MARGARET SPAULDING	SEC	28	T	9N	R	81W	TD 2380	MORRISON	1972
CONTINENTAL OIL	61	MCCALLUM UNIT	SEC	34	T	10N	R	79W	TD 1340	PIERRE	1972
CONTINENTAL OIL	1	STATE-16	SEC	16	T	9N	R	78W	TD 1173	PIERRE	1972
CONTINENTAL OIL	44	MCCALLUM UNIT-GOVT	SEC	13	T	9N	R	79W	TD 1462	PIERRE	1972
BURTON-HAWKS EXPL	3	MARGARET SPAULDING	SEC	28	T	9N	R	81W	TD 2615	MORRISON	1972
CONTINENTAL OIL	45	MCCALLUM UNIT-GOVT	SEC	2	T	9N	R	79W	TD 1026	PIERRE	1972
CONTINENTAL OIL	73	MCCALLUM UNIT-GOVT	SEC	2	T	9N	R	79W	TD 865	PIERRE	1972
CONTINENTAL OIL	41	MCCALLUM UNIT-GOVT	SEC	12	T	9N	R	79W	TD 994	PIERRE	1972
NIELSON ENTERPRISES	8-1	COWDREY-FEDERAL	SEC	8	T	10N	R	79W	TD 4180	LAKOTA	1972
JULANDER FRED ETAL	1	USA-HEWIT	SEC	5	T	2N	R	78W	TD 6811	GRANITE	1972
CONTINENTAL OIL	76	MCCALLUM UNIT-GOVT	SEC	33	T	10N	R	79W	TD 6957	GRANITE	1972
BASIN PET	1	RICHARD	SEC	17	T	9N	R	81W	TD 3757	PIERRE	1972
CONTINENTAL OIL	65	MCCALLUM UNIT	SEC	11	T	9N	R	79W	TD 1315	PIERRE	1972
CONTINENTAL OIL	48	MCCALLUM UNIT-GOVT	SEC	3	T	9N	R	79W	TD 1382	PIERRE	1972
BURTON-HAWKS EXPL	1	HARTSEL-GOVT	SEC	15	T	11S	R	75W	TD 6223	PIERRE	1973
SOHIO PETROLEUM ETAL	1	STATE 29	SEC	29	T	10N	R	78W	TD 5068	ENTRADA	1973
TREND EXPLORATION	1	FEDERAL /1-24/	SEC	24	T	8N	R	80W	TD11980	DAKOTA	1973
COLORADO ENERGY CORP	3-1	FEDERAL	SEC	3	T	8N	R	81W	TD 1899	RED PEAK	1973

CITIES SERVICE OIL	1	CHEDSEY-A	SEC	13	T	7N	R	82W	TD	3220	MORRISON	1973
LOUISIANA LAND & EXPL	1	FEDERAL	SEC	4	T	6N	R	81W	TD	6491	ENTRADA	1973
BURTON-HAWKS EXPL	16-1	STATE	SEC	16	T	9N	R	81W	TD	4207	LAKOTA	1973
BURTON-HAWKS INC	9-1	GRANNY GOVT	SEC	9	T	4N	R	81W	TD	3843	MORRISON	1973
CONTINENTAL OIL	38	GOVT	SEC	2	T	9N	R	79W	TD	311		1973
TREND EXPLORATION	1	GOVT	SEC	10	T	8N	R	81W	TD	6127	ENTRADA	1973
TREND EXPLORATION	1	STATE 1-36	SEC	36	T	7N	R	81W	TD	7046	FRONTIER	1973
BURTON-HAWKS EXPL	9	MARGARET SPAULDING	SEC	33	T	9N	R	81W	TD	3106	MORRISON	1973
BURTON-HAWKS EXPL	4-1	CORDREY	SEC	4	T	10N	R	80W	TD	7310	MORRISON	1973
SUBURBAN PROPANE GAS	1	STATE	SEC	36	T	9N	R	81W	TD	3382	LAKOTA	1973
BROOKS E B JR	1	GOVT	SEC	13	T	4N	R	77W	TD	2505	PIERRE	1973
FUEL RESOURCES DEV	25-1	STATE	SEC	25	T	8N	R	78W	TD	9425	MORRISON	1973
BURTON-HAWKS INC	1	NOFFSINGER MFG CO	SEC	33	T	9N	R	81W	TD	3540	MORRISON	1973
BURTON-HAWKS EXPL	7	MARGARET SPAULDING	SEC	33	T	9N	R	81W	TD	2880	MORRISON	1973
TREND EXPLORATION	1	VOLUSIA LOCATIONS	SEC	1	T	10N	R	82W	TD	3890	MORRISON	1973
TREND EXPL	1	FEDERAL 1-28	SEC	28	T	7N	R	81W	TD	7057	MOWRY	1973
SOHIO PETROLEUM ETAL	27-1	GOVT	SEC	27	T	11N	R	81W	TD	3160	SUNDANCE	1973
BURTON-HAWKS EXPL	29-1	STATE	SEC	29	T	9N	R	81W	TD	3494	DAKOTA	1973
CONTINENTAL OIL	75	MCCALLUM GOVT	SEC	12	T	9N	R	79W	TD	5866	MORRISON	1973
CITIES SERVICE OIL	1	FEDERAL B	SEC	34	T	9N	R	80W	TD	8884	MORRISON	1973
BURTON-HAWKS EXPL	2	GLEN SPAULDING	SEC	21	T	9N	R	81W	TD	2760	GRANEROS	1973
BURTON-HAWKS INC	1	FEDERAL	SEC	1	T	2N	R	81W	TD	3270	MOWRY	1973
SUBURBAN PROPANE GAS	1	CARL VERNER	SEC	32	T	9N	R	80W	TD	5668	LAKOTA	1973
BURTON-HAWKS EXPL	27-1	VAN VALK	SEC	27	T	9N	R	81W	TD	1364	MORRISON	1973
TREND EXPLORATION LTD	1	GOVT 1-35	SEC	35	T	7N	R	81W	TD	7100	MOWRY	1973
BURTON-HAWKS EXPL	8	MARGARET SPAULDING	SEC	28	T	9N	R	81W	TD	2530	LAKOTA	1973
BURTON-HAWKS	16	MARGARET SPAULDING	SEC	28	T	9N	R	81W	TD	2593	MORRISON	1974
BURTON-HAWKS INC	11	MARGARET SPAULDING	SEC	28	T	9N	R	81W	TD	2438	MORRISON	1974
BURTON-HAWKS EXPL	10	MARGARET SPAULDING	SEC	28	T	9N	R	81W	TD	2400	FRONTIER	1974
CONTINENTAL OIL	1	CONOCO FEDERAL-34	SEC	34	T	9N	R	78W	TD	6101	LAKOTA	1974
BURTON-HAWKS INC	14	SPAULDING	SEC	28	T	9N	R	81W	TD	2456	MORRISON	1974
CONTINENTAL OIL COMPANY	1	CONOCO FEDERAL 28	SEC	28	T	10N	R	79W	TD	6950	LAKOTA	1974
SOHIO PETROLEUM	1	P										
BURTON-HAWKS EXPL	13	MARGARET SPAULDING	SEC	28	T	9N	R	81W	TD	2622	MORRISON	1974
CONTINENTAL OIL	79	MCCALLUM	SEC	4	T	9N	R	79W	TD	6020	MORRISON	1974
CONTINENTAL OIL	2	CONOCO-STATE 16	SEC	16	T	9N	R	78W	TD	1035	PIERRE	1974
NARECO CO ETAL	1	COWDREY-GOVT	SEC	17	T	10N	R	79W	TD	4676	LAKOTA	1974
TREND EXPLORATION	1	TITANIUM	SEC	26	T	7N	R	81W	TD	6550	NIOBRARA	1974
CONTINENTAL OIL	1	CONOCO FEDERAL-22	SEC	22	T	9N	R	78W	TD	1532	PIERRE	1974
CONTINENTAL OIL COMPANY	78	MCCALLUM UNIT	SEC	11	T	9N	R	79W	TD	6107	MORRISON	1974

BURTON-HAWKS EXPL	9-1	BUTTE RANCH	SEC	9	T	8N	R	81W	TD	3078	CARLILE	1974
BURTON HAWKS INC	3-1	C LAZY U	SEC	3	T	2N	R	77W	TD	3073	MORRISON	1974
TREND EXPLORATION	1	KUIPERS	SEC	9	T	8N	R	81W	TD	4012	ENTRADA	1974
CONTINENTAL OIL	2	CONOCO-FEDERAL-21	SEC	21	T	9N	R	78W	TD	6310	LAKOTA	1974
UNION OIL OF CALIFORNIA	1-N-31	FEDERAL	SEC	31	T	5N	R	80W	TD	3870	GRANITE	1974
CONTINENTAL OIL	1	CONOCO-FEDERAL 21	SEC	21	T	9N	R	78W	TD	1200	PIERRE	1974
BURTON-HAWKS	9-2	GRANNY FEDERAL	SEC	9	T	4N	R	81W	TD	2820	INTRUSIVE	1974
CONTINENTAL OIL	3	CONOCO-FEDERAL 21	SEC	21	T	9N	R	78W	TD	1200	PIERRE	1974
BURTON-HAWKS INC	16-1	CORRAL PEAKS FED	SEC	16	T	3N	R	78W	TD	6240	INTRUSIVE	1974
SERIO EXPLORATION	1	GOVT	SEC	25	T	4N	R	78W	TD	10036	NIOBRARA	1974
BURTON-HAWKS INC	15	SPAULDING	SEC	28	T	9N	R	81W	TD	2533	MORRISON	1974
CONTINENTAL OIL	1	CONOCO FEDERAL-27	SEC	27	T	9N	R	78W	TD	1233	PIERRE	1974
BURTON-HAWKS INC	12	SPAULDING	SEC	33	T	9N	R	81W	TD	2786	MORRISON	1974
CONTINENTAL OIL	4	CONOCO-STATE 16	SEC	16	T	9N	R	78W	TD	1275	PIERRE	1974
FLANK OIL	2	WEBSTER	SEC	18	T	9N	R	78W	TD	1470	PIERRE	1974
BURTON-HAWKS EXPL	9-1A	BUTTE RANCH	SEC	9	T	8N	R	81W	TD	3925	LAKOTA	1974
SANDLIN GARY ETAL	1-X	STRAIT A	SEC	11	T	9N	R	78W	TD	492	NIOBRARA	1975
HELMERICH & PAYNE	1-19	MCCALLUM-FEDERAL	SEC	19	T	9N	R	78W	TD	7066	MORRISON	1975
CONTINENTAL OIL	3	CONOCO-STATE 16	SEC	16	T	9N	R	78W	TD	1080	PIERRE	1975
TRUE OIL ETAL	41-10	MEYRING	SEC	10	T	6N	R	80W	TD	10993	ENTRADA	1975
FUEL RESOURCES DEV	42-26	STATE OF COLORADO	SEC	26	T	8N	R	78W	TD	9448	CRETACEOUS	1975
BURTON-HAWKS	32-1	FEDERAL	SEC	32	T	9N	R	81W	TD	1993	MORRISON	1975
ALASKA ENERGY	1	FEDERAL	SEC	28	T	6N	R	81W	TD	5596	DAKOTA	1975
PAULEY PET ETAL	1	ALLARD	SEC	30	T	10N	R	79W	TD	6860	MORRISON	1975
BURTON-HAWKS	16-1A	STATE	SEC	16	T	9N	R	81W	TD	4207	LAKOTA	1976
GASCO INC	1	STATE OF COLO	SEC	2	T	9N	R	78W	TD	1875	JURASSIC	1976
BURLINGTON NORTHERN INC	15-1	BEAVER CREEK-FED	SEC	15	T	1S	R	77W	TD	2521	LAKOTA	1976
GMG O & G	3-11	BLEVINS	SEC	11	T	9N	R	78W	TD	500	PIERRE	1976
BURTON-HAWKS EXPL	18	SPAULDING	SEC	28	T	9N	R	81W	TD	2417	MORRISON	1976
PAULEY-PET ETAL	1	MATTOCKS	SEC	29	T	10N	R	79W	TD	7375	TRIASSIC	1976
OILTECH INC ETAL	3	STATE	SEC	12	T	9N	R	78W	TD	450	NIOBRARA	1977
OILTECH INC ETAL	1	STATE	SEC	12	T	9N	R	78W	TD	450	NIOBRARA	1977
CONTINENTAL OIL	2	CONOCO-FEDERAL 28	SEC	28	T	10N	R	79W	TD	6602	MORRISON	1977
CONTINENTAL OIL	1	CONOCO FEDERAL-29	SEC	29	T	10N	R	79W	TD	7480	JURASSIC	1977
GMG O & G	2 -11	BLEVINS	SEC	11	T	9N	R	78W	TD	500	NIOBRARA	1977
BURLINGTON NORTHERN	14-A-6	IOOF	SEC	6	T	8N	R	81W	TD	901	MORRISON	1977
CONTINENTAL OIL	81	MCCALLUM UNIT	SEC	12	T	9N	R	79W	TD	1460	PIERRE	1977
OILTECH INC ETAL	2	STATE	SEC	12	T	9N	R	78W	TD	450	NIOBRARA	1977
CONSOLIDATED O&G	1	GOVT	SEC	25	T	4N	R	78W	TD	10508	CRETACEOUS	1977
OILTECH INC ETAL	4	STATE	SEC	12	T	9N	R	78W	TD	452	NIOBRARA	1977

GASCO INC	2	STREIT RANCH	SEC 11	T 9N	R 78W	TD 400	NIOBRARA	1977
GEARY WILLIAM J	3	SCHATTINGER	SEC 10	T 8S	R 76W	TD 2200	PIERRE	1977
BURTON-HAWKS EXPL	5-1	BUTTE RANCH	SEC 5	T 8N	R 81W	TD 1125		1977
CONTINENTAL OIL	84	MCCALLUM UNIT	SEC 3	T 9N	R 79W	TD 1415	PIERRE	1977
GASCO INC	3	STREIT RANCH	SEC 11	T 9N	R 78W	TD 600		1977
CONTINENTAL OIL	83	MCCALLUM UNIT	SEC 34	T 10N	R 79W	TD 1470	PIERRE	1977
LECLAIR-WESTWOOD ETAL	2	ALLARD	SEC 19	T 10N	R 79W	TD 6950	CRETACEOUS	1977
CONTINENTAL OIL	85	MCCALLUM UNIT	SEC 11	T 9N	R 79W	TD 1390	PIERRE	1977
BURTON-HAWKS	4-1	GRANNY FEDERAL	SEC 4	T 4N	R 81W	TD 5217	VOLCANICS	1977
OILTECH INC ETAL	5	STATE	SEC 12	T 9N	R 78W	TD 462	NIOBRARA	1977
CONTINENTAL OIL	82	MCCALLUM UNIT	SEC 2	T 9N	R 79W	TD 1364	PIERRE	1977
CONTINENTAL OIL	2	FEDERAL	SEC 22	T 9N	R 78W	TD 1360	PIERRE	1978
CONTINENTAL OIL	96	MCCALLUM	SEC 34	T 10N	R 79W	TD 1315	PIERRE	1978
CONTINENTAL OIL	93	MCCALLUM	SEC 12	T 9N	R 79W	TD 917	PIERRE	1978
NORTH PARK ENERGY	1	TEXAS-STATE	SEC 11	T 9N	R 78W	TD 2300	LAKOTA	1978
NORTHWEST EXPL	1	DAVISON	SEC 33	T 4N	R 81W	TD 1175	MORRISON	1978
CONTINENTAL OIL	89	MCCALLUM	SEC 2	T 9N	R 79W	TD 490	PIERRE	1978
AMOCO PROD	1	STATE AY	SEC 10	T 10S	R 76W	TD 9010	PIERRE	1978
EMPIRE DRLG	B-1	FEDERAL	SEC 17	T 10N	R 79W	TD 4004		1978
BURLINGTON NORTHERN	34-30	UNION STATE	SEC 30	T 4N	R 80W	TD 5210	ENTRADA	1978
CONTINENTAL OIL	4	CONOCO-FEDERAL-21	SEC 21	T 9N	R 78W	TD 1669	PIERRE	1978
CONTINENTAL OIL	86	MCCALLUM	SEC 3	T 9N	R 79W	TD 1652	PIERRE	1978
CONTINENTAL OIL	91	MCCALLUM	SEC 2	T 9N	R 79W	TD 1028	PIERRE	1978
CONTINENTAL OIL	88	MCCALLUM	SEC 2	T 9N	R 79W	TD 630	PIERRE	1978
HELMERICH & PAYNE	1-2	WILLFORD UNIT	SEC 2	T 10N	R 80W	TD 6925	ENTRADA	1978
GASCO INC	1	STREIT RANCH	SEC 11	T 9N	R 78W	TD 400	NIOBRARA	1978
CONTINENTAL OIL	5	CONOCO-FEDERAL-21	SEC 21	T 9N	R 78W	TD 1227	PIERRE	1978
CONTINENTAL OIL	92	MCCALLUM	SEC 2	T 9N	R 79W	TD 794	PIERRE	1978
CONTINENTAL OIL	94	MCCALLUM	SEC 12	T 9N	R 79W	TD 1074	PIERRE	1978
CONTINENTAL OIL	95	MCCALLUM	SEC 34	T 10N	R 79W	TD 1620	PIERRE	1978
BURLINGTON NORTHERN	44-9	HINMAN	SEC 9	T 2N	R 81W	TD 1692	ENTRADA	1978
M & T INC	1-10	FEDERAL	SEC 10	T 8N	R 78W	TD 8526	ENTRADA	1978
TIGER OIL	1	USA-FEDERAL	SEC 31	T 3N	R 78W	TD 5819	GRANITE	1978
CONTINENTAL OIL	98	MCCALLUM	SEC 34	T 10N	R 79W	TD 1635	PIERRE	1978
M & T INC	1-25	UNIT	SEC 25	T 8N	R 78W	TD 9401	MORRISON	1978
BURTON HAWKS EXPL	5-1X	BUTTE RANCH	SEC 5	T 8N	R 81W	TD 3561	LAKOTA	1978
BURTON-HAWKS INC	1	TERTELING	SEC 28	T 9N	R 81W	TD 3190	ENTRADA	1978
CONTINENTAL OIL	90	MCCALLUM	SEC 2	T 9N	R 79W	TD 1428	PIERRE	1978
CONTINENTAL OIL	97	MCCALLUM	SEC 34	T 10N	R 79W	TD 1275	PIERRE	1978
OGLE PET	1	STATE	SEC 16	T 6N	R 79W	TD 2899	GRANITE	1978

CONTINENTAL OIL	87	MCCALLUM	SEC	3	T	9N	R	79W	TD	1095	PIERRE	1978
ZIMMERMAN OIL	44-9	HINMAN	SEC	9	T	2N	R	81W	TD	1692	ENTRADA	1979
AMOCO PROD	1	USA 32-2	SEC	32	T	8N	R	78W	TD	12235	MORRISON	1979
BURTON-HAWKS INC	6-1	CHIMNEY ROCK-FED	SEC	6	T	4N	R	80W	TD	1661	COALMONT	1979
NORTH PARK ENERGY	4	STREIT RANCH	SEC	11	T	9N	R	78W	TD	600	PIERRE	1979
NORTH PARK ENERGY	3	STREIT RANCH	SEC	11	T	9N	R	78W	TD	450	NIOBRARA	1979
NORTH PARK ENERGY	9	STREIT RANCH	SEC	11	T	9N	R	78W	TD	220	NIOBRARA	1979
OGLE PET	1	BURR	SEC	22	T	7N	R	79W	TD	4074	GRANITE	1979
NORTH PARK ENERGY	SR13	BLEVINS-A-STREIT	SEC	3	T	9N	R	78W	TD	380	NIOBRARA	1980
BURTON-HAWKS INC	23-1	LINKE	SEC	23	T	1N	R	77W	TD	3033	NIOBRARA	1980
SAKET PET	1	PETERSON	SEC	30	T	8N	R	80W	TD	4647		1980
NORTH PARK ENERGY	SR16	BLEVINS-B	SEC	3	T	9N	R	78W	TD	480	NIOBRARA	1980
NORTH PARK ENERGY	SR6	STREIT RANCH	SEC	2	T	9N	R	78W	TD	140	PIERRE	1980
TWENTIETH CENTURY	1NW	BATTLESHIP	SEC	16	T	10N	R	79W	TD	3980		1980
NORTH PARK ENERGY	SR14	BLEVINS-A-STREIT	SEC	3	T	9N	R	78W	TD	140	NIOBRARA	1980
NORTH PARK ENERGY	SR17	BLEVINS-B	SEC	3	T	9N	R	78W	TD	534	NIOBRARA	1980
NORTH PARK ENERGY	SR11	BLEVINS-A-STREIT	SEC	3	T	9N	R	78W	TD	350	NIOBRARA	1980
NORTH PARK ENERGY	SR12	BLEVINS-A-STREIT	SEC	3	T	9N	R	78W	TD	162	NIOBRARA	1980
NORTH PARK ENERGY	8	STREIT RANCH	SEC	11	T	9N	R	78W	TD	220	NIOBRARA	1980
GASCO INC	SRG-1	BLEVINS-A	SEC	3	T	9N	R	78W	TD	351	NIOBRARA	1980
YOUNG MARSHALL R OIL	35-1	MCNAMARA	SEC	35	T	6N	R	81W	TD	6634	MORRISON	1980
NORTH PARK ENERGY	SR-10	BLEVINS-A	SEC	3	T	9N	R	78W	TD	351	NIOBRARA	1980
BURTON-HAWKS INC	35-1	HUMBERT	SEC	35	T	9N	R	81W	TD	1552	MORRISON	1980
CONOCO OIL	107	MCCALLUM UNIT	SEC	14	T	9N	R	79W	TD	6540	MORRISON	1980
NORTH PARK ENERGY	SR-23	BLEVINS-A	SEC	11	T	9N	R	78W	TD	300		1981
CONOCO INC	100	MCCALLUM UNIT	SEC	2	T	9N	R	79W	TD	1750	PIERRE	1981
CONOCO INC	105	MCCALLUM UNIT	SEC	34	T	10N	R	79W	TD	1692	PIERRE	1981
NORTH PARK ENERGY	S-22	BLEVINS-A	SEC	11	T	9N	R	78W	TD	292	NIOBRARA	1981
VOYAGER PETROLEUMS LTD	1	GRANBY UNIT	SEC	15	T	2N	R	77W	TD	3385	MORRISON	1981
EXCEL ENERGY	12-29	EXCEL-ALLARD-JONES	SEC	29	T	10N	R	79W	TD	6960	MORRISON	1981
VOYAGER PETROLEUMS LTD	1	SMITH CREEK	SEC	24	T	2N	R	79W	TD	2417	JURASSIC	1981
CONOCO INC	106	MCCALLUM UNIT	SEC	34	T	10N	R	79W	TD	1233	PIERRE	1981
CONOCO INC	99	MCCALLUM UNIT	SEC	11	T	9N	R	79W	TD	1642	PIERRE	1981
VOYAGER PETROLEUMS LTD	1	FEDERAL-GILSONITE	SEC	10	T	4N	R	77W	TD	6157	TERTIARY	1981
NORTH PARK ENERGY	7	STREIT RANCH	SEC	2	T	9N	R	78W	TD	250	NIOBRARA	1981
VOYAGER PETROLEUMS LTD	1	FEDERAL-TROUBLESOME	SEC	14	T	3N	R	79W	TD	7414		1981
VOYAGER PETROLEUMS LTD	1-A	SMITH CREEK	SEC	24	T	2N	R	79W	TD	2417	GRANITE	1981
NORTH PARK ENERGY	SR 27	BLEVINS-A	SEC	11	T	9N	R	78W	TD	235	NIOBRARA	1981
BURTON-HAWKS INC	5-1	NOFFSINGER	SEC	5	T	8N	R	81W	TD	3079	GRANEROS	1981
BURTON-HAWKS INC	9-3	GRANNYS-FEDERAL	SEC	9	T	4N	R	81W	TD	2914		1981

NORTH PARK ENERGY	SR-25	BLEVINS-A	SEC 11	T 9N	R 78W	TD 297		1981
L & B OIL	1-34	WILLFORD-PERKINS	SEC 34	T 11N	R 80W	TD 7130	ENTRADA	1981
CONOCO INC	2	CONOCO JOHNSTONE-33	SEC 22	T 10N	R 79W	TD 5942	MORRISON	1981
NORTH PARK ENERGY	SR19	BLEVINS-B	SEC 3	T 9N	R 78W	TD 963		1981
BURTON-HAWKS INC	16-2	STATE	SEC 16	T 9N	R 81W	TD 3772	LAKOTA	1981
COSEKA RESOURCES	1	BAKER DRAW UNIT	SEC 10	T 8N	R 81W	TD 5182	CARLILE	1981
NORTH PARK ENERGY	SR21	BLEVINS-A	SEC 11	T 9N	R 78W	TD 410	PIERRE	1981
CONOCO INC	101	MCCALLUM UNIT	SEC 3	T 9N	R 79W	TD 1828	PIERRE	1981
NORTH PARK ENERGY	SR-24	BLEVINS-A	SEC 11	T 9N	R 78W	TD 320		1981
NORTH PARK ENERGY	SR 28	BLEVINS-A	SEC 3	T 9N	R 78W	TD 375	NIOBRARA	1981
BELCO PET	1-11	LINKE	SEC 11	T 1N	R 77W	TD 3483	MORRISON	1981
NORTH PARK ENERGY	SR20	BLEVINS-A	SEC 11	T 9N	R 78W	TD 244	NIOBRARA	1981
CONOCO INC	102	MCCALLUM UNIT	SEC 3	T 9N	R 79W	TD 1830	PIERRE	1981
VIKING PET	1-24	LINDLAND UNIT	SEC 24	T 7N	R 77W	TD 7000	ENTRADA	1981
CONOCO INC	104	MCCALLUM UNIT	SEC 34	T 10N	R 79W	TD 1797	PIERRE	1981
NORTH PARK ENERGY	SR18	BLEVINS-B	SEC 3	T 9N	R 78W	TD 293	NIOBRARA	1981
CONOCO INC	6	CONOCO FED 21C	SEC 21	T 9N	R 78W	TD 5778	LAKOTA	1981
CONOCO INC	2	CONOCO-JOHNSTONE-33	SEC 22	T 10N	R 79W	TD 5942	MORRISON	1981
LEMMON DRLG	2	DOWDELL	SEC 1	T 8N	R 82W	TD 1957		1982
NORTH PARK ENERGY	SR-26	BLEVINS-B	SEC 3	T 9N	R 78W	TD 245	NIOBRARA	1982
FULTON PRODUCING	2	SPAULDING	SEC 28	T 9N	R 81W	TD 2990		1982
MONSANTO CO	3-A	DWINELL	SEC 23	T 10N	R 79W	TD 5024	MORRISON	1982
C & M OIL	1	LINDLAND	SEC 13	T 7N	R 77W	TD 5665	ENTRADA	1982
MOBIL OIL	1	FEDERAL	SEC 31	T 10N	R 80W	TD 6038	RED PEAK	1982
NORTH PARK ENERGY	SR34	BLEVINS-A	SEC 2	T 9N	R 78W	TD 400	NIOBRARA	1982
CONOCO INC	109	MCCALLUM UNIT	SEC 34	T 10N	R 79W	TD 1030	PIERRE	1982
CONOCO INC	1	CONOCO-FEDERAL 34	SEC 34	T 10N	R 79W	TD 980	PIERRE	1982
LEMMON DRLG	1	DOWDELL	SEC 6	T 8N	R 81W	TD 692	DAKOTA	1982
CRANDALL DRLG & TRENCH	1A	WHITE COLUD-STATE	SEC 16	T 2N	R 81W	TD 540		1982
AMOCO PROD	1	REINECKER RIDGE GAS	SEC 34	T 9S	R 76W	TD 7611	MORRISON	1982
NORTH PARK ENERGY	SR32	BLEVINS-B	SEC 3	T 9N	R 78W	TD 400	PIERRE	1982
LEMMON DRLG	3	ODD FELLOWS-DOWDELL	SEC 6	T 8N	R 81W	TD 666	DAKOTA	1982
CONOCO INC	6	FEDERAL-20	SEC 20	T 9N	R 78W	TD 6440	SUNDANCE	1982
NORTH PARK ENERGY	SR 30	BLEVINS-B	SEC 3	T 9N	R 78W	TD 340	NIOBRARA	1982
COSEKA RESOURCES	1	BOLTON DRAW	SEC 7	T 8N	R 77W	TD 50		1982
GREAT EASTERN ENERGY	25-1	FEDERAL	SEC 25	T 5N	R 79W	TD11592	MORRISON	1982
CONOCO INC	108	MCCALLUM UNIT	SEC 34	T 10N	R 79W	TD 940	PIERRE	1982
GREAT EASTERN ENERGY	14-1	HOLLIDAY	SEC 14	T 6N	R 79W	TD 4620	GRANITE	1982
PETROSTATES RESOURCES	1	NORTH PARK COAL	SEC 18	T 9N	R 78W	TD 6160	MORRISON	1982
EXCEL ENERGY	22-29	JONES	SEC 29	T 10N	R 79W	TD 6697	CARLILE	1982

NORTH PARK ENERGY	SR33	BLEVINS-B	SEC	3	T	9N	R	78W	TD	330	NIOBRARA	1982
BURTON-HAWKS INC	4-1	SPAULDING	SEC	4	T	8N	R	81W	TD	3507	MORRISON	1982
COSEKA RESOURCES	1	SOUTH COALMONT	SEC	6	T	6N	R	80W	TD	8249	ENTRADA	1982
NORTH PARK ENERGY	SR 26-B	BLEVINS-B	SEC	3	T	9N	R	78W	TD	360	NIOBRARA	1983
TWENTIETH CENTURY	12-2	STATE	SEC	12	T	9N	R	78W	TD	475	NIOBRARA	1983
CONOCO INC	2	SOUTH MCCALLUM UNIT	SEC	27	T	9N	R	78W	TD	494	PIERRE	1983
QUALITY EXPL	1-5	GEER	SEC	5	T	7N	R	81W	TD	6200		1983
CANAAN OIL	1	DODGE RANCH	SEC	13	T	9N	R	78W	TD	700		1983
QUANTUM ENERGY ETAL	12-3	STATE	SEC	12	T	9N	R	78W	TD	468	PIERRE	1983
GREAT EASTERN ENRGY&DEV	23-13	RAND UNIT	SEC	23	T	6N	R	79W	TD	3322	GRANITE	1983
NORTH PARK ENERGY	SR 18-A	BLEVINS-B	SEC	3	T	9N	R	78W	TD	360	NIOBRARA	1983
QUANTUM ENERGY	11-1	STATE	SEC	11	T	9N	R	78W	TD	380	NIOBRARA	1983
QUANTUM ENERGY ETAL	102	STATE	SEC	12	T	9N	R	78W	TD	920	NIOBRARA	1983
NORTH PARK ENERGY	5	DODGE RANCH	SEC	13	T	9N	R	78W	TD	800	NIOBRARA	1983
CANAAN O&G	6	DODGE RANCH	SEC	13	T	9N	R	78W	TD	1050		1983
CANAAN OIL	3	DODGE RANCH	SEC	13	T	9N	R	78W	TD	100		1983
NORTH PARK ENERGY	SR9-A	BLEVINS-A	SEC	11	T	9N	R	78W	TD	202	NIOBRARA	1983
PETROSTATES RESOURCES	5-27X	FEDERAL	SEC	27	T	9N	R	78W	TD	1290	PIERRE	1983
PETROSTATES RESOURCES	7-27	FEDERAL	SEC	27	T	9N	R	78W	TD	695	PIERRE	1983
PETROSTATES RESOURCES	6-27	FEDERAL	SEC	27	T	9N	R	78W	TD	1027	PIERRE	1983
NORTH PARK ENERGY	SR36	BLEVINS-B	SEC	3	T	9N	R	78W	TD	402	NIOBRARA	1983
CANAAN OIL	2	DODGE RANCH	SEC	13	T	9N	R	78W	TD	1025		1983
PETROSTATES RESOURCES	5-27	FEDERAL	SEC	27	T	9N	R	78W	TD	736		1983
CONOCO INC	1	CONOCO FISCHER-15	SEC	15	T	9N	R	79W	TD	9109	RED PEAK	1983
NORTH PARK ENERGY	SR20-A	BLEVINS-A	SEC	11	T	9N	R	78W	TD	342	NIOBRARA	1983
NORTH PARK ENERGY	NP-1	DODGE RANCH	SEC	18	T	9N	R	77W	TD	1005	NIOBRARA	1983
CANAAN O&G	8	DODGE RANCH	SEC	13	T	9N	R	78W	TD	783		1983
PETROSTATES RESOURCES	3-27	FEDERAL	SEC	27	T	9N	R	78W	TD	395	PIERRE	1983
CONOCO INC	1-12	MCCALLUM UNIT	SEC	34	T	10N	R	79W	TD	1225	PIERRE	1983
CONOCO INC	113	MCCALLUM UNIT	SEC	12	T	9N	R	79W	TD	1373	PIERRE	1983
NORTH PARK ENERGY	SR 26-D	BLEVINS-B	SEC	3	T	9N	R	78W	TD	400	NIOBRARA	1983
NORTH PARK ENERGY	SR 18-C	BLEVINS-B	SEC	3	T	9N	R	78W	TD	380	NIOBRARA	1983
NORTH PARK ENERGY	SR 26-C	BLEVINS-B	SEC	3	T	9N	R	78W	TD	380	NIOBRARA	1983
NORTH PARK ENERGY	SR35	BLEVINS-B	SEC	3	T	9N	R	78W	TD	275	NIOBRARA	1983
CONOCO INC	1-10	MC CALLUM UNIT	SEC	34	T	10N	R	79W	TD	1300	PIERRE	1983
CONOCO INC	1-14	MCCALLUM UNIT	SEC	3	T	9N	R	79W	TD	2563	PIERRE	1983
PETROSTATES RESOURCES	1-27	FEDERAL	SEC	27	T	9N	R	78W	TD	1100	PIERRE	1983
PETROSTATES RESOURCES	2-27	FEDERAL	SEC	27	T	9N	R	78W	TD	990	PIERRE	1983
PETROSTATES RESOURCES	8-27	FEDERAL	SEC	27	T	9N	R	78W	TD	400	PIERRE	1983
CONOCO INC	1-11	MCCALLUM UNIT	SEC	34	T	10N	R	79W	TD	1008	PIERRE	1983

CONOCO INC	8-3	CONOCO-FEDERAL	SEC	8	T	9N	R 78W	TD	5455	MORRISON	1983
PETROSTATES RESOURCES	4-27	FEDERAL	SEC	27	T	9N	R 78W	TD	998		1983
PETRO ROUTT	1	FEDERAL	SEC	1	T	8N	R 82W	TD	700	MORRISON	1983
NORTH PARK ENERGY	SR2-11B	BLEVINS-A	SEC	11	T	9N	R 78W	TD	265	NIOBRARA	1983
JERONIMUS & BECHTOLD	1	STATE	SEC	12	T	9N	R 78W	TD	540		1983
BUCKHORN PET	13-7	STATE	SEC	7	T	8N	R 77W	TD	8557	RED PEAK	1983
NORTH PARK ENERGY	SR26-A	BLEVINS-B	SEC	3	T	9N	R 78W	TD	350	NIOBRARA	1983
GUSHER O&G ETAL	1-32	HOUSTON	SEC	32	T	8N	R 80W	TD	1958	COALMONT	1984
PETROSTATES RESOURCES	12-27	FEDERAL	SEC	27	T	9N	R 78W	TD	1010	PIERRE	1984
PETROSTATES RESOURCES	14-27	FEDERAL	SEC	27	T	9N	R 78W	TD	1062	PIERRE	1984
CONOCO INC	118	MCCALLUM	SEC	12	T	9N	R 79W	TD	1212	PIERRE	1984
QUANTUM ENERGY ETAL	12-4	STATE	SEC	12	T	9N	R 78W	TD	1500	NIOBRARA	1984
PETROSTATES RESOURCES	9-27	FEDERAL	SEC	27	T	9N	R 78W	TD	1250	PIERRE	1984
CONOCO INC	116	MCCALLUM	SEC	34	T	10N	R 79W	TD	620	PIERRE	1984
PETROSTATES RESOURCES	13-27	FEDERAL	SEC	27	T	9N	R 78W	TD	1020	PIERRE	1984
CONOCO INC	2	CONOCO-FEDERAL 34	SEC	34	T	10N	R 79W	TD	1050	PIERRE	1984
QUANTUM ENERGY	12-5	STATE	SEC	12	T	9N	R 78W	TD	575	PIERRE	1984
PETROSTATES RESOURCES	11-27	FEDERAL	SEC	27	T	9N	R 78W	TD	1339	PIERRE	1984
PETROSTATES RESOURCES	10-27	FEDERAL	SEC	27	T	9N	R 78W	TD	1300	PIERRE	1984
QUANTUM ENERGY ETAL	101	STATE	SEC	11	T	9N	R 78W	TD	500	NIOBRARA	1984
CONOCO INC	3	CONOCO FEDERAL 34	SEC	34	T	10N	R 79W	TD	650	PIERRE	1984
NORTH PARK ENERGY	SR2-11A	BLEVINS-A	SEC	11	T	9N	R 78W	TD	305	NIOBRARA	1984
PETROSTATES RESOURCES	15-27	FEDERAL	SEC	27	T	9N	R 78W	TD	1000	PIERRE	1984
EASTERN AMERICAN ENERGY	6-1	CONTINENTAL DIVIDE	SEC	6	T	4N	R 78W	TD	7948	DAKOTA	1984
CONOCO INC	117	MCCALLUM	SEC	2	T	9N	R 79W	TD	655	PIERRE	1984
CONOCO INC	119	MCCALLUM UNIT	SEC	12	T	9N	R 79W	TD	1199	PIERRE	1985
CONOCO INC	115	MCCALLUM UNIT	SEC	12	T	9N	R 79W	TD	922	PIERRE	1985
VALERO PRODUCING	5	VALERO FEDERAL 35	SEC	35	T	11N	R 80W	TD	3883		1985
PETRO ROUTT	4-1	DELANEY BUTTE	SEC	4	T	8N	R 81W	TD	4552	MORRISON	1985
QUANTUM ENERGY	12-1	STATE	SEC	12	T	9N	R 78W	TD	475	NIOBRARA	1985
VALERO PRODUCING	1	VALERO FEDERAL 35	SEC	35	T	11N	R 80W	TD	6100	ENTRADA	1985
QUANTUM ENERGY	11-2	STATE	SEC	11	T	9N	R 78W	TD	400	NIOBRARA	1985
DAUBE CO	33-1	MCFARLANE GOV'T	SEC	33	T	7N	R 79W	TD	2820	GRANITE	1986
SABINE CORP	1-5	BROWNLEE	SEC	5	T	9N	R 79W	TD	7785	LAKOTA	1986
CONOCO INC	125	MCCALLUM UNIT	SEC	3	T	9N	R 79W	TD	5958	ENTRADA	1986
CONTINENTAL OIL	2	CONOCO-FEDERAL 28	SEC	28	T	10N	R 79W	TD	6602	MORRISON	1986