THE GEOLOGICAL SURVEY OF WYOMING

Daniel N. Miller, Jr., State Geologist

REPORT OF INVESTIGATIONS No. 18

GEOMETRY OF THE PROSPECT-DARBY AND LA BARGE FAULTS AT THEIR JUNCTION WITH THE LA BARGE PLATFORM, LINCOLN AND SUBLETTE COUNTIES, WYOMING

by

D.L. Blackstone, Jr.

LARAMIE, WYOMING

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ABSTRACT

The eastern margin of the Wyoming salient of the foreland fold and thrust belt of western Wyoming lies approximately 15 miles west of Big Piney, Wyoming, and approximately six miles west of La Barge, Wyoming. Three major, low angle, west dipping reverse faults have been described in the area — the Darby, the Prospect and the Hogsback. The Hogsback fault plate, on the basis of attitude, internal stratigraphy, and structure, is the actual continuation of the Darby thrust plate offset to the east by strike slip movement on the Thompson fault. The latter is a tear fault in the Darby plate with left lateral movement of about three miles. The name Hogsback thrust should be abandoned. The major faults are considered to bottom out on a decollement in the Cambrian strata lying above the west dipping surface of the Precambrian basement.

The Moxa arch of the western Green River Basin merges to the north into the broad anticline of the La Barge platform. The platform trends approximately N. 45° W., passes beneath the thrusts of the salient, and may continue as far northwest as the Star Valley graben. The platform is older than the thrusting and appears to have deflected the trend of the major low angle thrust faults.

The Upper Cretaceous stratigraphic section above the Aspen Shale and below the Adaville Formation exposed in Snider Basin (T. 29 N., R. 115 W.) has been reported to be over 12,500 feet in thickness. Such a thickness is completely anomalous to the same section as encountered in wells drilled immediately east of the thrust belt in the Big Piney producing district. The reason for anomalous section is repetition by reverse faulting. The Frontier-Hilliard section is repeated by three reverse faults which surface in Snider Basin. The faults trend north to northwest, dip to the west, and are upthrown on the west side. When the section is corrected for repetition by faulting, it agrees very well in both thickness and lithological character with the section drilled to the east.

Review of subsurface data in the area of the Tip Top, Dry Piney and South Hogsback producing areas reveals two west dipping reverse faults below the Darby thrust plate which repeat the Cretaceous section. The faults are the Tip Top fault to the north and the more extensive La Barge fault to the south. The maximum slip is on the La Barge fault — 15,000 feet. The Tip Top fault can be traced downward to the west to the level of the Nugget Sandstone, and probably continues downward to the major decollement in the Cambrian strata.

East dipping thrust faults are also present. At the Tip Top field an east dipping fault — the Cretaceous Mountain thrust — is of limited extent. In the La Barge area and extending farther to the south is the Calpet fault. Previous structural sections have not adequately considered these faults. No root zone or primary decollement has been established for the east dipping faults.

The age relationships of the faulting are given in tabular form in the text.

INTRODUCTION

Location

The area lies in Tps. 26-30 N., Rs. 113-116 W., inclusive, in Lincoln and Sublette Counties, Wyoming (Fig. 1). The drainage is eastward to the Green River through South Piney, Dry Piney, Birch, and La Barge Creeks and their tributaries. Major topographic features include Mt. Darby, Mt. Thompson, Packsaddle Ridge, Thompson Plateau, and Hogsback Ridge (Fig. 2). Elevations range from approximately 7,000 feet to 10,600 feet. Access to the area is by Wyoming Highway No. 350 west from Big Piney along the South Piney Creek drainage, and west and northwest from La Barge up La Barge Creek. Numerous ranch, oil field, and Forest Service roads provide additional access.

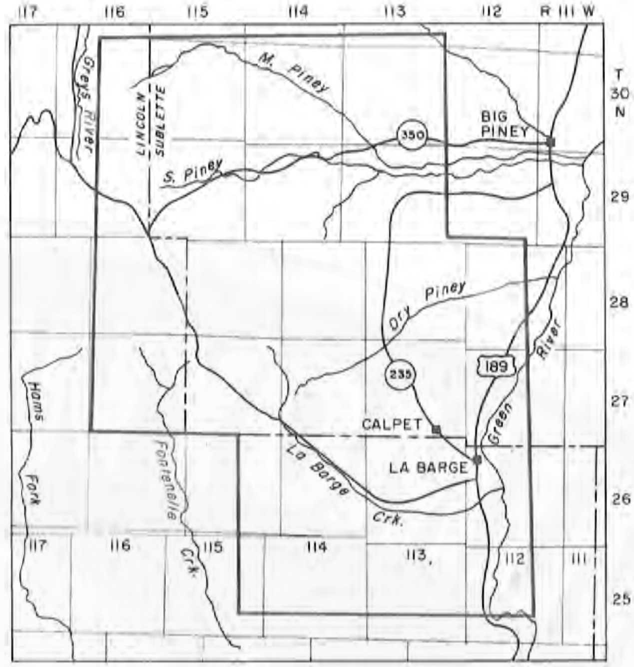

Figure 1. Location and access map of study area.

The area includes parts of the La Barge structural platform and parts of the greater Big Piney oil and gas producing district. Specific fields within the area are Tip Top, Dry Piney, Hogsback, and La Barge.

All comments refer to the study area unless otherwise specifically noted.

Previous Investigations

S. H. Knight (1955) reviewed the history of early geologic investigations in the Green River basin area. The first serious geologic investigation was done by U.S. Geological and Geographical Surveys of the Territories directed by F. V. Hayden. The area was reported upon by A. C. Peale and published by Hayden (1879). The maps covering the region are a part of the Twelfth Annual Report (Hayden, 1883). The major geological features are shown on Figure 2 of that report entitled "Geological map of portions of Wyoming, Idaho, and Utah," by A. C. Peale, Orestes St. John and F. M. Endlich. Additional detail appears on Figure 5 (Hayden, 1883), a map entitled "Parts of western Wyoming, southeastern Idaho and northeastern Utah," scale 4 inches = 1 mile. This map sheet covers approximately the same area as the modern AMS Map NK 12-5 Preston. No faults are shown, though the cross sections indicate high angle reverse faults.

The basic structural and stratigraphic study of the area is that of Schultz (1914). More recent mapping includes that of Bertagnolli (1941), Whittier and Kramer (1947), Rubey (1958), Privrasky (1963), Oriel (1969), Rubey (1973a), and Rubey and others (1975; 1976). Discussions of the occurrence of hydrocarbons in the

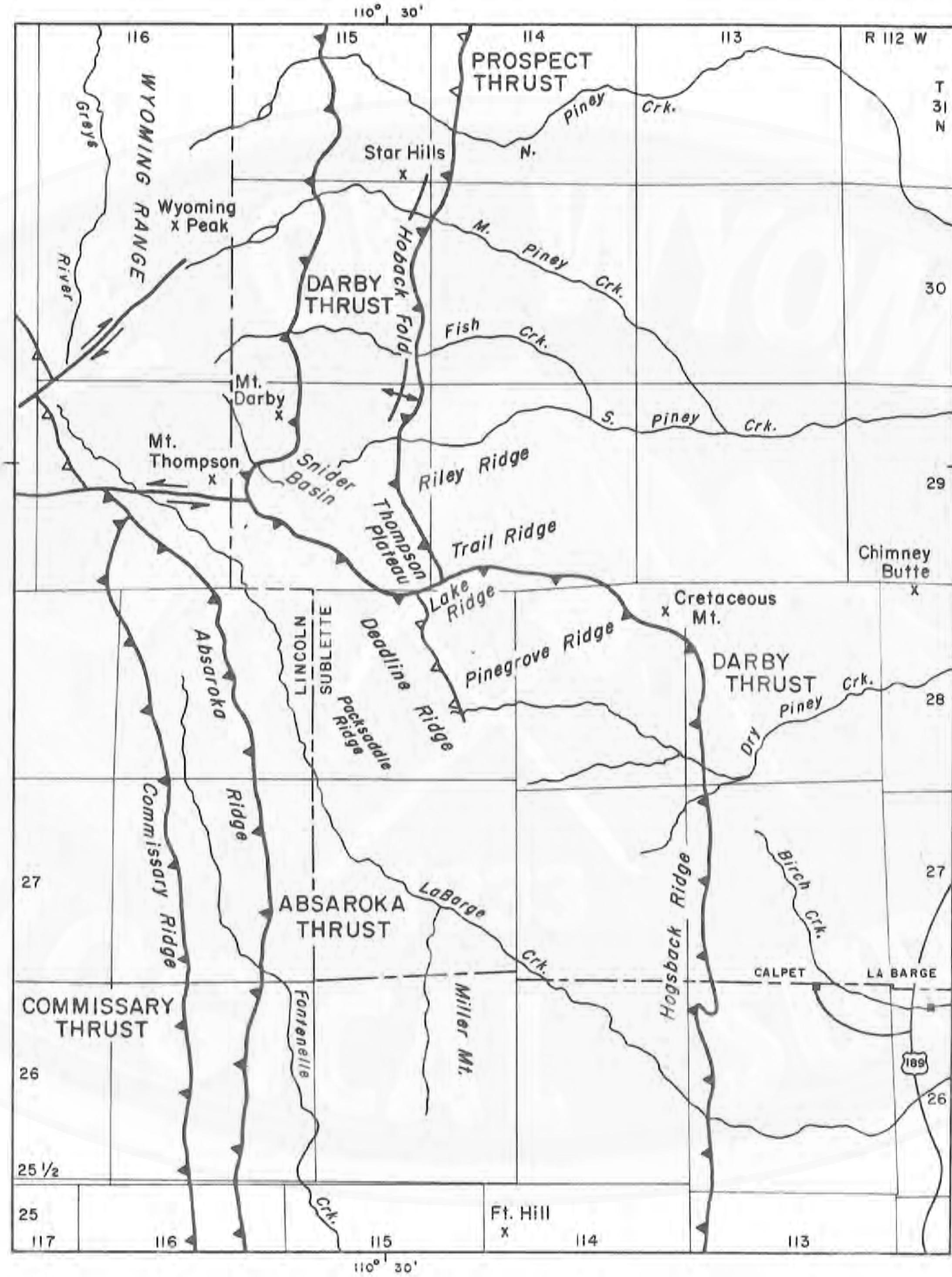

Figure 2. Tectonic index map, junction of Prospect - Darby and La Barge faults with the La Barge Platform.

region include those by Trumbull (1913), Davies (1934), Christensen and Marshall (1950), Howe (1955), Krueger (1955; 1960), Lackey (1960), Michael (1960), Biggs and Espach (1960), Shipp and Dunnewald (1962), Wheeler (1971), McDonald (1973), Wach (1977), and Webel (1977). Lines and Glass (1973) compiled a geologic map of the region. See Figure 3.

Reeside (1944) and Cobban and Reeside (1952) provide critical information concerning the Cretaceous stratigraphy.

Papers dealing with the structure of the area and the structural evolution include those by Rubey (1955), Rubey and Hubbert (1959), Murray (1960), Armstrong and Oriel (1965), Crosby (1969), Wheeler (1971), Monley (1971), Royse and others (1975), Blackstone (1977b), and Dorr and others (1977).

Acknowledgments

The writer acknowledges facilities provided by the University of Wyoming — office space, library, and the counsel of colleagues. The Wyoming Geological Survey provided electric logs, access to files, and drafting services. Donald Basko, State Oil and Gas Supervisor, provided well data. The writer fully recognizes that this study would not have been possible without the multimillion dollar drilling program of the petroleum industry and the availability of the data derived from such drilling. The geologic investigations of the U.S. Geological Survey have been invaluable.

As in any such study, the present investigator "stands on the shoulders" of all geologists who have previously worked in the area. Their contributions are appreciated and

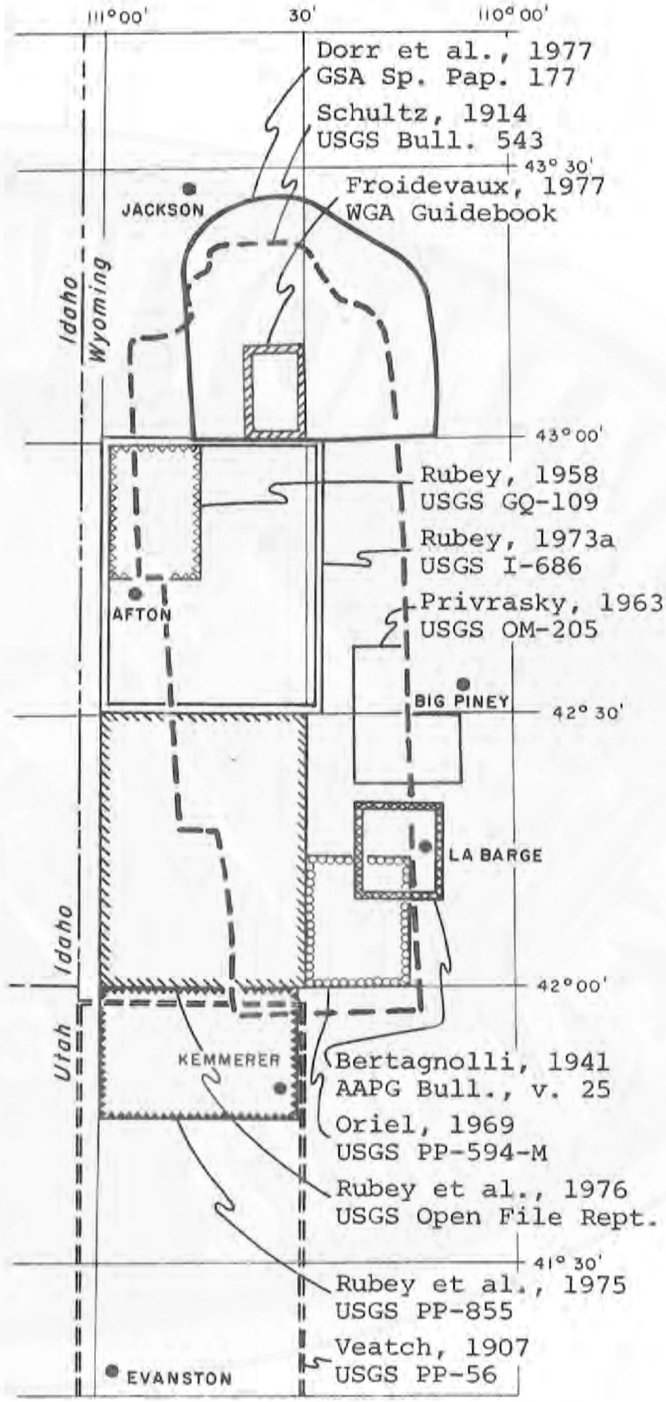

Figure 3. Index to published geologic mapping region of R.I. 18.

acknowledged.

The investigation has been carried out without grant funds from any source.

All conclusions are my responsibility.

Nature of the Problem

Several major thrust faults converge in the area, but the relationships of these features have not been adequately discussed and apparently are not well understood in a regional sense. The geology is further confused by a variety of fault names. Existing cross sections suffer from several common limitations. These include cross sections open at the bottom with no attempt to relate the structure at depth; the "sea level floating" syndrome, suggesting that all structure stops when a sea level datum is reached; and, finally, the "bottom of the page" syndrome which neatly excludes the difficulties. A further problem is that the faults that offset the Cretaceous rocks in the general Tip Top - La Barge area have been shown with no logical root zone.

The present paper will attempt to relate all phases of the structural geometry.

Methodology

The primary source of data for any area is an adequate geologic map of the surface geology at a scale of 1:62,500 or larger. Such a map provides data in a two dimensional framework, with a limited third dimension dependent upon the topography. The present study developed the third dimension — depth — by extensive use of data derived from wells. Most data of a structural nature can be presented by structure contours, but contours do not illustrate three-dimensional relationships as well as serial cross sections. The study has involved the construction of over 25 cross sections at a scale of 1 inch = 1 mile, spaced at intervals of one to three miles, and utilizing all available well data. The location of sections presented is shown on Plate 1.

Structure contours have been constructed on top of the Nugget sandstone to illustrate certain problems, and on the Darby (Hogsback) fault.

STRATIGRAPHY

General

The surface stratigraphic section has been described by Bertagnolli (1941) and Oriel (1969). Marzolf (1965) described cores and cuttings from the General Petroleum Tip Top Unit No. 22-19-G, NE¼ sec. 19, T. 28 N., R. 113 W., total depth 15,435 feet in Cambrian strata (the deepest stratigraphic penetration in the area), and correlated the lithologic descriptions with the electric logs.

The strata drilled in the General Petroleum No. 22-19-G below the Tip Top thrust are autochthonous and overlie crystalline(?) Precambrian basement. Strata west of the traces of the Prospect and Darby (Hogsback) thrust faults are allochthonous, and vary in thickness and character from the strata in the footwall of the thrust faults.

Electric logs are the principal source of subsurface control. Formation "tops" are well established, with the exception of the Late Cretaceous and Early Tertiary formations.

Correlation from well to well is excellent.

Wheeler (1971, cross section B-B') presents an excellent stratigraphic cross section of Frontier, Mowry (Aspen), and "Muddy" sandstone intervals in the Tip Top area — T. 28 N., R. 114 W.

Table I is a condensed version of the stratigraphy.

Upper Cretaceous Stratigraphy — Corrections to Previously Reported Thickness

SNIDER BASIN SECTION

A correct interpretation of the geologic structure of the panel of rocks exposed in Snider Basin between the Darby and Prospect faults requires that the thicknesses of the Upper Cretaceous rocks be adequately established. Previous investigators have reported thicknesses for the Frontier and Hilliard formations which are incompatible with local subsurface data. Schultz (1914) reported over 8,000 feet; Rubey (1973) indicates over 10,000 feet in cross sections; Reeside (1944) reported 19,000 feet in this general area; Fruchey (1962) 4,580 feet; Fuher (1962) 5,000 feet. Koenig (1971) reviewed the geology in Snider Basin and concluded that 3,812 feet of Frontier Formation and a minimum of 6,634 feet of Hilliard Shale were exposed. He also suggested that there could be an additional 2,000 feet of Hilliard Formation above the measured section, concealed by float from the Darby thrust plate.

If one *assumes* that a continuous, uninterrupted, right-side-up section of Frontier Formation and Hilliard Formation is exposed above the Aspen Shale along South Piney Creek in Snider Basin, the thickness can be interpreted to be as much as 12,456 feet (Koenig, 1971).

LA BARGE PLATFORM SECTION

Upper Cretaceous rocks have been drilled in scores of wells on the La Barge platform (Kreuger, 1955) and in the surrounding areas. The wells are located both east of the Prospect fault and beneath the Darby thrust plate. The thickness of the Upper Cretaceous rocks encountered in these wells is much less than that reported in the surface sections noted above. The average thickness of the post-Aspen Shale, pre-Adaville Formation interval on the La Barge platform derived from well data is given below.

Hillard Formation (Baxter Shale?)....	3200-3500 ft.
Frontier Formation...	1100-1200 ft.
Total	4300-4700 ft.

EXPLANATION OF THE DISCREPANCY IN THICKNESS

The discrepancy between the thickness of the Upper Cretaceous rocks exposed in Snider Basin and that encountered in wells cannot be resolved by lateral compounding of the section by eastward movement of the Prospect fault plate. The eastward movement of the Prospect plate is less than three miles, as shown by Section B-B', Plate 3. A stratigraphic (depositional) doubling of the section in a distance of two to three miles is unlikely in view of the gradual westward thickening shown by regional isopachs.

The *apparent* increase in thickness of section in the Prospect fault

TABLE 1. SUBSURFACE STRATIGRAPHIC TERMINOLOGY — GREATER BIG PINEY AREA

Age	General Lithology	Thickness
EOCENE	Rocks assigned to the Wasatch and Green River formations are not well differentiated in subsurface reports.	
	Unconformity	
PALEOCENE	Reported as Almy Member; Almy Formation; Fort Union; Paleocene; and Hoback Formation. Sombre to reddish mudstones with thin sandstones and conglomerates.	
	Unconformity	
CRETACEOUS	Adaville(?) Formation Reported by many operators as Mesaverde Formation. Sandstone, conglomeratic sandstone, and coal. Thickness variable because of unconformity at top --	0-2500
CRETACEOUS	Hilliard Formation Reported by some operators as Baxter Shale. Shale, marine, dark gray; sandstones in middle and upper parts. Upper shale........1700 Middle sandstone...400-500 Lower shale........1400	3500-3600
CRETACEOUS	First Frontier Sandstone unit Persistent sandstone at top grading downward into shale --	472
CRETACEOUS	Second Frontier Sandstone unit Sandstone at top followed by interbedded sandstones and shale. As many as five sandstone "benches" --	390
CRETACEOUS	Aspen Formation Shale, hard, siliceous; thin quartzitic sandstone; porcellanite. Top and bottom "picks" arbitrary on porcellanites or sandstones --	334
CRETACEOUS	Bear River Formation Persistent sandstone at top reported as "Muddy" sandstone. Interbedded dark shale and silt --	440
CRETACEOUS	Persistent hard black shale. Reported as "Thermopolis" shale --	82
CRETACEOUS	Sandstone units reported as "Dakota" Sandstone	280
CRETACEOUS	Gannett Formation Beckwith Formation of some reports. Variegated claystone, sandstone, conglomerates, and thin, dense limestones --	730

Age	General Lithology	Thickness
	FORMATION BOUNDARIES OF UNITS OLDER THAN THE GANNETT FORMATION AGREE WELL WITH SURFACE SECTION TERMINOLOGY	
JURASSIC(?)	Nugget Sandstone Sandstone, tan, buff, pink, salmon, cross laminated	524
TRIASSIC	Ankareh Formation Mudstone, purple, maroon, calcareous; interbeds of fine silt and sandstone --	800
	Thaynes Limestone Limestone, yellow; limestone, brown, manganiferous --	480
	Woodside Formation Dolomitic siltstone and fine sandstone, red to orange --	700
	Dinwoody Formation Siltstone, greenish gray --	103
PERMIAN	Phosphoria Formation Mudstone, phosphatic mudstone, dolomite, chert, and phosphorite --	276
PENNSYLVANIAN	Wells Formation Sandstone and quartzitic sandstone --	550
MISS.-PENN.	Amsden Formation Heterogeneous siltstone, claystone, sandstone, and dolomite, red --	382
MISSISSIPPIAN	Madison Formation Limestone, light blue gray; dolomite --	813
DEVONIAN	Darby Formation Dolomite, fetid; siltstone, red and green claystone, massive dolomite --	385
ORDOVICIAN	Bighorn Dolomite Dolomite, light gray, massive --	446
CAMBRIAN	Gallatin Formation Limestone, gray; flat pebble conglomerate --	180
	Gros Ventre Formation Upper Shale member Claystone, green micaceous --	400
	Death Canyon member Limestone, dark blue gray --	150
	Lower Shale and Sandstone member Green shales and sandstones --	(?)
PRECAMBRIAN	Crystalline(?) basement -- Not penetrated by drilling.	

plate is the result of repetition of section by folding and faulting along west dipping reverse faults. A generalized geologic map of the relationships is shown on Plate 1.

The easternmost fault in Snider Basin (Fig. 4) was penetrated in the Pacific Transmission Supply 23-15 Federal, NW¼SE¼ sec. 15, T. 29 N., R. 115 W. at a depth of 2,700 feet and repeated the Gannett-Stump interval with approximately 1,800 feet of vertical separation. Published maps (Rubey 1973a) do not show this fault; it does not appear to have offset beds in the California Co., No. 1 Tierney NE¼NE¼ sec. 15, T. 29 N., R. 115 W., but may emerge at the surface immediately west of that well. The attitude of the fault can only be inferred, but it must dip to the west at approximately 60°.

The second fault trends N. 30° W. across sec. 16, T. 29 N., R. 115 W. near the U.S. Forest Service Snider Basin Guard Station. The fault passes southward into a tight asymmetrical anticline in secs. 22, 24 and 27, T. 29 N., R. 115 W. (Plate 1).

The fault dips to the west and repeats approximately 1,700 feet of section, including the Frontier Formation. North of the Guard Station, the Frontier Formation can be traced around the nose of a south plunging syncline (Carlisle, 1979) which contributes to the repetition of section.

The third fault trends N. 42° W. and passes across section 18, T. 29 N., R. 115 W., as shown by Rubey (1973a) and Rubey and others (1976). The fault continues to the northwest up the valley of South Piney Creek and must extend farther to the northwest beneath the Darby thrust plate. The fault is believed to dip to the west and probably repeats the entire Hilliard Shale section, approximately 3,500 feet of section. The repeated interval is shown by Rubey (1973a) as the Blind Bull Shale. The late W. W. Rubey (personal communication, 1974) stated:

> *I have drawn a fault of nearly three miles length that passes near the northwest corner and the southeast corner of sec. 20, T. 29 N., R. 115 W. I interpret the Cardium-bearing sandstone that lies southwest of this supposed fault as the same as the Cardium-bearing sandstone that lies approximately 500 feet above the O. soleniscus bed that you mentioned as cropping out 3/4 mile west of the Ranger Station. If I am right about this, it means a fault of nearly 5,000 feet stratigraphic throw, up on the southwest, which diminishes greatly in throw southeastward and may die out near the center of section 28 where there are no exposures.*

The extent and character of these three faults in Snider Basin is poorly documented and needs to be studied in more detail.

The thickness of the Frontier Formation and the Hilliard Shale in the hanging wall and footwall of the Prospect fault is about equal if the effect of the faults is taken into account. The allochthonous section of Hilliard Shale is probably about 10% thicker than the autochthonous section, but the units agree well with those drilled on the La Barge platform.

NOMENCLATURE

An additional problem in comparing thickness of Upper Cretaceous rocks in this area is that of formational nomenclature. Rubey (1973a) divided the Upper Cretaceous rocks above the Aspen Shale into units collectively known as the Blind Bull Formation. Later, Rubey (1973b) defined the Blind Bull Formation, published a detailed description of the formation, and designated a type locality. The type locality is near the head of Blind Bull Creek along the divide between Horse Creek and the Hoback River from SW¼ sec. 18, T. 35 N., R. 115 W. through the S½ sec. 24, to S½ sec. 23, T. 35 N., R. 116 W., about 30 miles north of Snider Basin. The subdivisions as mapped by Rubey (1973b) are given below:

Hilliard Shale-----upper tongue
Blind Bull---------upper unit
Hilliard Shale-----lower tongue
Blind Bull---------lower unit

The lower unit of the Blind Bull Formation appears to correlate with the Frontier Formation on the La Barge platform. The Blind Bull upper unit appears to correlate with the middle sandstones of the Hilliard Shale, and the sands near the top of the upper unit of the Blind Bull and the overlying beds may be the equivalent of the Adaville Formation or possibly of the Bacon Ridge sandstone (Love, 1950).

GEOLOGIC STRUCTURE

General Statement

The writer's interpretation of the structural geology is based on the assumption that the Precambrian - sedimentary rock interface is a surface of low relief which has been broadly arched, but not faulted. The basement surface rises at low dip from the Green River Basin to the east (-35,000 feet; datum is sea level), reaches a maximum elevation across the La Barge platform - Moxa arch (-9000 feet), and then slopes to the west beneath the overthrust belt. The slope of the Precambrian surface over large areas toward the Wyoming-Idaho border is 2° to 3° west (Royse and others, 1975; Blackstone, 1977b). Locally, on the west flank of the La Barge Platform, the slope of the Precambrian surface is as much as 10° west.

Deformation of the sedimentary rocks in much of the Wyoming salient must take place above a major decollement in Cambrian strata above the crystalline basement (Blackstone, 1977b; Royse and others, 1975). All cross sections presented here are constructed with parallel folding, and the cross sections are balanced in the fashion described by Dahlstrom (1969).

The elevation of the Precambrian basement on the La Barge Platform is established by the Mobil Oil Corp. Tip Top Unit #22-19-G, NE¼ sec. 19, T. 28 N., R. 113 W., which bottomed in Cambrian strata at a total depth of 15,436 feet, approximately 1,060 feet above the basement (Marzolf, 1965). The stratigraphic section from this well is used to predict the depth to basement in all cross sections.

Detailed Structural Descriptions

LA BARGE PLATFORM

The La Barge platform (Krueger, 1960) is a broad arch trending northwesterly through the area around La Barge, Wyoming. The broad fold plunges to the southeast and continues southward as the Moxa arch, but is overridden to the northwest by the Prospect and Darby thrust plates. Structure contours constructed on top of the Nugget Sandstone (Plate 2) depict the fold. The configuration of the surface of the Precambrian basement is essentially the same as that of the Nugget Sandstone.

The La Barge platform continues to the northwest beneath the thrust belt as a basement upwarp which underlies the regional decollement. The Prospect fault overrides the La Barge as it is expressed in the Nugget Sandstone but does not rupture the basement; therefore, the platform probably continues to the northwest for a considerable distance beneath the thrust belt.

HOBACK ANTICLINE AND PROSPECT FAULT

Schultz (1914) mapped and described the elongate anticline which trends north-south and extends northward 60 miles from Snider Basin to the Hoback River. He named this sinuous, compound fold the Hoback anticline, but did not recognize the associated low angle thrust fault. He quotes at length from St. John (Hayden, 1883) in his discussion of the fold.

The low angle, west dipping fault bounding the east flank of the Hoback anticline is known as the Prospect fault. Rubey (1951) inferred its existence and used the name in cross sections (Rubey and Hubbert, 1959). Armstrong and Oriel (1965) used the name, as did Rubey (1973a). Dorr and others (1977) discussed the relationship of the Prospect fault to the Cliff Creek and Jackson faults to the north, and consider them one and the same. The type locality of the fault is presumed to be near Prospect Hill, T. 34 N., R. 114 W. (Schultz, 1914), now labeled Prospect Mountain (Rubey, 1973a). Unfortunately, the fault is concealed for long distances north and south of Prospect Mountain by the Wasatch Formation.

The Prospect fault is the easternmost fault in the thrust belt from T. 29 N. northward at least to Prospect Mountain in T. 34 N., and probably beyond (Dorr and others, 1977). The southern termination of the fault is concealed beneath the Darby (Hogsback) fault plate in T. 28 N., but the fault has been penetrated by eight wells in the Snider Basin area, and the attitude of the fault is well defined. The dip of the fault is 10° or less at the toe, but steepens rapidly to 45° - 60° W. (see cross section B-B', Plate 5), then flattens westward as the fault plane approaches the major decollement. The oldest exposed stratigraphic unit in the hanging wall of this fault in Snider Basin is the Triassic Ankareh Formation.

The geometry of the fault indicates that it is completely separate from the Darby (Hogsback) fault. The attitude of the autochthonous strata in the footwall of the thrust was established from well data and is shown by structure contours on top of the Nugget Sandstone (Plate 2). The cut-off line for the Nugget Sandstone in the footwall is projected to map view on Plate 2. The attitude of the Nugget Sandstone in the hanging wall was established by surface geology and well control and is shown on Plate 3, as is the hanging wall cut-off line.

The hanging wall and footwall cut-off lines for the Nugget Sandstone converge and intersect near sec. 20, T. 28 N., R. 115 W. The minus 4,000 foot structure contour on the Nugget Sandstone is common to both the hanging wall and the footwall and indicates that the Prospect fault terminates and the deformation continues as a south plunging asymmetrical fold. The slip on the fault varies from zero miles to about 3.5 miles maximum.

DARBY FAULT NORTH OF THOMPSON PASS

The Darby fault was named by Schultz (1914), and the type locality designated as the east face of Mt. Darby (T. 30 N., R. 115 W.). Peale (Hayden, 1879) had observed this fault but considered it as an extension of his Absaroka fault. Schultz (1914) stated:

> *It is an enormous thrust fault in which the thrust has come from the west. Its south end terminates east and south of La Barge Ridge. North of Thompson Plateau the Thompson fault cuts the beds between the Darby and Absaroka faults at nearly right angles to the strike of the beds and in a way connects these two overthrust faults.*

The attitude of the fault cannot be established definitely since only one well — Union Producing Co. No. 1 Sheep Creek, sec. 10, T. 33 N., R. 116 W. — has penetrated the fault in this area. On the basis of this well and the surface elevation of the fault trace, the dip is 10° west or less over a horizontal distance of 3.5 miles, but must steepen to the west to bring the fault plane down to the elevation of the regional decollement. At the south end of Mt. Darby in sec. 18, T. 29 N., R. 115 W., the three point dip solution for the fault plane is 11° west (section B-B', plate 5).

The Darby fault at the south end of Darby Mountain dips at a lesser angle than the strata in the hanging wall, with the result that the strata in the hanging wall terminate in the fault plane against all formations from the Darby to the Ankareh. From Darby Mountain northward, the fault trace lies in the Darby formation but rises up section until, at Blind Bull Creek (T. 35 N., R. 116 W.), the fault is at the level of the Phosphoria Formation.

The amount of displacement (slip) on the fault cannot be established by the writer. In view of this information concerning this fault in the Kemmerer area (Royse and others, 1975), it is anticipated that the slip would be in the order of ten miles or more.

Royse and others (1975, Fig. 4) indicate that the movement on the Prospect fault is transferred upward to the Darby (Hogsback) fault. The present interpretation indicates decreasing slip on the Prospect fault to the south with the termination of the fault occurring near sec. 20, T. 28 N., R. 115 W. beneath the Darby thrust plate. No transverse "step" or transverse fault as proposed by Royse and others (1975) could be established. However, the Prospect fault as shown in cross sections C-C' and D-D' (Plate 5) can be interpreted as cutting up section and across the Darby thrust plate, establishing the age of the Prospect fault as definitely younger than the Darby thrust plate.

THOMPSON FAULT

Mt. Thompson is located in sec. 13, T. 29 N., R. 116 W. near the west side of Snider Basin. Thompson Pass, between the South Piney and La Barge Creek drainages, is situated about one mile south of the peak. A high angle, left lateral fault extends through Thompson Pass and continues westward for some seven miles as described by Schultz (1914):

This fault connects the Absaroka and Darby faults and cuts across the main trend of the Wyoming and Hoback anticlines at nearly right angles. The extension of the fault for a short distance east of Thompson Plateau could not be traced, as it is completely covered by talus and Tertiary beds, but it is very probable that the Thompson fault connects with the overthrust fault along the east side of La Barge Ridge, which represents the southward continuation of the Darby fault.

Thompson fault is a tear fault which formed in the hanging wall of the Darby thrust plate, but also was propagated upward into the *older* and overlying Absaroka thrust plate (Furer, 1962; Rubey, 1973a; Rubey and others, 1975). Horizontal separation along the fault is at least three miles.

MAJOR LOW ANGLE FAULT SOUTH OF THOMPSON PASS

A striking aspect in the Wyoming salient of the overthrust belt is the

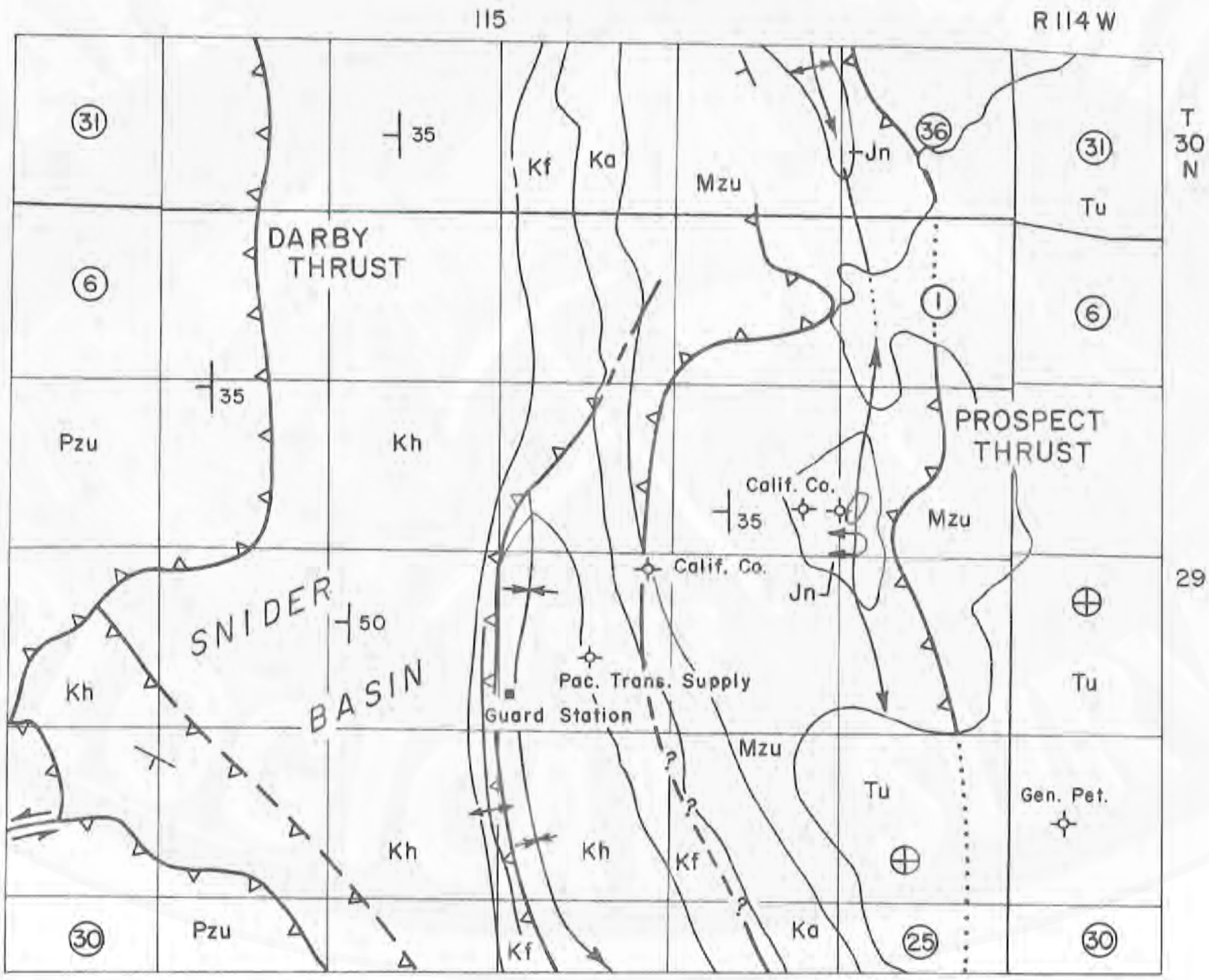

Figure 4. Generalized map of surface geology, Snider Basin, showing width of outcrop of Upper Cretaceous rocks and faults which repeat the section. Tertiary undivided (Tu); Hilliard Shale (Kh); Frontier Formation (Kf); Aspen Shale (Ka); Mesozoic undivided (Mzu); Nugget Sandstone (Jn); Paleozoic undivided (Pzu).

NOTE

The term tear fault has been used in the greater Big Piney area by a number of investigators. For clarity, a review of the definition of the term seems in order.

Dennis (1967, p. 55) defines a tear fault as follows:

Tear faults are strike-slip faults formed by differential movements within a thrust or slide mass. They are limited to such sheet or mass.

Billings (1972, p. 179) defines the pertinent terms:

The term slip is used to indicate the relative displacement of formerly adjacent points on opposite sides of the fault, and is measured in the fault surface ... The strike-slip is the component of net slip parallel to the strike of the faults; ...

The writer believes that the definition of tear fault should be modified, since in any situation *except* when the controlling thrust fault is horizontal the slip must be *oblique* rather than parallel to the strike of the tear fault. The fault segment in relative forward motion must move not only forward in the direction of tectonic transport, but also *upward.* The direction of upward motion will have a pitch angle equivalent to the pitch angle of the trace of the major thrust on a vertical plane, i.e., the tear fault. All tear faults must by definition terminate downward at the thrust fault plane underlying the block in which the tear fault occurs.

Dahlstrom (1970, p. 375) has added a second category of tear faults based on his experience in the Canadian Rockies. His definition follows since it appears many geologists are unfamiliar with his proposed terminology.

Kinds of tear faults —

A tear fault is a species of strike-slip fault which terminates both upwards and downwards against movement planes that may be detachments or thrust faults or low-angle normal faults. In folded and/or thrust filled terrain there are two basic types of tear faults: 1. tears wholly within one thrust sheet or packet of thrust sheets, which may be either (a) transverse (primary or secondary) or (b) oblique to the regional trend; 2. tears that are an integral part of the bounding surface of the deformed sheet.

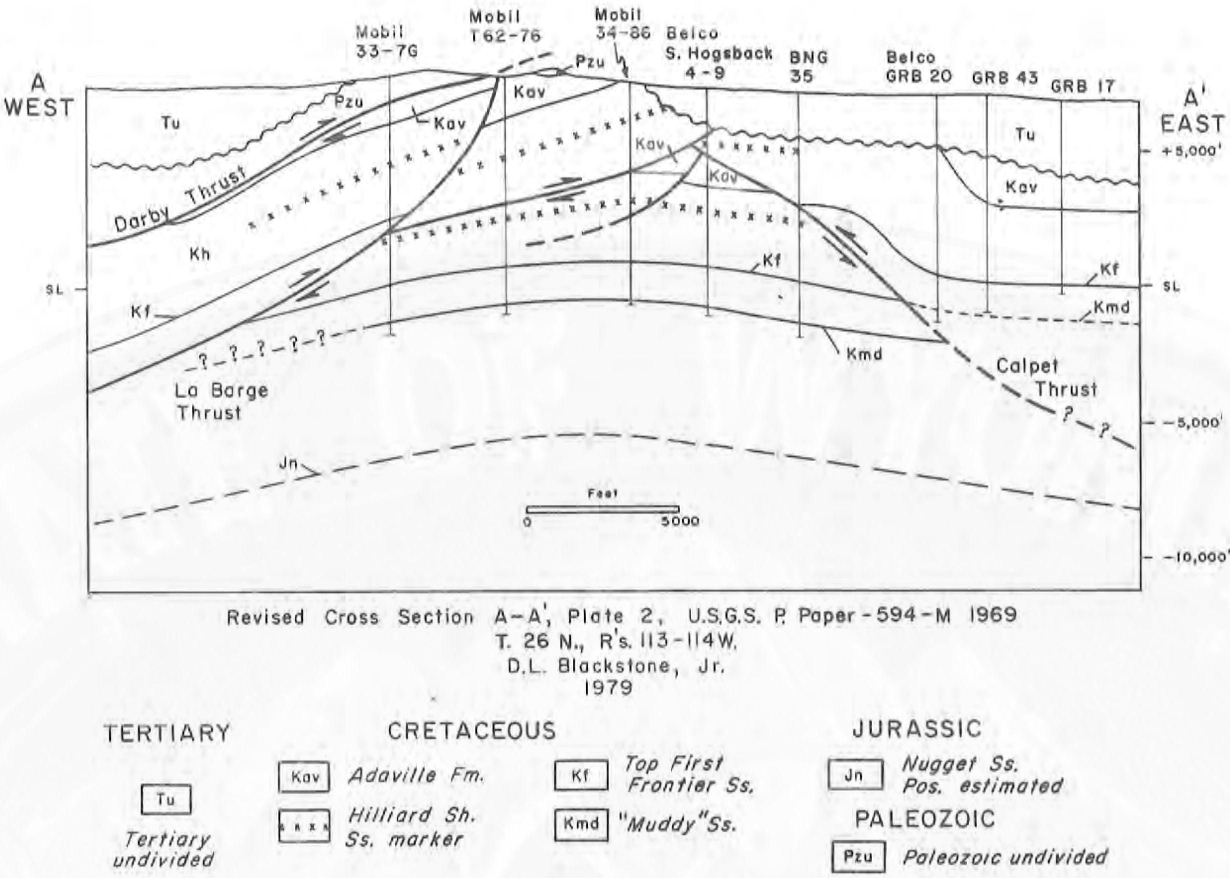

Figure 5. Revised cross section from Fort Hill quadrangle.

large eastward offset of the frontal faults just south of Snider Basin to Cretaceous Mountain and around the east side of Hogsback Ridge (La Barge Ridge), so that the trace of the Darby (Hogsback) fault lies about nine miles east of the trace of the Prospect fault (see Fig. 2).

The high ridge along the range line between Rs. 113 and 114 W. in Tps. 27 and 28 N. has been known under several names. Hayden (1883, map 5) called the triangulation station at this point La Barge Mountain. Schultz (1914) indicated the same feature as La Barge Ridge, as did Bertagnolli (1941). Subsequently, the U.S. Geological Survey used the name Hogsback Ridge upon the 7½ minute, 1:24,000 topographic quadrangle map. The formal approval of this name by the U.S. Board on Geographical Names will appear in Decision List No. 7801.

Schultz (1914) and Bertagnolli (1941) considered the thrust fault which crops out along the east face of the Hogsback Ridge (La Barge Ridge) as the continuation of the Darby thrust. Oriel (1962) used the term Darby(?) and in a footnote stated:

> *A query is used for the thrust fault along the east side of Hogsback Ridge and Cretaceous Mountain which both make up La Barge Ridge, to distinguish it from the thrust fault at Mount Darby (Schultz, 1914, pl. 1, p. 84) because the two may not be the same.*

Armstrong and Oriel (1965, p. 1857) applied a new name to the same fault.

> *Hogsback is a new name for the thrust fault south of Snider Basin called Darby by Schultz (1914, pl. 1) and subsequent workers, and Darby(?) by Oriel (1962, p. 2172). The fault is named for its excellent exposures along Hogsback Ridge, west of La Barge, Wyoming.*

The problem still remains: are we dealing with two faults — Darby and Hogsback — or is this a single fault with two names? An attempt will be made to answer this question.

The surface trace of a major thrust fault which places Cambrian, Ordovician, and Devonian rocks in fault contact with the Hilliard Shale and the Frontier Formation has been mapped in T. 29 N., Rs. 115 and 116 W. in the northeast corner of the Cokeville quadrangle (Rubey and others, 1976) immediately south of the Thompson fault. This fault trace is the direct continuation of the Darby fault as mapped by Rubey (1973a). The trace continues to the southeast as shown at a scale of 1:250,000 on the Preston two degree sheet (Oriel, 1978). A limited part of the fault was mapped by Privrasky (1963) in the northwest corner of T. 28 N., R. 114 W. Mapping of the thrust trace along the east face of Hogsback (La Barge) Ridge is provided by Schultz (1914), Bertagnolli (1941), and Oriel (1960).

A fault trace shown on Plate 1 is interpreted as the trace of a single fault plane, even though some areas are covered by Tertiary strata. Numerous wells drilled in the Tip Top, Deadline Ridge, and Dry Piney areas have penetrated a low angle thrust fault across which Paleozoic rocks as old as Cambrian are in fault contact with Upper Cretaceous strata. The writer has contoured the presumed single fault surface using available well data (Plate 4).

Farther south, in the Fort Hill quadrangle, Oriel (1969) described a similar situation as the Hogsback thrust, with three imbricate slices named, from east to west, Fort Hill, Meridian, and Pine Ridge. The position of these is established primarily from subsurface data in the following wells (T.D. is total depth):

Belfer Petroleum Corp.
Hoback III Unit 4-4
SW¼SE¼ sec. 4, T. 28 N., R. 115 W., El. 9975 T.D. 11,532
(Nugget Ss.)

Carter Oil Co.
Meridian Ridge Unit I
SW¼SW¼ sec. 10, T. 26 N., R. 115 W., El. 8000 T.D. 14,390
(Mowry Shale)

Belfer Petroleum Corp.
Unit 2-22
2315 fsl 1272 fel sec. 22,
T. 27 N., R. 115 W.
El. 7738 KB T.D. 12,994
(Frontier Formation)

Mountain Fuel Supply Corp.
Deadline Ridge Unit I
SW¼SE¼NW¼ sec. 22, T. 28 N.,
R. 115 W.
El. 10,888 KB T.D. 12,585
(Nugget Ss.)

Belfer Petroleum Corp.
Hoback Unit 3-15
1679 fwl 519 fnl sec. 15,
T. 28 N., R. 115W.
El. 9940 KB T.D. 11,509
(Nugget Ss.)

Phillips Petroleum Corp.
No. I Fort Hill
SW¼ sec. 18, T. 25 N.,
R. 114 W.
El. KB T.D. 17,345
(Nugget Ss.)

In these wells the elevation of the Darby (Hogsback) thrust plane rises to the northeast (Plate 2), and at the site of the Belfer Unit 4-4 only one splay of the fault remains above the sole fault.

The formations in the plate under discussion, as well as those in the overlying Absaroka and Commissary Ridge plates (Plate 1), change strike drastically as they approach the Thompson fault. The general change in strike is from north-south to approximately N. 30° W. along the township line between T. 27 N. and T. 28 N. The strata above the Absaroka plate have been folded into anticlines and synclines with recumbent east limbs. In addition, the northern part of the Commissary Ridge fault near its termination appears to have been refolded so that the dip is reversed due to the drag effect along the Thompson fault.

Geologic mapping, combined with data from drilled wells, demonstrates that there is a large thrust plate south of the Thompson fault. The tectonic transport direction of this plate is from west to east on a fault plane that dips to the west at angles as great as 15°. The plate has Cambrian shales or limestones or both at the base; is complicated by folding and imbrication; and overlies Upper Cretaceous rocks.

Geometry of a Single Fault Plane — Combined Darby and Hogsback Faults

Data concerning the faults described north and south of Thompson Pass have been combined on two maps: (a) a generalized geologic map — Plate 1, and (b) a structure contour map of the combined fault surface — Plate 4.

The geologic map demonstrates the existence of a more or less continuous fault trace extending across the entire area. Segments of the trace are concealed but are reasonably limited in position by well data. Except where movement on the Thompson fault has created offset, the stratigraphic units show excellent continuity throughout the plate in a north-south direction. The map shows the change in the stratigraphic unit at the base of the plate from Cambrian to Devonian age rocks. Reasons for this will be discussed later. Folding or imbrication exist in all parts of the plate, and the fold system is considered to have been continuous across the present Thompson fault.

The structure contour map (Plate 4) of the combined fault systems reveals that the surface is bulged upward into a ridge trending N. 40° W. The bulge extends from the edge of the thrust plate at the southern end of Snider Basin in a southeasterly direction to the southern end of Hogsback Ridge. Southwest of the bulge, the surface slopes to the southwest at a rate of 1,500 feet per mile (15°) and flattens to 10° or less. Northeast of the bulge, the fault surface slopes to the east into a sag and then rises rapidly to the east where the fault reaches the surface.

The contours show a slight deflection near the deep reentrant in the fault surface along the west side of Snider Basin. If the northern (Darby) segment of the plate were restored to the position occupied prior to displacement of the plate along the Thompson fault, the contours would show a smoother surface without serious deflection.

The strike of the fault surface changes from approximately N. 15° E.

to N. 50° W. across the Thompson fault. At the latitude of La Barge, the strike changes again to almost north-south and continues in this fashion for a long distance to the south.

Additional evidence for continuity of the Darby thrust fault with the major thrust fault to the south across the Thompson fault is provided by a displaced anticline. Rubey (1973a) mapped a tight, faulted, north-plunging anticline in T. 29 N., R. 116 W. which trends N. 40° W. for at least five miles. Oriel (1978) reports a south-plunging anticline in T. 28 N., R. 115 W. with Darby Formation in the core. The fold trends approximately N. 20° W. and continues southward from the edge of the plate for several miles.

Horizontal separation along the Thompson fault is left lateral, and may be as great as three miles. If the horizontal separation is removed, the two segments of the anticline align almost perfectly. The southern segment exposes a deeper section stratigraphically because the fault plate south of the Thompson fault has moved both laterally and upward. The writer believes that the two displaced segments were once a single continuous fold.

Conclusions Relative to the Continuity of the Darby-Hogsback Faults

The writer concludes that the Darby fault is continuous with the major thrust fault south of Thompson Pass, and recommends that the name Hogsback fault proposed by Armstrong and Oriel (1965) be abandoned. The reasons for this conclusion are given below.

(1) Structure contours of the two fault planes show no discontinuity across the Thompson fault, and show a consistent form for a single fault surface.

(2) The stratigraphic position of the fault plane is consistent with a regional rise of the fault surface to the north.

(3) There is continuity of folds across the Thompson fault, if horizontal separation on that fault is taken into account.

(4) Similar age rocks exist in the footwall throughout the area studied.

(5) The apparent discrepancy in the eastern displacement is the result of control by the La Barge Platform.

(6) The Prospect fault is an independent fault and cannot be related to either the Darby or the Hogsback faults.

Relationship of the Darby Fault Surface to Underlying Structure

Comparison of the configuration of the top of the Nugget Sandstone (Plate 2) with that of the Darby fault surface (Plate 4) shows a remarkable similarity in geometry. The crest of the La Barge Platform coincides almost exactly with the upward bulge in the fault surface. Likewise, the syncline and sag show coinciding positions.

The Darby thrust plate is imbricated, but has a very uniform lower boundary. The only interruption of the sole fault plane is caused by the offsetting of the plate by the Prospect fault, as mentioned previously.

One interpretation of the coincidence of fault surface with the underlying structure is that the fault surface has been warped after emplacement by renewed elevation of a fold in the underlying basement.

La Barge - Tip Top Fault Complex

REVIEW OF PREVIOUS WORK AND NOMENCLATURE

A system of faults which repeats the Upper Cretaceous Frontier, Hilliard, Adaville(?) and Hoback(?) formations can be traced from the Tip Top field (T. 28 N., R. 114 W.) southward to the Fort Hill quadrangle. The names Tip Top, Hilliard, and La Barge have been applied to these faults, and their distribution and continuity have been variously interpreted.

Schultz (1908; 1914, p. 33-34) did not recognize any faults east of the Darby thrust. Trumbull (1913) presents a simple map and cross section of the La Barge area, but shows only the Darby thrust. Bartram and Hupp (1929, p. 1284, Fig. 7) discussed the structure of the La Barge field and recognized a thrust fault east of the Darby fault trace to which they applied the name La Barge fault.

> *Parallel with the Darby fault is a smaller thrust fault, now called the La Barge fault, which has thrust Hilliard shale of Upper Cretaceous age over some Tertiary beds ... Assuming that the La Barge fault originated from an overturned fold that finally broke, the anticline or faulted anticline in the Frontier sands may be expected west of the field, perhaps somewhat as shown in Fig. 7.*

Davies (1934, p. 692) paraphrases the above statement:

> *Parallel with the Darby thrust is a smaller fault, now called La Barge fault, which has thrust Adaville and Hilliard beds of Upper Cretaceous age over the Almy formation of Eocene.*

Bertagnolli (1941) used the term La Barge fault, and quotes Davies (1934).

Christensen and Marshall (1950), by a map and cross sections of the La Barge field, show Hilliard shale overthrust to the east over the Wasatch Formation on a fault named the Hilliard. Howe (1955), in a diagrammatic cross section of the Tip Top field, shows the Darby thrust fault and an "intermediate thrust block" bounded on the west by a west dipping thrust which offsets the Cretaceous rocks.

The 1960 Wyoming Geological Association Guidebook contains several papers dealing with faulting in this area. Murray (1960) discussed the low angle faults as the Hilliard thrust. Krueger (1960, Fig. 4) used the term La Barge thrust. Michael (1960) discussed the Hogsback and Tip Top units, and used the term La Barge thrust in the Hogsback unit and applied a new name, the Tip Top thrust, in the Tip Top unit.

Shipp and Dunnewald (1962) recognized the La Barge and Tip Top faults and separated them by an east-west trending tear fault. Wheeler (1971) discussed the Tip Top unit but considered the Tip Top fault to be of minor importance, and added a new name, the "Conundrum" thrust.

Oriel (1969) expressed a preference for the older term, La Barge thrust, rather than the name Hilliard, which has a stratigraphic connotation.

The questions still remain — how many faults are there and how are they related, and are tear faults present?

The prevailing definition of tear faults as given previously in this paper allows only certain fault geomtries. No tear fault can terminate a low angle thrust fault situation of which it is a part, since the tear fault must be limited to the hanging wall and terminate against the sole fault. The fault described by Shipp and Dunnewald (1962) does not fit the definition.

PRESENT INVESTIGATION AND RECOMMENDED NOMENCLATURE

The extent and geometry of the fault system affecting the Upper Cretaceous rocks has been determined by constructing serial cross sections. The most useful subsurface markers were the top of the First and Second Frontier Sandstone units; the "Muddy" Sandstone unit; the "Thermopolis" Shale unit; and, finally, the Stump and Nugget Sandstones. Numerous "picks" were made in the Hilliard Shale for detailed correlation. The fault system strikes in a general north-south direction and continues into the Fort Hill quadrangle (Oriel, 1969). The faults vary in dip from very steep (70°) to very flat (less than 5°), west.

The hanging wall and footwall cutoffs of the top of the First Frontier Sandstone unit were determined for all major faults. These traces were projected vertically into the map view (Plate 4) for ready viewing of the horizontal separation for the faults.

Serial sections (Plates 5 and 6) reveal that there are three distinct *west* dipping faults which displace the Upper Cretaceous section. The northernmost of these faults is the Tip Top (Michael, 1961). The projected cutoff lines extend from the southwest corner of T. 27 N., R. 113 W. into the southwest corner of T. 28 N., R. 113 W. The southernmost and most extensive fault is the La Barge fault (Plate 4), which extends from the northeast corner of T. 27 N., R. 114 W. through Tps. 26 and 27 N., Rs. 113 and 114 W. and southward into the Fort Hill quadrangle.

The third west dipping fault — the Dry Piney — affects the Nugget Sandstone in the Deadline Ridge - Dry Piney field - Hogsback field areas.

TIP TOP FAULT

The Tip Top fault (Plate 4, cross sections C-C', D-D') is about 8 miles in length, trends N. 15° W., dips 50° southwest, and has a maximum horizontal separation of approximately 500 feet.

The termination of the fault at the north and south extremities is established by the convergence of the cutoff lines. Privrasky (1963) mapped an east-west trending strike slip fault with left lateral displacement in secs. 11 and 12, T. 28 N., R. 114 W. and sec. 7, T. 28 N., R. 113 W. which apparently is a tear fault in the hanging wall of the Tip Top thrust fault. Several minor splays or imbrications occur in the hanging wall of the Tip Top thrust, but were not projected into map view.

LA BARGE FAULT

The La Barge fault (Plate 4, and cross sections E-E' through G-G') originates in sec. 3, T. 27 N., R. 114 W., and can be traced through the subsurface for 12 miles to the south into the Fort Hill quadrangle.

The southern termination was not determined. The general strike of the La Barge fault is north-south and the maximum horizontal separation is at least 15,000 feet. The fault dip varies from nearly horizontal to 30° west. Vertical separation of the First Frontier Sandstone unit is about 2,000 feet in the area of greatest tectonic overlap.

The southern continuation of the La Barge fault system in the Fort Hill quadrangle (Oriel, 1969) was reviewed, and my interpretation is considerably different from that of Oriel in that I believe there are fewer imbrications than shown by Oriel. The omission of the east dipping Calpet thrust fault by Oriel leaves the remainder of the interpretation suspect.

The northern termination of the La Barge fault has been established on data from 50 wells drilled adjacent to the common corner of Tps. 27 and 28 N., Rs. 113 and 114 W. and seven supplemental cross sections in the area. Murray (1960) shows the north termination of the Hilliard (La Barge) fault trending essentially east-west and extending westward beyond the limits of his map. Shipp and Dunnewald (1962) consider the Tip Top and La Barge faults as parts of a single thrust broken by a tear fault located in the same general position as the northern termination of the Hilliard thrust as depicted by Murray (1960). Michael (1960) treats the La Barge fault as one of an en echelon set.

The writer believes that the northern termination of the La Barge fault is in sec. 3, T. 27 N., R. 114 W. and that the thrust is separate and distinct from the Tip Top thrust, and that the displacement increases rapidly to the south as is shown in Plate 4.

Murray (1960) and Shipp and Dunnewald (1962) make reference to normal faulting in the Mountain Fuel Supply Dry Piney Unit No. 5 well, sec. 2, T. 27 N., R. 114 W., which cuts out either 500 or 150 feet of Hilliard Shale. This normal fault does exist, and 300 feet of Hilliard shale is omitted. The normal fault also displaces the La Barge thrust fault, and is therefore younger than the thrust. The normal fault is anomalous for the area and appears to be the "exception that tests the rule," but is not evidence for a tear fault.

DRY PINEY FAULT (DEADLINE RIDGE - DRY PINEY FIELD - HOGSBACK FIELD)

At the level of the Nugget Sandstone, a well defined anticline extends southeastward from Deadline Ridge to the Hogsback field. The fold has low structural relief, is asymmetrical to the east, and is faulted on the east flank. The faulting associated with the fold has small vertical separation (150-300 feet) and can be definitely established only in the closely drilled areas. The faulting is treated here as continuous from T. 28 N., R. 115 W. southeastward to the northwest corner of T. 26 N., R. 113 W. (Plate 4). The fault is interpreted as dipping steeply to the west below the Nugget Sandstone level and then flattening in dip to coincide with the dip of the Cambrian strata above the basement. The eastward extent of the fault is indeterminate.

If the interpretation presented here is correct, the Deadline Ridge - Dry Piney field - Hogsback field line of faulting is the youngest thrust fault in the area under consideration. Tectonic movement on this fault was minimal and ceased before the fault plane propagated upward and reached the surface.

ROOT ZONE FOR THE TIP TOP AND LA BARGE FAULTS

The La Barge thrust fault has a horizontal separation at the top of the First Frontier Sandstone unit of 2.5 miles and tectonic overlap of the hanging wall and the footwall on an essentially flat fault surface. A fault of such major displacement must be rooted in a major decollement at depth. Murray (1960, sections A-A', B-B') suggests a detachment surface in the Mowry (Aspen) Shale but does not carry the fault far enough west to critically establish a root zone. Other investigators have avoided the problem by terminating their cross-sections before the problem became embarrassing.

Oriel (1969, all cross sections) extends the La Barge fault downward and parallel to the bedding in the Gannett Group. Despite structural overlap of the Frontier Formation of two miles, Oriel terminates the La Barge fault (zero movement) in the bedding of the Gannett about two miles west of the point of maximum overlap. The problem of bed length in the hanging wall is completely disregarded; the termination of the fault as indicated is highly improbable.

Webel (1977, Section A-A') interpreted the La Barge thrust to be parallel to bedding in the Hilliard Shale, but does not extend the section far enough west to demonstrate a root zone for the fault. In Section B-B', the La Barge fault is shown as parallel to the bedding in the upper part of the Hilliard Shale and parallel to the Darby fault plane. I have been unable to verify this relationship, and I disagree with the existence of the Tip Top fault in this section.

Tip Top Thrust

The Tip Top fault extends downward and to the west and can be directly related to faulting at the level of the Nugget Sandstone in the Tip Top field. The relationship is complicated by the east dipping Cretaceous Mountain fault, which is younger than, and offsets, the Tip Top thrust. The north-south extent of the Tip Top fault at the level of the Frontier Formation and the Nugget Sandstone are essentially parallel (Plate 4). The cross sections are drawn on the assumption that the faults existing at the two levels are one and the same. The position of the Tip Top thrust plane below the level of the Nugget is in doubt because there is no well control. Probably the fault follows the regional pattern and steepens in dip downward across the Paleozoic section, and then flattens into the regional decollement at the level of the Cambrian strata.

La Barge Thrust

The La Barge thrust, in the subsurface, is characterized by moderately steep dip (30°+) in the region where it cuts up section to reach the surface, but then flattens to the west to near horizontal. In the zone where the fault plane has very low dip, the fault plane must approximate the attitude of the bedding. Tectonic overlap of the Frontier Formation in the La Barge thrust is as much as three miles.

No direct linkage can be established of the La Barge thrust fault at the level of the Frontier Formation with faulting at the level of the Nugget Sandstone, since no wells penetrate to the Nugget in the critical areas. The writer has extended the La Barge fault westward in the Cretaceous interval as essentially a bedding plane fault. The La Barge thrust must eventually cut down section across the Nugget Sandstone and merge into the major regional decollement at the level of the Cambrian strata.

Faults of Uncertain Relationship

Three faults have been recognized in Snider Basin, but very little data concerning them is available. The faults displace the Mesozoic rocks on the west limb of the Hoback anticline, and are confined to the Prospect fault plate. Details concerning these faults were presented earlier under the discussion of the Cretaceous rocks exposed in Snider Basin.

East Dipping Faults

An unusual set of faults has been recognized, which dip to the east, are reverse in nature, and have the east side relatively up, in the Tip Top and La Barge field areas. Faults of this type were first called to my attention by Milton Childers (personal communication).

Oriel (1969) considered that such faults might exist, but offered a disclaimer on the ground that he did not have time to collect and evaluate the available subsurface data.

CRETACEOUS MOUNTAIN FAULT

An east dipping fault associated with the Tip Top field is figured by Wheeler (1971) and named by him the Cretaceous Mountain fault. Webel (1977) also figures this fault. The fault strikes N. 75° W. and dips 60° east in the near surface part and flattens to the east at depth. The slip is probably 200 feet or less.

CALPET FAULT

A second east dipping fault occurs in the area of the La Barge field in Tps. 26 and 27 N., R. 113 W. The fault strikes essentially north-south and dips 30° to 40° east near the surface. The horizontal separation is as great as 3,000 feet. Geologists dealing with the La Barge area have informally referred to this fault as the Calpet fault. The name was formally used by Webel (1977).

AGE OF DEFORMATION

Age of the Prospect Fault

Regional analysis of the foreland fold and thrust belt (Armstrong and Oriel, 1965; Price and Mountjoy, 1969; Mudge, 1970; Royse and others, 1975) indicates that the easternmost thrusts are the youngest. In the Wyoming salient between Hoback River and Snider Basin, the Jackson-Cliff Creek-Prospect fault system fills this role. Dorr and others (1977, p. 51) consider the Cliff Creek fault to be the same as the Prospect fault and give its age in the following statement.

> *At the close of Paleocene but before Eocene time, a new plate broke and moved eastward along the Cliff Creek thrust. This thrust is best exposed in its central section along the west edge of the Hoback Basin (Figs. 2, 16) where it forms the main frontal (easternmost) thrust of the thrust belt. It is also the most closely dated of the thrusts.*

Rubey (1973a) shows the Prospect fault plate overriding the Paleocene Chappo Member of the Wasatch Formation and overlain by the Wasatch

Formation, placing the age of the fault development as in part Paleocene.

Armstrong and Oriel (1965) considered the Prospect fault to have developed in middle early Eocene, as stated below:

> *Few of the thrusts can be dated within narrow limits by the usual geologic methods. One that can be, however, is the Prospect thrust (Fig. 16). The fault cuts the Hoback Formation of Paleocene and earliest Eocene age; the Eocene part of the Hoback is folded with the underlying strata, but only the Paleocene part is cut by the fault. South of where the fault cuts the Hoback, its trace is overlain by Wasatch strata of late early Eocene age. Major fault movement on the fault thus occurred in middle early Eocene time.*

The discrepancy in ages may mean that the faults are not continuous, that the dating is wrong in one of the areas, or that the fault propagated southward with time.

Age of the Darby Fault

The Darby fault at Mt. Darby can only be dated as post-Upper Shale Tongue of the Hilliard Formation (Rubey, 1973a). The writer concludes that the Darby fault is the same as the Hogsback (Armstrong and Oriel, 1965); a more exact dating of the fault is therefore possible.

Oriel (1969) states that the Hogsback (Darby) fault moved in Paleocene time. Strata assigned to the Adaville(?) Formation and dated as Late but not latest Cretaceous age are cut by the fault. The hanging wall plate, the fault trace, and Hilliard shale in the footwall are overlain with angular unconformity by the nearly horizontal beds of the Chappo Member of the Wasatch Formation of Paleocene and Eocene age. The age of the Adaville(?) was determined by Privrasky (1963) who mapped the Darby (?) fault at Cretaceous Mountain. His conclusion as to age follows.

> *These Paleozoic rocks lie in a thrust sheet that has overridden rocks as young as Cretaceous. The trace of the thrust fault and the underlying Adaville Formation are exposed in the Big Piney area on the north side of Cretaceous Mountain.*

Privrasky (1963), on the basis of the flora, assigned the Cretaceous rocks to the Adaville Formation of Upper Cretaceous age (Judith River equivalent). The Adaville is folded and in turn overlain by part of the Main Body of the Wasatch Formation, which is in turn folded. Privrasky (1963) considered the folding to have occurred in two stages. The critical fact is the absence of rocks of Paleocene age at this locality.

Age of the La Barge Fault

The surface trace of the La Barge thrust fault appears locally along the east side of Hogsback Ridge, and the fault plane dips westward beneath the Darby thrust plate. Oriel (1969) is cited in the following passage:

> *The La Barge fault is younger than the Hogsback thrust fault. If the faults on the east side of Hogsback Ridge, shown as reverse faults on Plate 1, are indeed slices of the La Barge thrust, as interpreted on plates 1 and 2, then the La Barge thrust fault cuts and offsets the Hogsback fault. The La Barge fault cuts*

both the Chappo Member of the Wasatch Formation and the Hoback(?) Formation. The fault is unconformably overlain by the La Barge Member of the Wasatch Formation. Movement along this fault, therefore, was in early, possibly middle early (Lysite), Eocene time.

The geologic map of the Fort Hill quadrangle does not show these relationships, hence the evidence must be derived from another locality.

Interpretation of the slices is based on section A-A', plate 1 (Oriel, 1969) which is grossly in error. A revised interpretation of the data is shown on Fig. 5. The slices in sec. A-A' would have the combined effect of elevating the trace of the Darby thrust rather than lowering it as shown. The isolated mass of Bighorn Dolomite in the cross section is interpreted by me to be a gravity emplaced block derived from the Darby thrust and moved to a lower elevation. Under this interpretation, the slices do not displace the Darby thrust and the relationship does not prove that the La Barge thrust fault is younger. Despite the lack of critical cross cutting relationships, the La Barge fault no doubt developed beneath the La Barge fault plate, and is younger.

Age of the Cretaceous Mountain and Calpet Faults

The age of the east dipping Calpet fault can be established on the basis of cross cutting relationships with the La Barge thrust fault. The Calpet fault is definitely older than the La Barge thrust since the latter overrides and truncates the Calpet. The Calpet fault is also pre-Hoback (?) Formation since the Hoback(?) Formation unconformably overlaps the Adaville Formation in the La Barge field producing area.

The age of the Cretaceous Mountain fault is more difficult to establish. Wheeler (1971) leaves the question of age in doubt. The fault is definitely older than the Darby thrust, but may be younger than the Tip Top fault.

Chronological Sequence of Deformation

A chronological sequence of thrust faulting is not easy to establish on an absolute basis. Under the assumption that the easternmost faults are youngest, a possible order of events is given in Table II.

Summary on Age of Faulting

Faulting progressed from west to east with time. All older fault plates moved eastward en masse as new fault planes developed at the front of the salient, and motion was transferred to new sole faults at the toe of the mass. Differential movement within the plates was accommodated by tear faults, folds, and imbricate back limb thrusts.

REGIONAL CONSIDERATIONS

Stratigraphic Level of the Major Faults

The most continuous faults in the Wyoming salient are the Absaroka and the Darby as re-defined in this paper. The faults are similar in the continuity of the stratigraphy in the hanging and footwalls, but the order is reversed from one to the other. The Darby thrust from Thompson Pass to the Uinta Mountains lies

TABLE II. GREATER BIG PINEY AREA
CHRONOLOGY OF STRUCTURAL DEFORMATION

I.	Emplacement of the Absaroka thrust plate, easternmost thrust at that time.	Latest Cretaceous Montana or Lance time.
II.	Probable elevation of the Moxa Arch - La Barge Platform, development of east dipping faults on east flank and Cretaceous Mountain and Calpet faults.	Some scalping of Cretaceous Adaville Fm. (Mesaverde) from crest of fold.
III.	Emplacement of the Darby thrust plate. New fault at eastern edge of the salient. No accurate dating from Mt. Darby north to northern termination (Rubey, 1973a)	Early Cretaceous rocks thrust over Frontier Fm. Darby thrust is post-Absaroka, therefore post-Lance or post-Montana.
	Darby thrust south of Thompson Pass. Cuts Adaville Fm. and is overlain by Chappo Member of the Wasatch Fm.	Movement ceased before the deposition of latest Paleocene (Clarkforkian).
	Thompson fault (tear fault) developed concomitantly with the advance of Darby thrust plate.	
IV.	Emplacement of the Prospect fault plate, new fault at the eastern edge of the salient.	
	a) Cliff Creek thrust at Battle Mt. (Dorr and others, 1977)	Fault overlies deformed mid-Tiffonian part of the Hoback Fm. (pre-Eocene). Fault overlapped by the Lookout Mt. Cgl. Mb. of the Wasatch Fm. (Graybullian)
	b) Prospect fault near Prospect Mt. (Armstrong and Oriel, 1965)	Later than the Paleocene part of the Hoback Fm. (Clarkforkian), before "late, early Eocene" (Lostcabinean).
	c) Prospect fault south to Prospect Mt. (Rubey, 1973)	Later than Chappo Mb. of Wasatch Fm. (Graybullian and Clarkforkian); appears to cut Darby plate.
	NOTE: Movement on the Prospect fault may be equivalent to imbricate faulting in Darby plate south of Thompson Pass.	
	NOTE: Cliff Creek fault movement slightly older than the Prospect movement farther south.	
V.	Back limb thrusts, slices or imbrications in the Darby thrust plate. Folding in some parts. May have been activated simultaneously with La Barge fault.	
VI.	Emplacement of the La Barge (Hilliard) and Tip Top thrusts. New thrust fault at eastern edge of the salient.	
	a) Tip Top is older than the Darby fault and truncated by it.	
	b) La Barge thrust - younger than the Darby (Hogsback) (Oriel, 1969)	Hilliard Shale overides Adaville(?) Fm.
VII.	Renewed or continuing upwarping of the La Barge Platform, arching up both the La Barge and Darby thrust plates.	

at the level of Cambrian age rocks. North of Thompson Pass, the fault plane rises in section until, near the northern termination in T. 41 N., R. 118 W., the fault lies at the level of Jurassic age rocks in the hanging wall (Albee and others, 1967). Upper Cretaceous rocks are consistently present in the footwall.

The northern part of the Absaroka fault east of Grand Valley exhibits a similar pattern, but in a reverse order. The fault lies at the level of Cambrian age strata, but south of Thompson Pass the fault rises in section at least as high as the Pennsylvanian Wells Formation near Ryckman Creek (Royse and others, 1975; Vietti, 1977), and may lie at a higher level in the vicinity of Evanston, Wyoming.

No simple explanation for the change in stratigraphic level of these faults has been proposed. The advancing front of deformation undoubtedly varied in intensity and direction during the development of the salient. If all major faults "bottom out" on a major decollement at or near the Precambrian-sedimentary interface, the conditions described above could be the result of large scale rotational movement. The maximum movement was in the segment where the Cambrian strata are now at the surface, and the least movement was in the segment where only the Mesozoic rocks appear in the hanging wall.

The significant geometric aspect of these relationships is that the crossover of the two faults relative to the stratigraphy occurs at the latitude of Thompson Pass.

Imbrication of the Darby Thrust Plate

Eastward tectonic transport of the Wyoming salient of the overthrust belt is assumed to have taken place on a major decollement, thrusting younger rocks over older (Blackstone, 1977b). In the area under study, some information concerning the loci of movement is available.

The Darby thrust south of Thompson Pass is imbricated by at least three faults (named, from west to east, Pine Hill, Meridian, and Fort Hill; Oriel, 1969) which decrease in displacement and pass into asymmetric folds northward from the Fort Hill quadrangle. None of these faults extend as far north as T. 28 N., R. 115 W. The imbrications probably developed after the leading edge of the Darby thrust reached its maximum forward motion and was "locked," so to speak; and further motion was accomodated either by folding or imbrication of the plate, or both.

The faults are defined on the basis of data from three deep exploratory tests for oil and gas:

Phillips Petroleum Corp. 1-A Fort Hill, C SW¼ sec 18, T. 25 N., R. 114 W. Elevation 8,130, T.D. 17,345 (Nugget Sandstone)

Carter Oil Co. 1 Meridian Ridge, C SW¼ SW¼ sec. 10, T. 26 N., R. 115 W. Elevation 8,000, T.D. 14,390 (Aspen Shale)

Belfer Petroleum Corp. 2-22 Meridian Ridge, NE¼ SE¼ sec. 22, T. 26 N., R. 115 W. Elevation 7,736, T.D. 13,100 (Frontier Fm.)

The well data provide only one active dimension of fault movement — vertical separation. The total slip on these faults, as reconstructed on the cross sections, is approximately 2.5 miles.

Eastward tectonic movement of the Darby thrust plate by imbrication and folding should have a counterpart north of Thompson Pass. The writer suggests that the Prospect fault was the site of forward motion of the salient equivalent to the movement on the imbricate faults farther south. The amount of eastward transport on the Prospect fault is comparable to that on the imbrications.

Age of Imbricate Faults — Darby Thrust Plate - Ft. Hill Quadrangle

The writer interprets the Pine Ridge, Meridian, and Ft. Hill imbricate faults to be younger than the Darby fault. The reasons, based on data from Oriel (1969, Plates 1 and 2), are set forth below.

The Pine Ridge fault (Oriel, Plate 1; Plate 2, sec. D-D') is shown as an inferred fault which cuts the Conglomerate Member of the Wasatch Formation, then passes into a fold *overlain* by the part of the Conglomerate Member which is younger than the Chappo Member of the Wasatch, thus placing the age of the Pine Ridge fault as younger than the Darby thrust fault.

The Meridian fault does not crop out since it is overlapped by that part of the Conglomerate Member of the Wasatch which is older than the Green River Formation and the Upper Tongue of the Green River which is equivalent to the La Barge Member of the Wasatch, and therefore the fault is younger than the Chappo Member of the Wasatch Formation. This relationship dates the Meridian fault as questionably younger than the Darby Thrust fault.

The Fort Hill thrust is of lesser extent than originally described by Oriel (1969). Data from the Continental Oil Co. Canyon Ranch No. 1, N½SW¼SE¼ sec. 15, T. 25 N., R. 114 W. require that the Fort Hill fault trace beneath the Tertiary strata lie west of the well site. The fault is overlain unconformably by the La Barge Member of the Wasatch Formation and is therefore younger than the Darby thrust.

Relationship of the Darby Thrust to the La Barge Platform

The eastward deflection of the surface trace of the Darby thrust fault (Plate 1) may be a re-entrant due to erosion of a once more extensive Darby plate north of Snider Basin. A more likely explanation is that the emplacement of the Darby thrust plate was controlled by the older La Barge Platform.

The La Barge Platform trends N. 45° W.; the west flank slopes 15° to the west-southwest at the top of the Precambrian and is overridden by the thrust belt. The platform is an early structural feature, elevated in late Cretaceous time as evidenced by the removal of the Adaville(?) Formation from parts of the crest (Thomaidis, 1973; Wach, 1977). The Darby fault broke to the surface because of impingement upon the west flank of the platform. North of Snider Basin, the Darby thrust plate overrode the platform; but south of Thompson Pass, the plate was less restrained and could move farther to the east before it encountered the flank of the platform and was forced to deflect upward to the surface. In the southern segment, the Cambrian strata were carried upward and to the east over the platform. North of Thompson Pass, the fault rose to the level of the

Upper Paleozoic strata and these strata are in the base of the hanging wall.

The eastward deflection of the surface fault trace is the result of angle of intersection of the advancing thrust sheet and the older, anticlinal arch in the footwall.

INFERRED STRUCTURAL CONTROL BY BASEMENT WARPING IN THE WYOMING SALIENT

The tectonic map of the Wyoming salient of the overthrust belt (Blackstone, 1977a; 1978; 1979) reveals some regional relationships deserving of comment. The structural pattern in the Wyoming foreland province includes a number of elements with northwest trends, such as:

Wind River Mts.	N. 45° W.
South flank Gros Ventre Mts.	N. 65° W.
Buffalo Fork area	N. 25° W.
Rawlins Uplift	N. 30° W.

These features are large asymmetric anticlinal uplifts with Precambrian basement exposed in the cores. Precambrian basement has been differentially displaced by as much as 50,000 feet vertically and as much as ten miles horizontally on faults which bound the uplifts on the steep side.

One of the major uplifts of the Precambrian basement in terms of length is the sinuous fold known variously as the Church Buttes Arch (Thomaidis, 1973), Moxa Arch (Wach, 1977) and La Barge Platform (Krueger, 1960). The Arch extends from the Uinta Mountain front at Bridger Lake field (T. 3 N., R. 14 E., Utah) northward to an area west of Big Piney, Wyoming, where it intersects the frontal thrusts of the Wyoming salient.

The La Barge Platform may continue to the northwest beneath the overthrust plates. Several features within the thrust belt suggest an underlying control, ostensibly at the level of the Precambrian basement. The aligned features will be discussed from northwest to southeast. The features are depicted upon the tectonic map of the area (Blackstone, 1977a; 1978; 1979).

The Sheep Mountain thrust fault along the southwest flank of the Caribou Range in Idaho trends S. 45° E. from T. 3 S., R. 41 E. in Bonneville County, Idaho, to the Idaho-Wyoming boundary just west of Afton, Wyoming, at which point the fault changes in trend to S. 10° W. and continues southward to the Meade thrust. Fold axes southwest of the Sheep Mountain - Meade fault show similar deflection in trend.

Fault traces and fold axes in the Salt River Range southeast of Afton, Wyoming (Rubey, 1973a) terminate or are deflected to a northwest trend. An extensive strike slip fault with right lateral movement extends southeastward from Afton, Wyoming, to Thompson Pass. The Absaroka and Darby thrust fault traces in particular show a marked deflection in trend in the same general area. The Star Valley Graben (Rubey, 1973a) is offset and interrupted at the Narrows about five miles north of Afton.

The Caribou range intrusive complex in T. 4 S., R. 43 E., Bonneville County, Idaho, lies along the projected line of structural discontinuity.

The writer suggests that these structural discontinuities are the result of a deep-seated upward bulge at the interface between the sedimentary cover and the Precambrian basement. This bulge is the logical northwestward extension of the

La Barge Platform beneath the thrust belt. The La Barge Platform is well defined (Plate II) where it intersects the frontal thrusts of the Wyoming salient and shows no evidence of a northwest plunge such as would be expected if the platform terminated a short distance northwest of the frontal thrust faults. The principal effect of an arch beneath the thrust belt would be to deflect the overriding plate along the steeper southwest limb of the arch.

When viewed in a regional setting, the La Barge Platform and its northwest extension is subparallel to the marked line of structural discontinuity along the southwest flank of the Gros Ventre Mountains, which is only one of many northwest trending features.

The Moxa Arch - La Barge Platform is a major structural trend that did not fracture and develop into a faulted uplift such as the Gros Ventre or Wind River Mountains. Rather than impinging upon the foreland in the fashion documented in the Hoback Basin by Dorr and others (1977), the basement-controlled arch was in part overridden and exerted an indirect influence on the positioning and upward deflection of the thrusts and folds above the major decollement.

Exploration activity within the thrust belt for oil and gas has led to a great deal of geophysical investigation. From these data, new interpretations of the structure will no doubt be made. One of the ideas presented here relative to the extent of the La Barge Platform will be tested. By such testing the science of geology moves forward.

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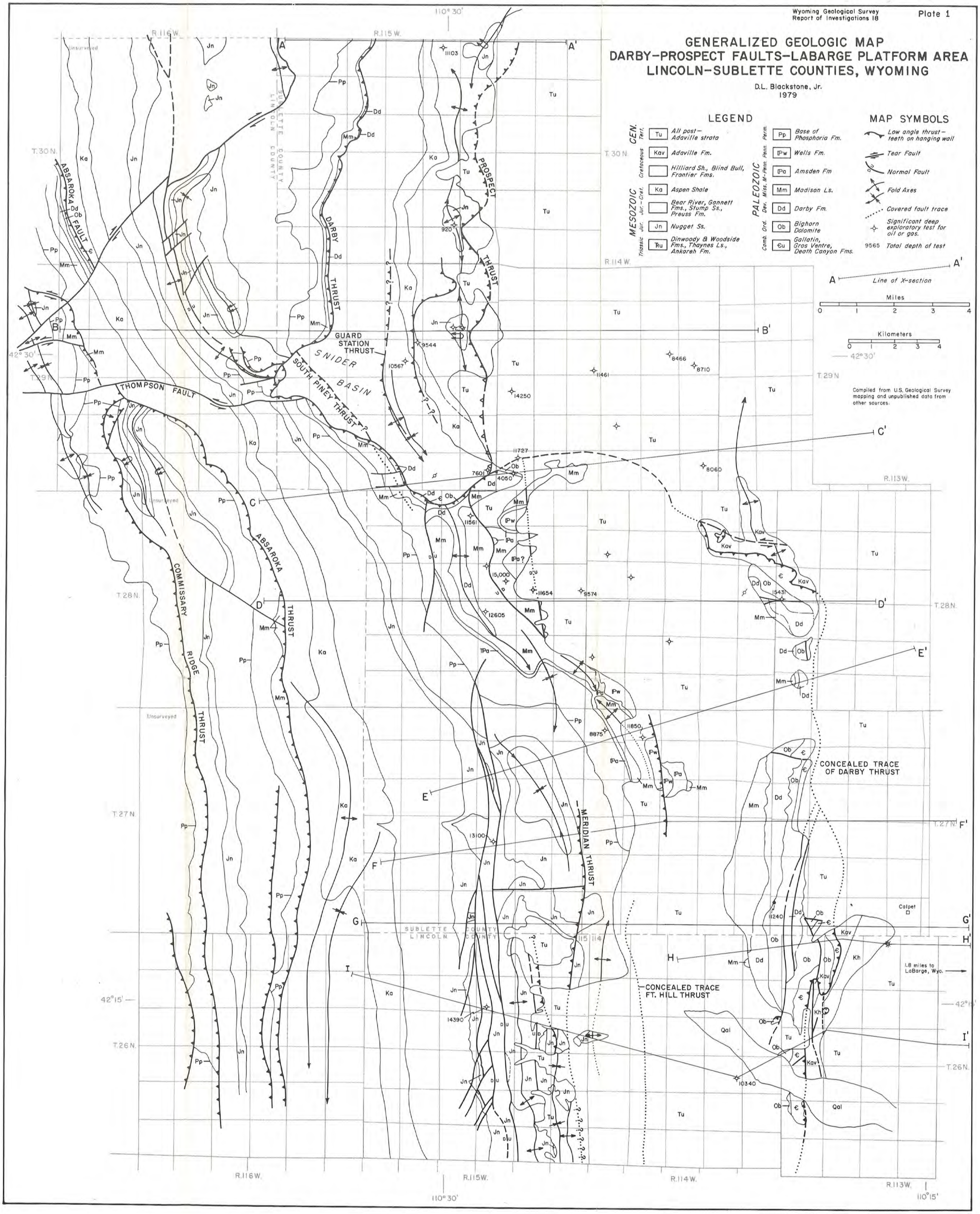

Wyoming Geological Survey
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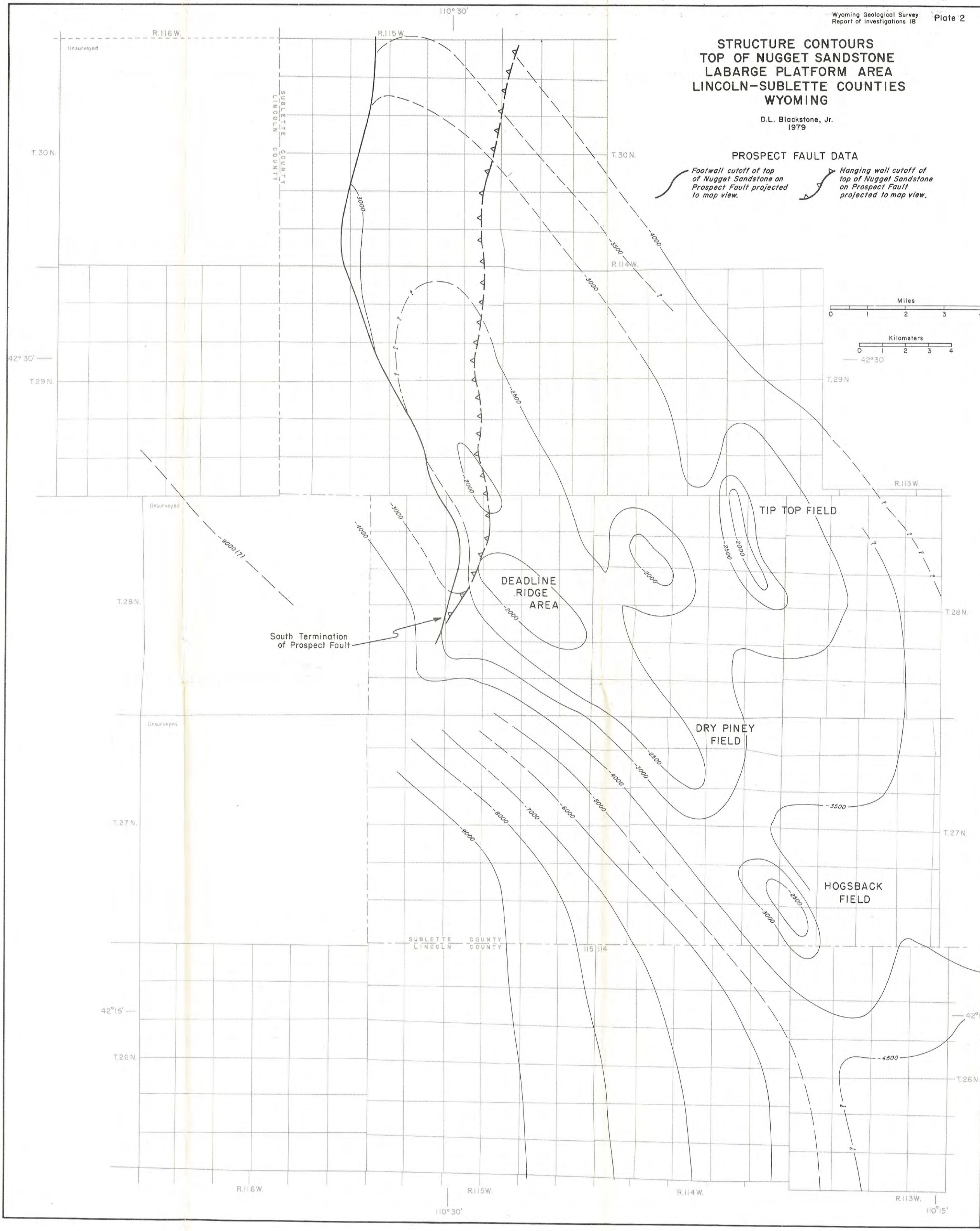
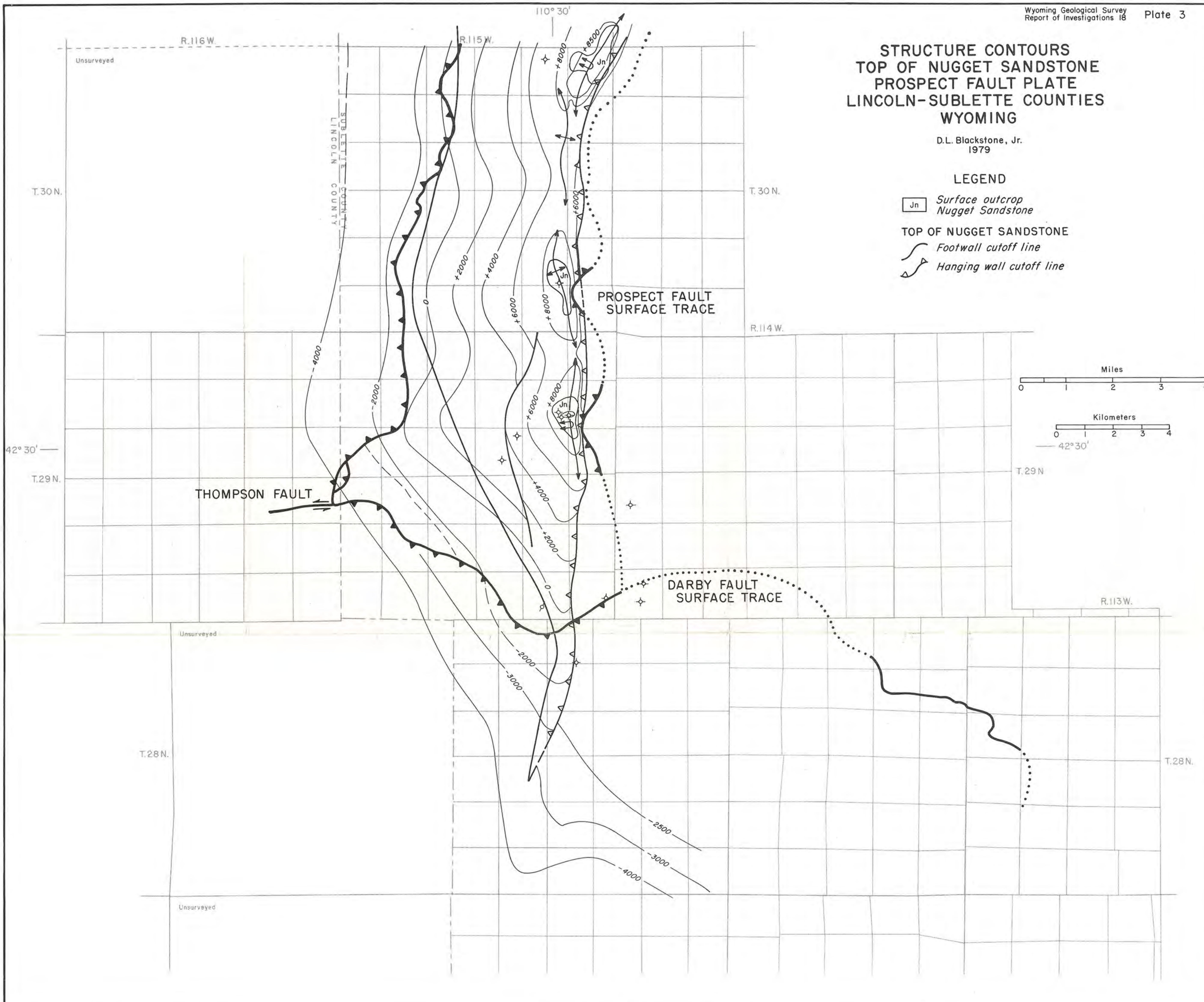
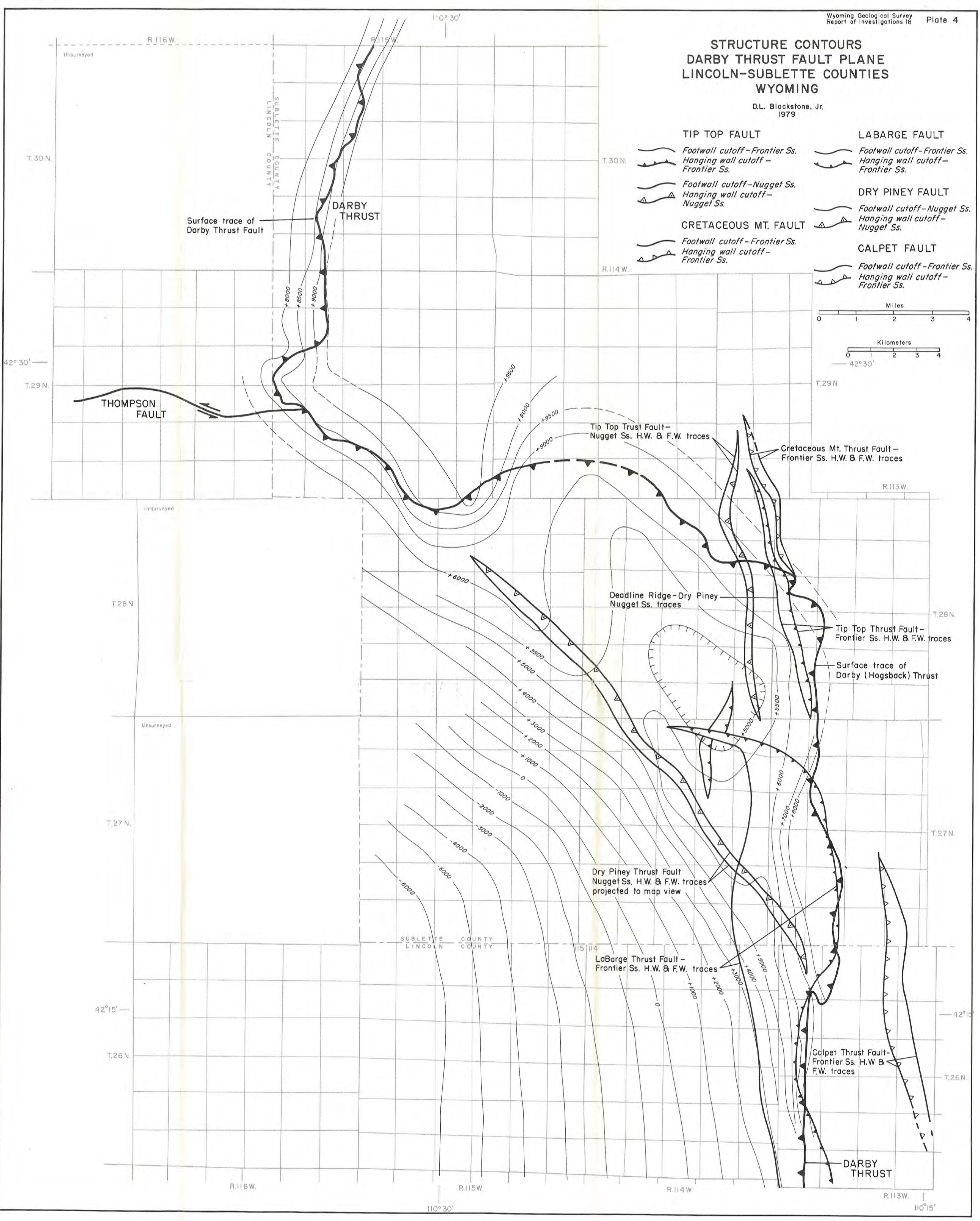
Plate 1
GENERALIZED GEOLOGIC MAP
DARBY-PROSPECT FAULTS-LABARGE PLATFORM AREA
LINCOLN-SUBLETTE COUNTIES, WYOMING
D.L. Blackstone, Jr.
1979
LEGEND
CEN. Tert.
Tu All post-Adaville strata
MESOZOIC
Cretaceous
Kav Adaville Fm.
Hilliard Sh., Blind Bull, Frontier Fms.
Ka Aspen Shale
Jur.-Cret.
Bear River, Gannett Fms., Stump Ss., Preuss Fm.
Jur.
Jn Nugget Ss.
Triassic
TRu Dinwoody & Woodside Fms., Thaynes Ls., Ankareh Fm.
PALEOZOIC
Perm.
Pp Base of Phosphoria Fm.
Penn.
IPw Wells Fm.
M-Penn.
IPa Amsden Fm
Miss.
Mm Madison Ls.
Dev.
Dd Darby Fm.
Ord.
Ob Bighorn Dolomite
Camb.
Єu Gallatin, Gros Ventre, Death Canyon Fms.
MAP SYMBOLS
Low angle thrust-teeth on hanging wall
Tear Fault
Normal Fault
Fold Axes
Covered fault trace
Significant deep exploratory test for oil or gas.
9565 Total depth of test
A A' Line of X-section
Miles
0 1 2 3 4
Kilometers
0 1 2 3 4
Compiled from U.S. Geological Survey mapping and unpublished data from other sources.
ABSAROKA FAULT
DARBY THRUST
PROSPECT THRUST
GUARD STATION THRUST
SNIDER BASIN
SOUTH PINEY THRUST
THOMPSON FAULT
ABSAROKA THRUST
COMMISSARY RIDGE THRUST
MERIDIAN THRUST
CONCEALED TRACE OF DARBY THRUST
CONCEALED TRACE FT. HILL THRUST
SUBLETTE COUNTY
LINCOLN COUNTY
1.8 miles to LaBarge, Wyo.
Calpet
Unsurveyed
R.116W.
R.115W.
R.114W.
R.113W.
T.30N.
T.29N.
T.28N.
T.27N.
T.26N.
110°30'
110°15'
42°30'
42°15'
11103
920
9544
10567
14250
11461
8466
8710
11727
7601
4050
8060
11561
15,000
11654
9574
12605
15431
8875
11850
13100
11240
14390
10340

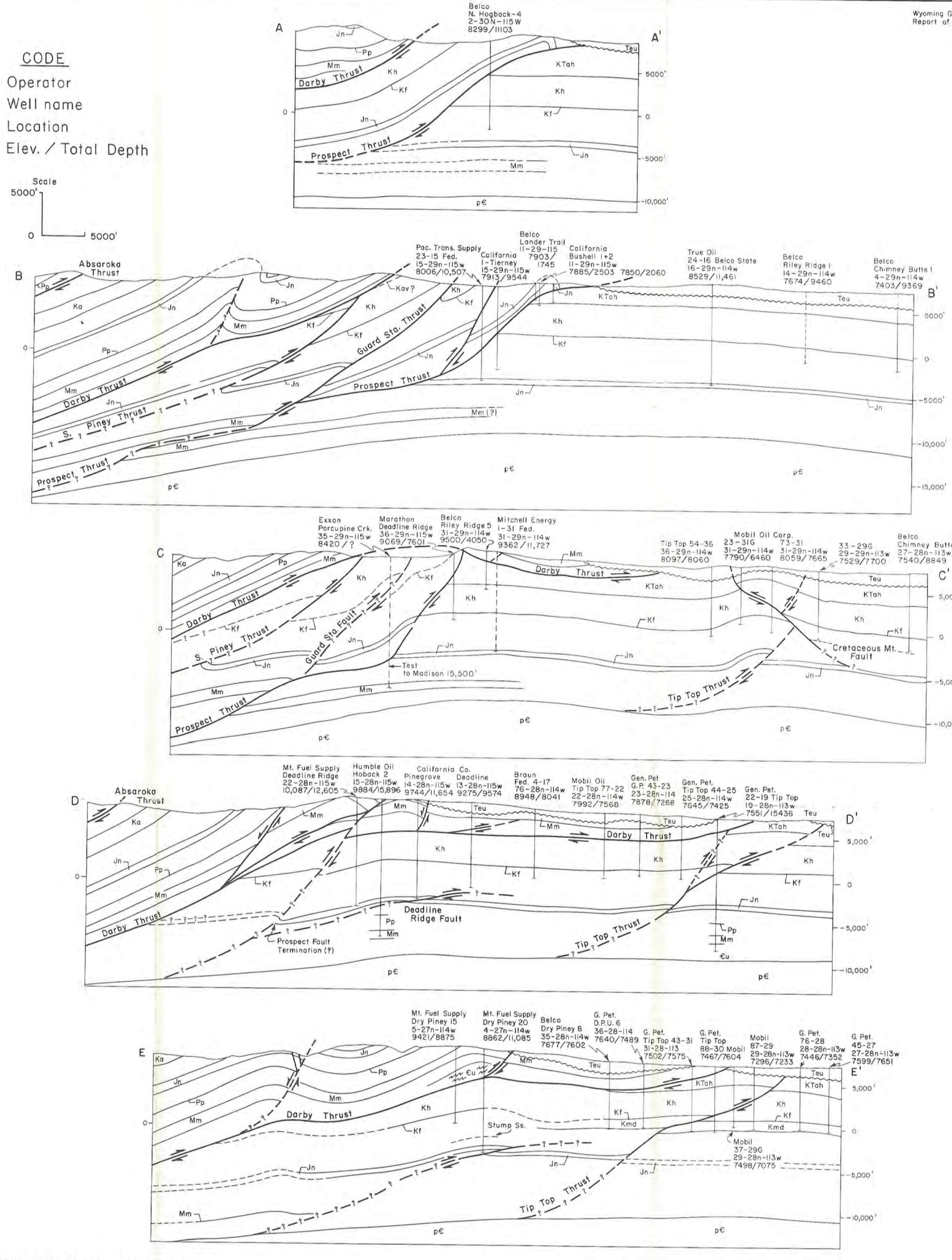


Wyoming Geological Survey
Report of Investigations 18
Plate 2
STRUCTURE CONTOURS
TOP OF NUGGET SANDSTONE
LABARGE PLATFORM AREA
LINCOLN–SUBLETTE COUNTIES
WYOMING
D.L. Blackstone, Jr.
1979
PROSPECT FAULT DATA
Footwall cutoff of top of Nugget Sandstone on Prospect Fault projected to map view.
Hanging wall cutoff of top of Nugget Sandstone on Prospect Fault projected to map view.
Miles
0 1 2 3 4
Kilometers
0 1 2 3 4
110° 30'
110°15'
42° 30'
42°15'
R.116 W.
R.115 W.
R.114 W.
R.113 W.
T.30 N.
T.29 N.
T.28 N.
T.27 N.
T.26 N.
Unsurveyed
SUBLETTE COUNTY
LINCOLN COUNTY
115 114
TIP TOP FIELD
DEADLINE RIDGE AREA
DRY PINEY FIELD
HOGSBACK FIELD
South Termination of Prospect Fault
-9000 (?)
-4500



Wyoming Geological Survey
Report of Investigations 18
Plate 3
STRUCTURE CONTOURS
TOP OF NUGGET SANDSTONE
PROSPECT FAULT PLATE
LINCOLN-SUBLETTE COUNTIES
WYOMING
D.L. Blackstone, Jr.
1979
LEGEND
Jn Surface outcrop Nugget Sandstone
TOP OF NUGGET SANDSTONE
Footwall cutoff line
Hanging wall cutoff line
Miles
0 1 2 3 4
Kilometers
0 1 2 3 4
42°30'
110° 30'
R.116W.
R.115W.
R.114W.
R.113W.
T.30N.
T.29N.
T.28N.
42° 30'
Unsurveyed
SUBLETTE COUNTY
LINCOLN COUNTY
PROSPECT FAULT
SURFACE TRACE
THOMPSON FAULT
DARBY FAULT
SURFACE TRACE
Jn
+8500
+8000
+6000
+4000
+2000
0
-2000
-2500
-3000
-4000


Wyoming Geological Survey
Report of Investigations 18
Plate 4
STRUCTURE CONTOURS
DARBY THRUST FAULT PLANE
LINCOLN-SUBLETTE COUNTIES
WYOMING
D.L. Blackstone, Jr.
1979
TIP TOP FAULT
Footwall cutoff-Frontier Ss.
Hanging wall cutoff - Frontier Ss.
Footwall cutoff-Nugget Ss.
Hanging wall cutoff - Nugget Ss.
CRETACEOUS MT. FAULT
Footwall cutoff-Frontier Ss.
Hanging wall cutoff - Frontier Ss.
LABARGE FAULT
Footwall cutoff-Frontier Ss.
Hanging wall cutoff - Frontier Ss.
DRY PINEY FAULT
Footwall cutoff-Nugget Ss.
Hanging wall cutoff - Nugget Ss.
CALPET FAULT
Footwall cutoff-Frontier Ss.
Hanging wall cutoff - Frontier Ss.
Miles
0 1 2 3 4
Kilometers
0 1 2 3 4
42°30'
110° 30'
R.116W.
R.115W.
R.114W.
R.113W.
T.30N.
T.29N.
T.28N.
T.27N.
T.26N.
42°30'
42°15'
110°15'
Unsurveyed
SUBLETTE COUNTY
LINCOLN COUNTY
Surface trace of Darby Thrust Fault
DARBY THRUST
THOMPSON FAULT
Tip Top Trust Fault - Nugget Ss. H.W. & F.W. traces
Cretaceous Mt. Thrust Fault - Frontier Ss. H.W. & F.W. traces
Deadline Ridge - Dry Piney Nugget Ss. traces
Tip Top Thrust Fault - Frontier Ss. H.W. & F.W. traces
Surface trace of Darby (Hogsback) Thrust
Dry Piney Thrust Fault Nugget Ss. H.W. & F.W. traces projected to map view
LaBarge Thrust Fault - Frontier Ss. H.W. & F.W. traces
Calpet Thrust Fault - Frontier Ss. H.W & F.W. traces
DARBY THRUST
115 114
+8000
+8500
+9000
+9500
+6000
+5500
+5000
+4000
+3000
+2000
+1000
0
-1000
-2000
-3000
-4000
-5000
-6000
+7000
+3000



LEGEND—Plates 5 & 6—Structural Cross Sections
See TABLE I for Stratigraphic Section

PALEOZOIC MESOZOIC
- Jur. Cret. — Ka — Aspen Shale
- Jn — Nugget Ss.
- Pp — Phosphoria - Top of unit
- Mm — Madison Ls.
- €u — Cambrian undivided
- p€ — Crystalline basement

MESOZOIC CENOZOIC
- Eoc. — Teu — Eocene undivided
- Cret.-P. — KTah — Hoback Formation (Th) Adaville Formation (Kav)
- Cretaceous — Kh — Hilliard Shale
- Kf — Top First Frontier Ss.
- Kmd — "Muddy" Sandstone

CROSS SECTIONS

to accompany

Fault Geometry of the Prospect-Darby and LaBarge Faults at the Junction with LaBarge Platform, Lincoln & Sublette Co's., Wyoming

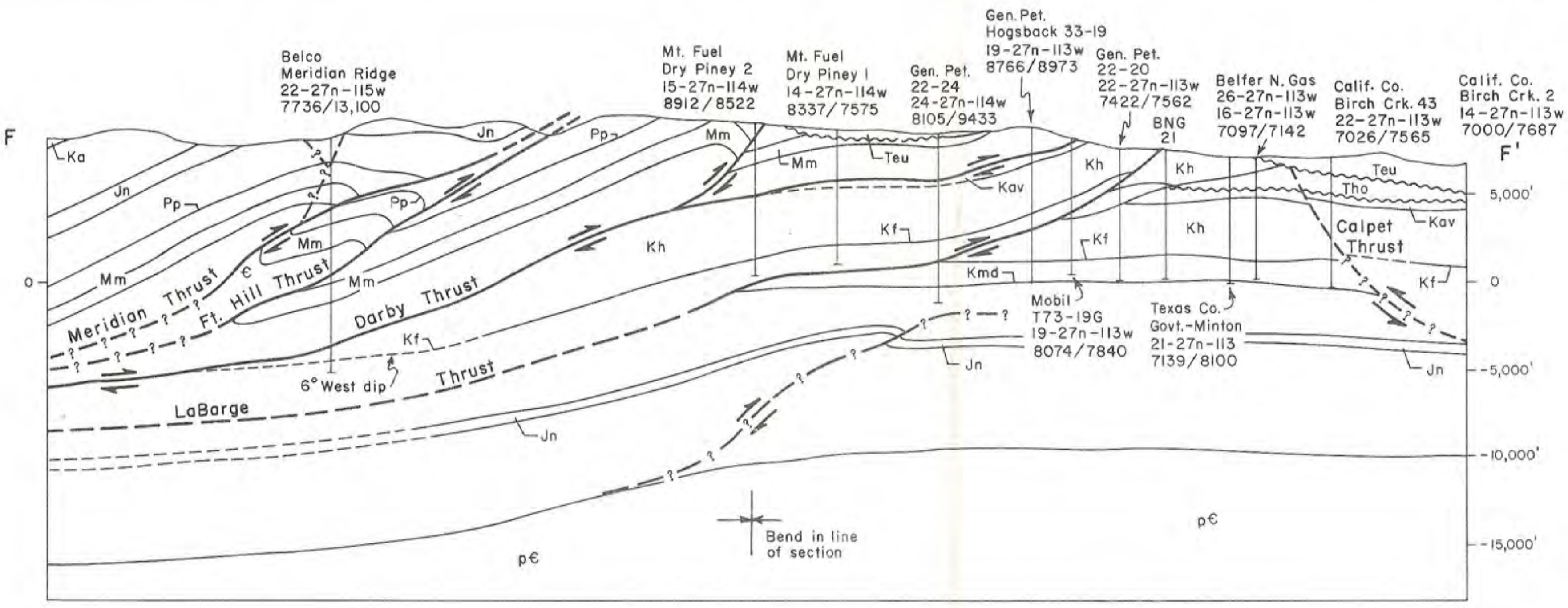
D.L. Blackstone, Jr.
1979

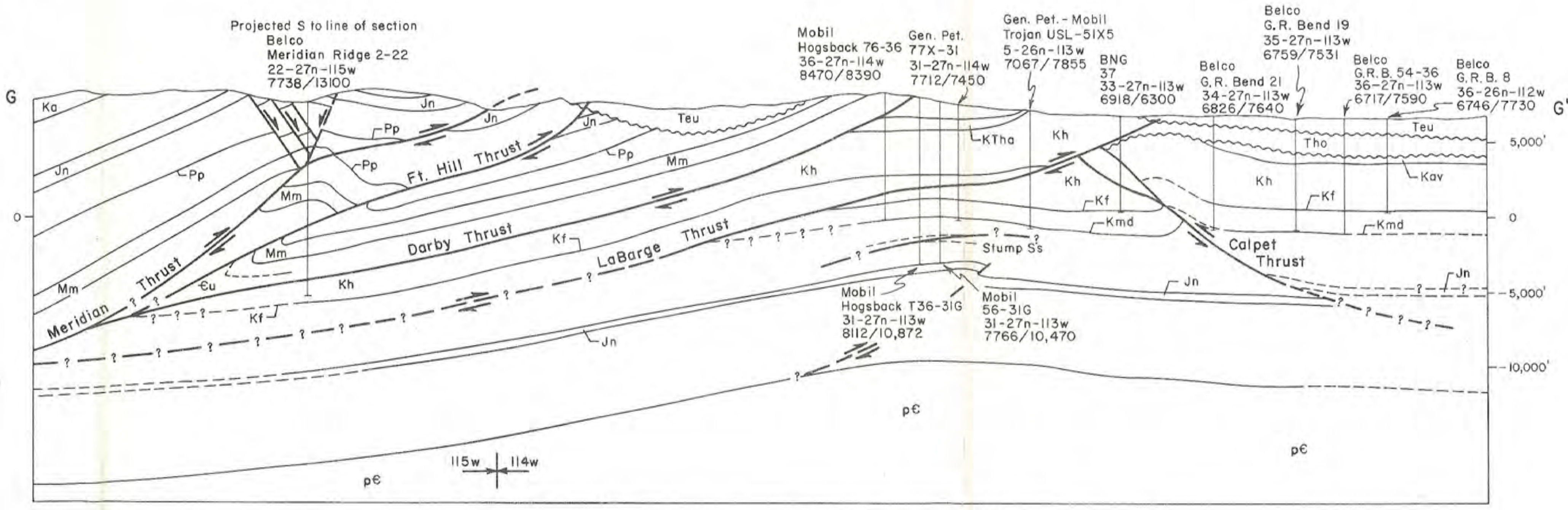
CODE

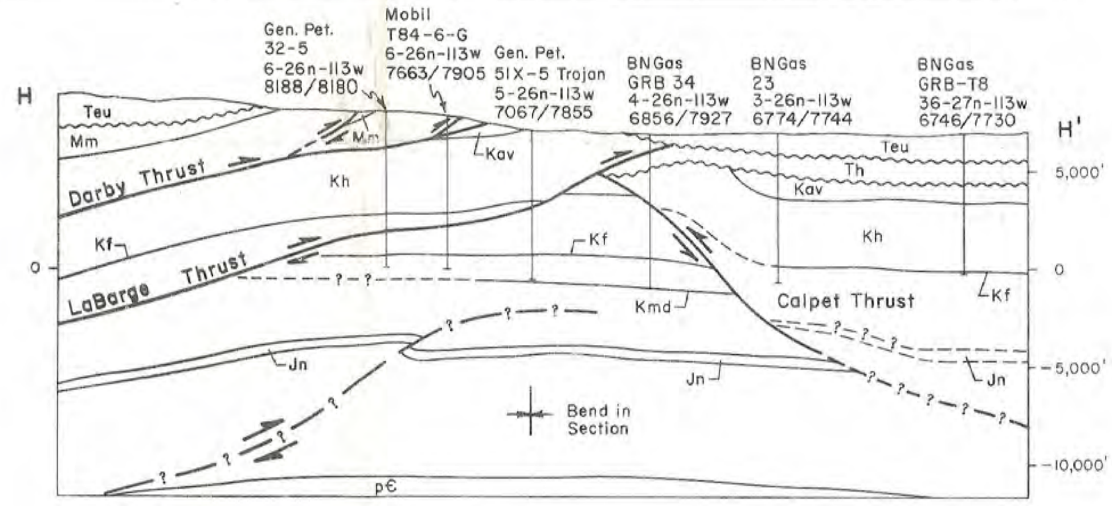
Operator
Well name
Location
Elev. / Total Depth

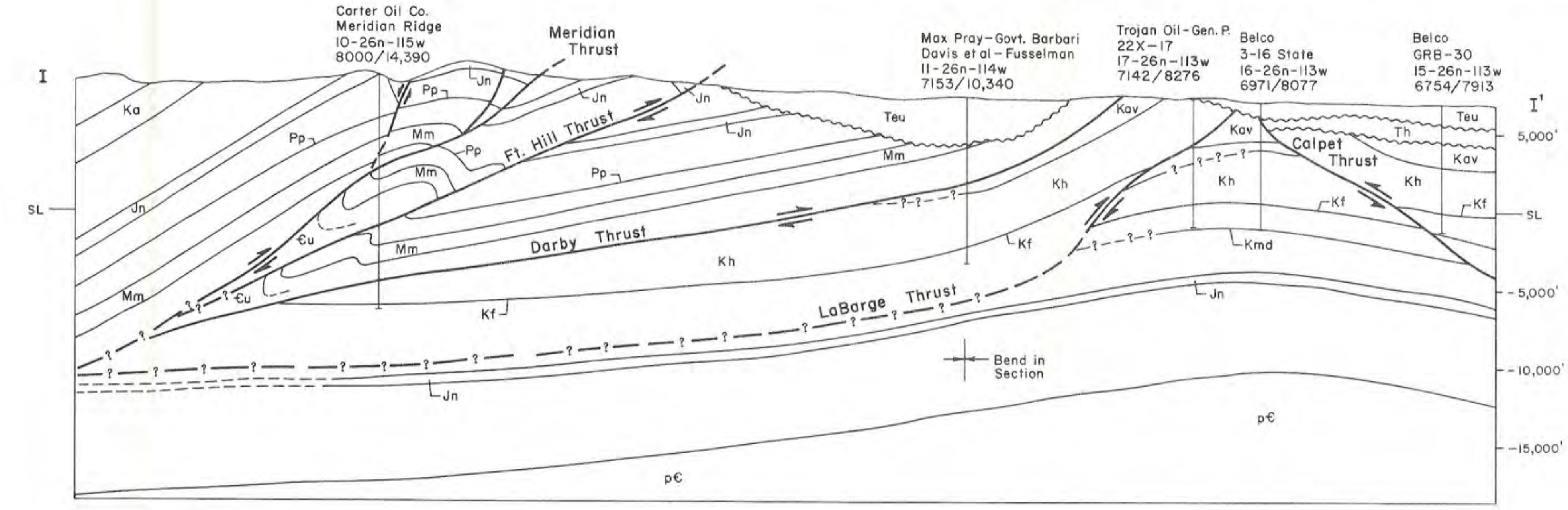
Scale
5000'
0 5000'

FORMATION LEGEND
ON PLATE 5









CROSS SECTIONS

to accompany

Fault Geometry of the Prospect-Darby and LaBarge Faults at the Junction with LaBarge Platform, Lincoln & Sublette Co's., Wyoming

D. L. Blackstone, Jr.
1979