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Fracture Data for the Divide Creek and Wolf Creek Anticlines Area, Southern Piceance Basin, Northwestern Colorado

by

Marilyn A. Grout[1]

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[1]Box 25046, MS 913, Federal Center, Denver CO 80225

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ABSTRACT

Data on field-observed characteristics of joints in Upper Cretaceous through Eocene strata on two thrust-related intrabasin folds, the Divide Creek and Wolf Creek anticlines in the southern Piceance basin, Colorado, are presented in this report. These data form part of a larger study, involving more than 900 localities, of the fracture history of the Piceance basin and surrounding uplifts. The data for the 51 stations are presented in tabular form in the Appendix; included is much information on the multiple physical and spatial fracture characteristics that collectively permitted grouping the fractures into genetic sets for purposes of reconstructing the regional fracture history.

INTRODUCTION

The Divide Creek and Wolf Creek anticlines (fig. 1) contain the principal natural-gas producing fields in the southern part of the Piceance basin, northwestern Colorado. Anticlinal structure, however, apparently has had limited effect on accumulation of hydrocarbons within the producing horizons since commercial gas is found also in areas with no obvious structural traps (Gunter, 1962). For the purposes of this report, this economically important area is considered to include not only the above-mentioned fields but also the Buzzard Creek, Sheep Creek, Hell's Gulch, and Baldy Creek gas fields (fig. 1). The producing horizons are chiefly marginal-marine blanket sandstones associated with mudstones, shales, and coals of the Upper Cretaceous Mesaverde Group; most of the gas is produced from depths of approximately 760-2280 m (Dunn, 1974; Donaldson and MacMillan, 1980). Unfractured sandstone plugs from the reservoir rocks generally have very low matrix permeabilities, from 0.01 to 0.40 microdarcies (Branagan and others, 1984; Seccombe and Decker, 1986). Formation (in-situ) permeabilities, however, range from 20 to 100 microdarcies (Branagan and others, 1985; Lorenz and others, 1986). This large difference between laboratory- and field-tested permeabilities has been attributed to a partially open, three-dimensional system of interconnected fractures in the reservoir rocks. Economic production of natural gas is so dependent on fractures in these and numerous other fields of the western United States that systematic efforts are underway to determine the extent to which the geometry of subsurface fracture networks can be predicted from surface studies.

The Piceance basin fracture study by the U.S. Geological Survey has involved the collection of fracture data from more than 900 outcrops and man-made cuts in the Piceance basin and surrounding uplifts, in strata that range in age from Precambrian through Quaternary. Of these, about 750 stations are in the Upper Cretaceous through Eocene rocks of the Mesaverde Group and overlying Wasatch, Green River, and Uinta Formations. Reports on the fracture history of the basin, other than the Divide Creek-Wolf Creek area, can be found in Grout and Verbeek (1983, 1985) and Verbeek and Grout (1983, 1984a, b, 1986, 1987). The field-observed characteristics of fractures in outcrop on the Divide Creek and Wolf Creek anticlines were used to interpret the fracture history of the area in relation to its tectonic history as discussed in Grout (in press). The tectonic history of the anticlines is related to thrusting along the eastern basin margin, part of the Laramide (Late Cretaceous through Eocene) orogenic boundary between the Colorado Plateau and the Rocky Mountain foreland, and is discussed in Grout and others (1988, in press).

OTHER FRACTURE STUDIES IN THE PICEANCE BASIN

Other fracture studies in the Piceance basin include those of Smith and Whitney (1979), who mapped orientations of fractures from both outcrop study and aerial photographic interpretation; Kelley and Clinton (1960) and Welder (1971), who mapped fracture patterns from aerial photographs; and Clark (1983), who studied fractures in outcrop and in core to interpret aspects of late Cenozoic stress history of the southeastern part of the basin. Mineral fillings and orientations of fractures in oriented cores from Mesaverde Group strata were discussed by Lorenz (1985), Pitman and Sprunt (1986), Lorenz and Finley (1987), and Finley and Lorenz (1989). The orientations of cleats (major and minor fractures) in coal beds of the Mesaverde Group along the southern rim of the Piceance basin were discussed by Geological Services of Tulsa, Inc. (1980) and Boreck and Strever (1980). The orientations of coal cleats in cores from correlative strata in the west-central part of the basin were reported by Seccombe and Decker (1986) and Horner (1986). Studies of the surface pattern of joints within the Grand Hogback monocline include those of Harper (1966), Murray (1966; 1967), Dula (1981), and Garrett and Lorenz (1989). In addition, there are several unpublished industry reports on the orientations of surface fractures. With the exception of the studies by Lorenz and his colleagues and by Verbeek and Grout (mentioned in the previous section), generally only one aspect of fractures was measured--their orientation.

FRACTURE STATIONS IN THE STUDY AREA

This report contains data on field-observed characteristics of fractures studied at 51 fracture stations in Mesaverde and Wasatch rocks in the Divide Creek-Wolf Creek anticlines area (fig. 1). Forty three of the fracture stations are located in the Wasatch Formation, which crops out on the flanks of the anticlines and in surrounding areas; six are located in the Mesaverde Group along the crest of the Divide Creek fold. Of the two remaining stations, one is in Tertiary intrusive rocks (Tmi on fig. 1) that crop out on the southern end of the Divide Creek anticline; the other is in slightly metamorphosed Wasatch sandstone near the intrusion. The data from these stations are tabulated in the Appendix and augment two other reports on the structure of the area: the first, Grout (in press), summarizes the fracture data and interprets the fracture history of the rocks of the Divide Creek and Wolf Creek anticlines in relation to tectonic development of the basin's eastern margin; the second, Grout and others (in press), interprets the subsurface structure and formation of the anticlines in light of new gravity (Abrams and Grout, 1987, 1990) and seismic data.

FRACTURE TERMINOLOGY

In this report, fracture is used as a general term to denote all internal rock surfaces across which cohesion has been lost through mechanical failure induced by differential stress. Fractures along which appreciable shear displacement has occurred--from a few cm to km (Bates and Jackson, 1980)--are termed faults, whereas fractures associated with significant amounts of movement normal to the fracture walls are perhaps best termed fissures, in keeping with common English usage. All other fractures--those associated with little or no displacement in any direction--are termed joints.

The various terms as defined above are nongenetic and imply nothing about mechanisms of fracture. A fault, for example, is not synonymous with a shear fracture, nor a joint with an extension fracture, though the mistake commonly is made. Although many faults in the Piceance basin can be shown to have originated as shear fractures, others are extension fractures that subsequently were reactivated in shear. Both types of structure conform to

historic definitions of "fault" (see Dennis, 1967). Similarly, joints apparently can initiate either as extension or shear fractures but are termed joints in either case if the net offset is very small. Fault, joint, and fissure, then, are field terms whose usage, as established through long precedent, is based on observed amounts and senses of offset. Shear fracture, extension fracture, and related expressions are rock-mechanical terms that denote genetic types of fractures formed through specific mechanisms of failure. Where the mode of failure of a particular fracture has been determined, an appropriate modifier conveys that fact, as in extension joint.

Of the various types of fracture mentioned above, extension joints are by far the most plentiful in the Piceance basin, the study area included. Most occur in sets, a term used to denote groups of parallel to subparallel joints (Dennis, 1967) whose common orientation generally (though not necessarily) reflects a common genesis. Two to four sets of joints cut most outcrops on and near the Divide Creek and Wolf Creek anticlines and collectively define the joint or fracture system of the area.

FRACTURE NOTATION

Sets of fractures have been given the designation F_X or MV_X to agree with the notation established earlier for the northern and central parts of the basin (Verbeek and Grout, 1983, 1984a). F_X refers to all fractures that formed during the X^{th} period of fracture in the basin, from F_1 (oldest) to F_5 (youngest), and with which the sets in the vicinity of the Divide Creek and Wolf Creek anticlines can be correlated (Grout, in press). These sets comprise the Piceance system of fractures and have been found in basin and pre-basin rocks ranging in age from Upper Cretaceous to middle Eocene (Verbeek and Grout, 1983, 1984a, b, 1986, 1987; Grout and Verbeek, 1983, 1985). Older sets of fractures, collectively termed the Hogback system, have been found only in pre-basin rocks ranging in age from Mississippian through Paleocene along the Grand Hogback monocline (Verbeek and Grout, 1984a, b). Because these older fracture sets are found mostly in strata of the Mesaverde Group, they are designated as the MV_X sets; only the MV_2 set, the youngest, is found in the study area. The other data for the Grand Hogback are as yet unpublished.

One additional feature of the fracture notation deserves mention here. In many outcrops, fractures of the F_2 period, to select a common example, are nearly vertical in well-cemented beds but are inclined at 60°-70° in associated, more weakly cemented beds. In some beds the F_2 form not one but two sets of inclined fractures that have similar strikes but that dip in opposite directions, thereby dividing the rock into diamond-shaped blocks. Abutting relations and mineralization histories of these fractures suggest that they are all at least roughly contemporaneous and thus formed during the same (F_2) period of fracture in the basin. To convey these relations, we refer to the two sets of moderately steeply dipping fractures as F_{2A} and F_{2B}, and to the vertical fractures as F_{2C}. In many outcrops the distinction between the three sets is clear and the orientation data do not overlap, but in some areas the sets appear to be gradational. A similar notation is employed where appropriate for other periods of fracture. The origin of these related fractures is to some extent problematical and will be addressed in later papers. Grout (in press) found that some of the moderately steeply dipping fractures are local and present only in the crestal region of the Divide Creek anticline.

FIELD METHODS

Joints in the Divide and Wolf Creek areas have been grouped into genetic sets, not simply into geometric sets based on orientation. The difference is

fundamental to accurate interpretations of fracture history. Although geometric and genetic sets often are equivalent--common orientation implies common genesis--exceptions are known and probably are not rare. The F_2 and F_5 sets in the basin, for example, have nearly identical orientations but differ markedly in all other observed characteristics, such as size, shape, age relative to other fractures, and mineralization history. In this case a single geometric set is the combined expression of two discrete periods of fracture widely separated in time. All joint data presented in this report are grouped into genetic sets.

Field methods used for the collection of fracture data in the Piceance basin, including the study area, have been described in Grout and Verbeek (1983). At each locality, and within all beds studied, only the largest and most planar fractures of each set were selected for orientation measurements, as it is these that most accurately reflect paleostress orientations as they existed immediately prior to fracture. The later members of each set formed in increasingly anisotropic rock and thus reflect local, discontinuity-related stress perturbations to a greater degree than their predecessors; these later fractures tend to be both more irregular and shorter than those formed earlier. For all fracture properties other than orientation, however, all fractures present were studied to document the characteristics of each set as a whole. If at any station the bedding dip exceeds about 6° and evidence exists that the joints predate the bed rotation, the poles to the fracture planes were rotated around the strike of the bedding to reconstruct the original bed-horizontal orientation of the joints. If the beds are tilted but the joints are known to have formed later, there is no reason to rotate the joint data.

The manner in which the fractures of coexisting sets terminate within the rock is the prime information from which the relative ages of the sets can be determined. Fractures of the earliest set commonly die out laterally as tapering hairline cracks because no earlier fractures existed to impede lateral growth. Fractures of successively younger sets, if they are extension joints as in the study area, abut all older fractures unless those older fractures have been cemented and the rock rehealed. Younger extension joints, then, either terminate against or cut across older ones, depending on the degree of cohesion between the walls of each older fracture. Conversely, younger shear fractures generally cut across and offset older fractures; and for these, the conventional rules for determining relative ages of intersecting faults apply. Fuller discussions of relative-age criteria are found in Kulander and others (1979) and Grout and Verbeek (1983).

The mode of failure--by extension or shear--is most directly and rigorously determined through observation of the detailed structure of the fracture surface. Kulander and others (1979) summarize much of the available data on this topic, known as fractography. Surface structures such as twist-hackle fringes, plumose structure, and arrest lines are common among fractures in the study area and are diagnostic of failure in extension. In contrast, slickenside striations--either as true scratches on the fracture surface or as fibrous mineral coatings--indicate slip parallel to the striation direction. Such slip, however, must not be taken as proof of a shear mechanism of failure. More commonly the shear is secondary and indicates renewed movement along an original extension fracture.

Fracture-surface structures also indicate the direction that the fracture propagated. In the Divide and Wolf Creek areas, the fractures in all of the sets propagated laterally, parallel to bedding, while maintaining a vertical to moderately steeply dipping profile.

DATA-SHEET TERMINOLOGY

Station Number--An identification number given to each station where data were

collected, keyed to the map of the study area (fig. 1). Identification numbers such as 580a and 580b refer to separate data sets gathered from different rock types at the same locality. All fracture stations in the Piceance basin and adjacent uplifts are numbered in the order in which they were studied. The Divide Creek and Wolf Creek areas contain only 51 of the more than 900 stations studied.

Twp, Range, Section--A shorthand notation is used in the data tables to indicate station location. For example, T9S, R90W, NW1/4 sec 1 = Township 9 South, Range 90 West, northwest quarter of section 1.

Exposure description--Includes information on exposure elevation, facing direction, size, topography, location relative to nearby physiographic and cultural features, and exposed rock types. Abbreviations used: SH = State Highway, FR = Forest Road, FS = Forest Service.

Stratigraphic Unit--Formal map name of rock group, formation, or member (from Tweto and others, 1978) where data were collected.

Lithology (General)--General rock type(s) of the specific bed(s) within which the majority of data were collected, including obvious facies changes.

> **Cement**--Brief description of nature of cement and estimated degree of induration of rock, based on field inspection with hand lens and HCl acid.
>
> **Color, fresh**--Informal field color of a freshly broken, dry piece of rock.
>
> **Color, weathered**--Informal field color of the outer, weathered surface of naturally exposed rock.
>
> **Grain size, sorting, and roundness**--Grain characteristics as observed with a hand lens in the field.

Bed orientation and thickness--The average orientation of the strata at each exposure and the thickness(es) of the bed(s) studied.

F_x or MV_x Orientation--The average orientation of the fractures in each set as determined visually from Schmidt-stereonet plots of the poles to their planes. The number of fractures measured in each set (n = x) is given also. Note that if there are less than n = 4 data points for a given set, the average should not be considered meaningful. For stations where the poles to joints in dipping beds have been rotated to reconstruct their original, bed-horizontal orientations, the rotated average is indicated by (R). For each station, however, it is the actual (unrotated) data that are listed and that are displayed on the lower-hemisphere Schmidt stereonet projections.

Spacing--The perpendicular distance between adjacent fractures of the same set within the measured bed(s). The data may be given as any one or a combination of several measures of spacing: total range (tr) refers to the observed maximum and minimum spacings, common (or partial) range (cr) to the most frequently observed spacings, and average (avg) to the mean spacing. Spacings of fractures in some beds define such broad, skewed, and irregular distributions that the concept of an average spacing has little merit, and the total range gives little clue as to what constitutes "normal" or "common" values. For such beds the common range is the most informative measure of spacing, though it corresponds to no rigorously defined statistic. The data in any case should be viewed as only semiquantitative: they are meant to convey an informal impression of joint abundance as based on a limited number of readings, and are not intended as accurate descriptors of the shapes of the actual frequency distributions of spacings.

Height--The dimension of a fracture as measured perpendicular to its length (see below) and within the plane of the fracture. If only partial heights were observable, then the symbol > is used. The data may also be given as any one or a combination of several measures of height: total range (tr) refers to the observed maximum and minimum heights, common (or partial) range (cr) to the most frequently observed heights, and average (avg) to the mean height.

Length--The dimension of a fracture as measured parallel to bedding. If only partial lengths were observable, then the symbol > is used. The data may also be given as any one or a combination of several measures of length: total range (tr) refers to the observed maximum and minimum lengths, common (or partial) range (cr) to the most frequently observed lengths, and average (avg) to the mean length.

Structures--Structures on the walls of fractures can be grouped into two general types: (1) those that resulted from the progressive advance of an extension-fracture front through previously intact rock, such as the fracture origin, plumose structures (or plumes), arrest lines, and twist-hackle faces and associated steps (collectively termed twist hackle or twist-hackle fringe); and (2) those that indicate slip between the fracture walls, such as slickenlines scratched on the rock surface, or fibrous to platy or columnar mineral coatings. Structures of both groups locally are seen in combination, as where an extension fracture has been later reactivated in shear.

Shape--The overall configuration of the fracture surface, regardless of its size. Three general categories are recognized: planar, subplanar, and nonplanar. Also included are comments on additional shape characteristics, such as sinuosity along strike, hooking into adjacent fractures, deviation in dip in different beds, and forking, the splitting of fractures into separate segments along lithologic discontinuities.

Termination--The manner in which the individual fractures of a given set terminate within the rock. Common types include gradual tapering of hairline cracks to zero aperture, lateral terminations against other fractures, and vertical terminations against lithologic discontinuities (bedding) or bed-parallel partings. From such information the order in which the various sets formed can be determined.

Mineralization--A brief description of the identity and character of various minerals, if any, that fill or coat the joints of each set.

Remarks--A brief summary of the most pertinent characteristics of each fracture set plus additional information unsuitable for list format.

Geologist(s)--The personnel responsible for data collection in the field, listed for each station in order of responsibility. MAG, Marilyn A. Grout; DBY, Douglas B. Yager; CWJ, Caren W. Johannes; REM, Ruth E. M'Gonigle.

Data Date--Date(s) of visitation to exposure for data collection.

EXPLANATION OF DATA FORMAT

The fracture data in the Appendix are listed in tabular format, from oldest to youngest set, for each station in the Divide Creek-Wolf Creek area. The data have also been entered into a computer database program (dBase III Plus, Ashton-Tate Version 1.1, 1985, 1986) to allow sorting from each "field" or line of information. Sorting can be either from a character string--a sequence of letters, numbers, and symbols--or more readily from numeric fields that contain only numbers. Most of the data as shown in the Appendix are in character strings, so additional fields (not printed) were set up to express some of the same information in numeric form to facilitate sorting of the most

commonly used pieces of information. For example, a common spacing range of 1-2 m is stored as 1.5 in the computer database but appears as 1-2 m on the data-sheet printout. Then, if a search is made for, say, all stations containing sandstone layers 2-4 m thick with joint spacings of >1.5 m, these data can quickly be sorted and listed.

The actual (unrotated) fracture-orientation data collected at each station in the field are plotted on lower-hemisphere Schmidt stereonet projections using the MicroNET program of Guth (1987) and immediately follow the tabulated data for each station in the Appendix.

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Figure 1--Generalized geologic map of the Divide Creek and Wolf Creek anticlines and part of the southern leg of the Grand Hogback monocline, southern Piceance basin, Colorado, showing location of fracture stations (numbered solid circles) and approximate outline of gas fields (shaded). The fracture data for the numbered stations are listed in numerical order in the Appendix. normal fault, bar and ball on downthrown side. inferred zone of blind splays form low-dip reverse fault; sawteeth on upper plate. anticline. syncline. monocline. Tbb, Pliocene and Miocene basalt; Tmi, Middle Tertiary intrusive rocks; Tg, Tertiary Green River Formation; Tw, Tertiary Wasatch Formation; Kmv, Upper Cretaceous Mesaverde Group; Kmu, upper part of Upper Cretaceous Mancos Shale; KTru, lower part of Upper Cretaceous Mancos Shale through Upper Triassic Chinle Formation, undifferentiated; PPm, Lower Permian and Pennsylvanian Maroon Formation; Pe, Middle Pennsylvanian Eagle Valley Formation. Geology from Tweto and others (1978), Berry (1959), and Tichy and Rettger (1961), and Johnson (1983). Gas-fields from Petroleum Information Corp. and Barlow and Haun, Inc. (1986).

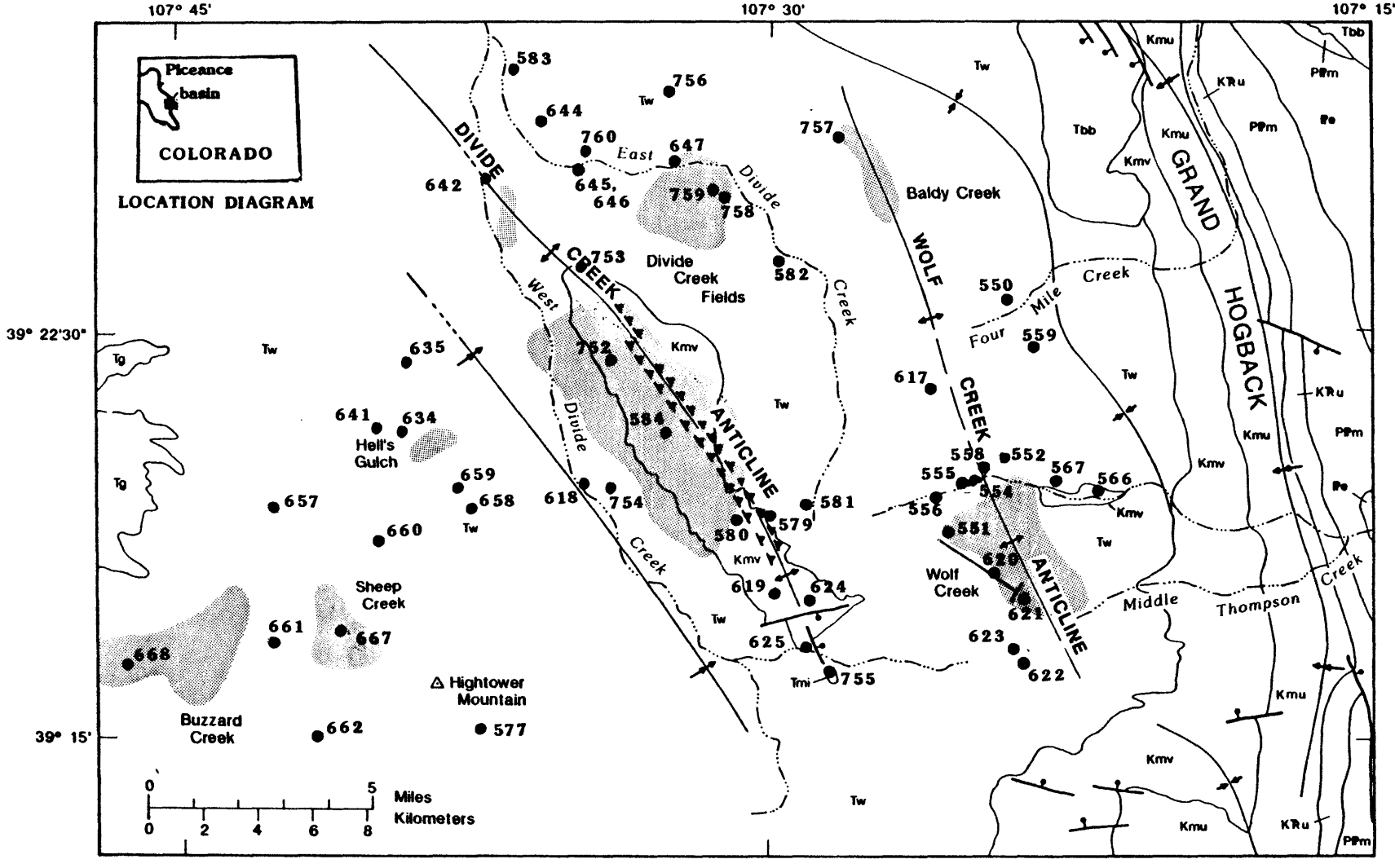

107° 45'
107° 30'
107° 15'
39° 22'30"
39° 15'
Piceance basin
COLORADO
LOCATION DIAGRAM
DIVIDE
CREEK
West Divide Creek
East Divide Creek
Divide Creek Fields
Baldy Creek
WOLF CREEK ANTICLINE
Wolf Creek
GRAND HOGBACK
Four Mile Creek
Middle Thompson Creek
Hell's Gulch
Sheep Creek
Buzzard Creek
Hightower Mountain
583
644
756
760
647
757
642
645, 646
759
758
753
582
550
752
635
559
617
641
634
584
659
658
657
618
754
581
579
660
580
619
624
625
755
623
622
621
620
558
552
555
554
567
566
556
551
661
667
668
662
577
0 5 Miles
0 2 4 6 8 Kilometers
Tw
Tg
Kmv
Kmu
Tbb
Tmi
KTru
Pfm
Pe

Figure 1

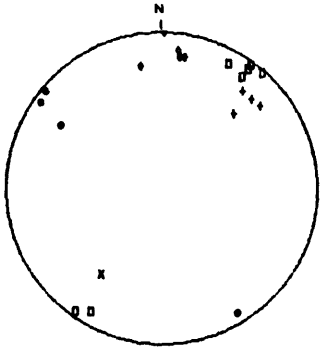
APPENDIX

FRACTURE DATA

Station Number	550
Quadrangle	Center Mountain 7.5'
Twp, Range, Section	T8S, R90W, NE1/4 SW1/4 NW1/4 NW1/4 sec 1
Exposure Description	Elev. 8970 ft. S-facing slump scar, NW side Four Mile Creek and Park, S side of small knoll in a SSE-draining tributary, 0.5 km upstream. 15 m h x 20 m l. Low-angle crossbedded to laminated; locally massive and conglomeratic. Luster mottled.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Very calcareous; well indurated
Color, fresh	Dark maroonish red
Color, weathered	Maroonish red
Grain size	Very fine to coarse medium-grained
Grain sorting	Moderately to poorly sorted
Grain roundness	Subrounded to angular
Bed Orientation	N56W/14NE (n=2)
Bed Thickness	0.25-1.5 m
F2A Orientation	N45W/68SW (n=4)
Spacing	1.5 m (avg)
Height	>1.5 m
Length	Not determined
Structures	Coarse plumose structure
Shape	Planar
Termination	None seen
Mineralization	None seen
F2B Orientation	N55W/57NE (n=1)
F2C Orientation	N54W/88SW (n=7)
Spacing	0.05-0.15 m
Height	0.25-1.5 m
Length	Not determined
Structures	Coarse plumose structure
Shape	Planar
Termination	Against F2A
Mineralization	None seen
F3C Orientation	N85W/76SW (n=5)
Spacing	Variable
Height	0.25->1 m
Length	>1.5 m
Structures	Not determined
Shape	Subplanar
Termination	None seen
Mineralization	None seen
F4 Orientation	N35E/85SE (n=4)
Spacing	Variable
Height	0.25-1 m
Length	0.05-1.5 m (tr)
Structures	Weathered
Shape	Subplanar; undulatory in both strike and dip
Termination	Against F2 and F3
Mineralization	None seen

Station Number	550 (contd)
Remarks	The SW-dipping F2A fractures dominate the cut and are fairly planar. Only one NE-dipping F2B fracture occurs. The F2C fractures are prominent in the finer grained layers, but also occur between the F2A fractures in the coarser grained beds. The F3 fractures are oriented WNW, similar to many F2 fractures in other outcrops, but abut the F2 fractures here. They therefore are designated as F3 fractures. F4 fractures are layer confined, nonplanar and broadly curved. The outcrop weathers to rounded ledges.
Geologist(s)	MAG, CWJ
Data Date	05/29/85

n = 21



♦ F2A n = 4
▪ F2B n = 1
● F2C n = 7
♦ F3C n = 5
● F4 n = 4

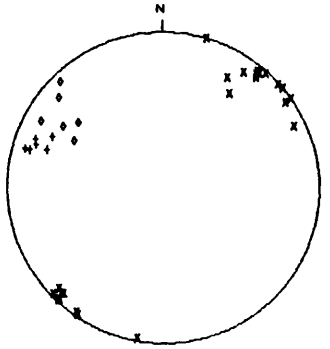
Schmidt net, lower hemisphere projection

550F2A	550F2B	550F2C	550F3C	550F4
N40W71SW	N55W57NE	N60W80NE	N80E68SE	N59E83NW
N45W70SW		N55W86NE	N89W90SW	N32E66SE
N50W70SW		N54W77SW	N82W74SW	N40E87SE
N46W56SW		N54W88SW	N80W74SW	N35E85SE
		N54W84SW	N83W78SW	
		N62W80SW		
		N49W88SW		

Station Number	551
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T8S, R90W, NE1/4 SW1/4 NE1/4 SW1/4 sec 34
Exposure Description	Elev. 9480 ft. Roadcut, W side FS Rd. 300, 1.15 km S of Baylor Park and 0.55 km S of Wolf Creek and Gasco No. 3; ~150 m long x 10 m high. ESE-facing sandstone ledge, discontinuously exposed for ~50 m; 2-5 m thick. Massive-appearing; locally, very low-angle crossbedded; rip-up clasts.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone
Cement	Siliceous; moderately friable to well indurated
Color, fresh	Light tan
Color, weathered	Light tan; local Fe oxide stains and concretions
Grain size	Medium to coarse grained
Grain sorting	Fairly poorly sorted
Grain roundness	Subangular to subrounded
Bed Orientation	Subhorizontal
Bed Thickness	0.1-3 m
MV2 Orientation	N17E/77SE (n=6)
Spacing	1.5
Height	1-3 m
Length	8-10 m
Structures	Prominent coarse plumose structure, arrest lines
Shape	Fairly planar; somewhat undulatory in strike
Termination	None seen
Mineralization	None seen
F2C Orientation	N47W/90 (n=24)
Spacing	1.5-1.75
Height	0.1-3 m
Length	Not determined
Structures	None seen
Shape	Fairly planar; locally broadly curved in dip
Termination	Against MV2
Mineralization	Noncalcareous slickensides (downdip)
F4 Orientation	N35E/70SE (n=6)
Spacing	Not determined
Height	1-3 m
Length	1.5- 1.75 m
Structures	None seen
Shape	Subplanar
Termination	Against F2
Mineralization	None seen
Remarks	The MV2 fractures dominate the S end of the roadcut, are large, and are fairly planar for such coarse-grained sandstone. Locally, they are in 10-50-cm wide zones composed of as many as 9 individual fractures. It was not possible to differentiate F1 fractures from F2 fractures. They occur in all of the layers but are the most planar in the thinner beds. The F4 fractures are prominent only at the north end of the roadcut.
Geologist(s)	MAG, CWJ
Data Date	05/30/85

Station 551

n = 36



♦ MV2 n = 6
x F2C n = 24
♦ F4 n = 6

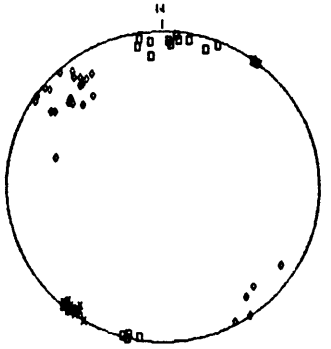
Schmidt net, lower hemisphere projection

551MV2	551F2C	551F4
N16E78SE	N80W88NE	N32E64SE
N16E81SE	N74W90SW	N28E54SE
N25E67SE	N50W85SW	N29E78SE
N21E76SE	N47W83NE	N41E77SE
N19E75SE	N44W88NE	N46E84SE
N18E67SE	N47W88NE	N38E58SE
	N55W79SW	
	N40W90SW	
	N44W83NE	
	N46W84NE	
	N48W88SW	
	N50W82SW	
	N55W87NE	
	N47W89NE	
	N56W88NE	
	N40W90SW	
	N51W86SW	
	N51W84SW	
	N42W89SW	
	N25W82SW	
	N35W85SW	
	N35W90SW	
	N55W63SW	
	N60W71SW	

Station Number	552
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T8S, R90W, SE1/4 SW1/4 NW1/4 SE1/4 sec 23
Exposure Description	Elev. 9420 ft. Sandstone erosion pavement, 0.2 km E of FS Rd. 300 and East Park Creek, 0.65 km N of Park Creek. Discontinuously exposed; 40 x 15 m sq Massive-appearing; some mudstone and mudstone rip-up clast conglomerate. Locally eroded into steps; ledges exposed for 10 m max.
Stratigraphic Unit	Wasatch Fm.
Lithology (General)	Sandstone
Cement	Siliceous; very well indurated
Color, fresh	Dark red
Color, weathered	Maroon
Grain size	Fine to medium grained
Grain sorting	Well to poorly sorted
Grain roundness	Subrounded to subangular
Bed Orientation	N60W/12.5NE (n=1)
Bed Thickness	0.1-0.75 m
F2C Orientation	N55W/88NE (n=25)
Spacing	0.01-0.5 m (tr); 0.1-0.33 m (cr)
Height	>0.75 m
Length	1.5 m
Structures	Plumes, twist-hackle fringes, local arrest lines
Shape	Planar
Termination	None seen
Mineralization	Noncalcareous films, probably quartz
F3C Orientation	N84W/85SW (n=15)
Spacing	Variable
Height	0.45 m
Length	1.2 m
Structures	Coarse plumose structure
Shape	Subplanar; undulatory in both strike and dip
Termination	None seen
Mineralization	None seen
F4 Orientation	N48E/76SE (n=25)
Spacing	Not determined
Height	0.1-0.75
Length	0.01-0.5 m
Structures	Local arrest lines and coarse plumose structure
Shape	Nonplanar; very undulatory in both strike and dip
Termination	Against F2 and F3
Mineralization	None seen
Remarks	The F2 fractures dominate the outcrop. They are planar, closely spaced, and mineralized in >4-m long zones composed of <1.5-m long, individual, overlapping fractures. F3 fractures are more crudely formed and sparse; they occur chiefly where the F2 fractures are widely spaced. They may be a later formed F2 set, however, for their strikes are similar to that of F2 fractures at other outcrops. F3 fractures are subplanar, layer confined, and terminate against fractures of the other two sets. F4 fractures probably were included in this set. Joints that developed upon weathering of the exposure are numerous, curve broadly in strike and terminate against all other surfaces.
Geologist(s)	MAG, CWJ
Data Date	05/30/85

Station 552

n = 65



* F2C n = 25
* F3C n = 15
* F4 n = 25

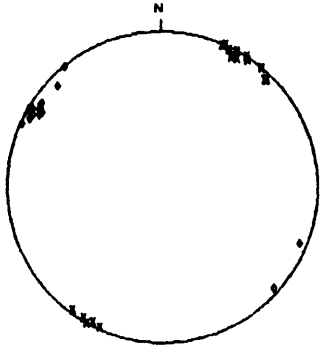
Schmidt net, lower hemisphere projection

552F2C	552F3C	552F4
N53W87NE	N75W89NE	N42E69SE
N53W88NE	N80E81SE	N55E73SE
N52W88NE	N80W85SW	N51E79SE
N51W90NE	N85E73SE	N34E80NW
N54W90NE	N84W84SW	N52E72SE
N53W90NE	N73W82SW	N43E67SE
N54W90SW	N81W88NE	N48E88SE
N51W89NE	N77W90NE	N15E60SE
N53W90SW	N85W88SW	N41E85SE
N50W88NE	N87W81SW	N52E83SE
N50W88NE	N69W87SW	N53E62SE
N51W88NE	N77W87NE	N62E88NW
N54W87NE	N88W84SW	N40E88SE
N56W82NE	N85E83SE	N53E77NW
N51W85NE	N81E86SE	N34E88SE
N57W86NE		N44E70SE
N54W87NE		N56E89NW
N55W87NE		N58E74SE
N55W87NE		N48E75NW
N54W87NE		N53E76SE
N60W90NE		N35E73SE
N56W89NE		N46E62SE
N56W87NE		N34E75SE
N55W90SW		N36E89SE
N52W90SW		N51E72SE

Station Number	554
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T8S, R90W, NE 1/4 SE1/2 SW1/4 NW1/4 sec 26
Exposure Description	Elev. 9240 ft. Roadcut, NW side N Thompson Creek and FS Rd. 300, between Park Crk. and Baylor Park. Several thin, purple-weathering sandstone ledges that pinch out laterally within 7 m to the SW at the massive-appearing sandstone of Sta. 555. Local carbonaceous material. Locally slumped.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone
Cement	Moderately calcareous; very well cemented
Color, fresh	Olive tan
Color, weathered	Purplish maroon and olive tan
Grain size	Silty to very fine grained
Grain sorting	Moderately sorted
Grain roundness	Subrounded to subangular
Bed Orientation	Subhorizontal
Bed Thickness	0.05-0.25 m
F2C Orientation	N61W/90 (n=17)
Spacing	0.03-0.36 m (tr); 0.08-0.25 (cr)
Height	0.05-0.25 m
Length	0.25-0.33 m
Structures	Arrest lines, twist hackle, local delicate plumes
Shape	Subplanar; short-amplitude undulatory
Termination	None seen
Mineralization	Secondary calcite along some F2 planes
F4 Orientation	N31E/84SE (n=15)
Spacing	0.25-0.33 m (avg)
Height	0.05-0.25 m
Length	0.03-0.36 m (tr); 0.08-0.25 m (cr)
Structures	arrest lines and twist-hackle fringes
Shape	Nonplanar; undulatory in both strike and dip
Termination	Against F2
Mineralization	None seen
Remarks	The F2 fractures are numerous and dominate the roadcut. Most are undulatory in profile and only some are planar. Myriad, undulatory, mineralized cracks occur parallel to and between the F2 fractures; most terminate within the lenses. The F4 fractures are even more nonplanar and irregular in shape than the F2 fractures against which they terminate.
Geologist(s)	MAG
Data Date	06/02/85

Station 554

n = 32



x F2C n = 17
♦ F4 n = 15

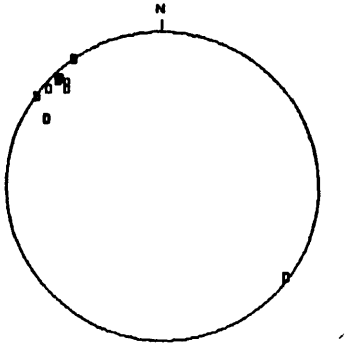
Schmidt net, lower hemisphere projection

554F2C	554F4
N62W85SW	N42E86NW
N60W85SW	N51E89SE
N54W88NE	N27E85SE
N57W90SW	N32E90SE
N46W86SW	N30E81SE
N67W89SW	N24E89SE
N56W88SW	N44E83SE
N59W88NE	N35E84SE
N50W90SW	N22E85NW
N62W84SW	N30E89SE
N64W88SW	N31E87SE
N61W90SW	N32E81SE
N46W85SW	N29E85SE
N66W90SW	N32E83SE
N63W87NE	N34E84SE
N66W88NE	
N61W90NE	

Station Number	555
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T8S, R90W, NE1/4 SE1/4 SW 1/4 NW1/4 sec 26
Exposure Description	Elev. 9240 ft. Roadcut, immediately adjacent to and SW of Sta. 554, NW side N Thompson Creek and FS Rd 300. Cut is ~3 m high X 18 m long of massive and low-angle, locally medium-angle cross-bedded, micaceous sandstone. Local maroon-weathering concretionary lenses. Locally slumped.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone
Cement	Noncalcareous; well indurated
Color, fresh	Tan
Color, weathered	Dark grayish tan
Grain size	Very fine to fine-grained
Grain sorting	Moderately well sorted
Grain roundness	Subrounded to subangular
Bed Orientation	N70E/1.5 NW (n=1)
Bed Thickness	0.25-1 m
F3C Orientation	N45E/85SE (n=10)
Spacing	0.25-0.5 m (cr)
Height	0.25->1.5 m
Length	1.5->2 m
Structures	Abundant coarse plumose structure
Shape	Fairly planar; slightly undulatory in strike
Termination	None seen
Mineralization	None seen
Remarks	All joints in beds that appeared to be in place were measured. The F3 fractures comprise the only fracture set, and are long and fairly planar for such a massive-appearing sandstone. Single F3 fractures cut several beds and are not confined by the muddy partings. Several cracks occur about perpendicular to the F3 fractures, but all were in the slumped part of the roadcut and not measured. They probably correspond to the F5 fractures.
Geologist(s)	MAG
Data Date	06/02/85

Station 555

n = 10



F3C n = 10

Schmidt net, lower hemisphere projection

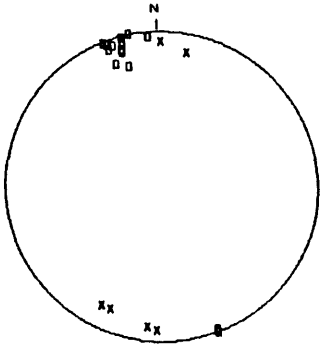
555F3C

N40E86SE
N46E85SE
N55E90SE
N45E85SE
N45E77SE
N35E89SE
N36E88NW
N47E80SE
N47E80SE
N30E75SE

Station Number	556
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T8S, R90W, SE1/4 NW 1/4 NE1/4 SW 1/4 sec 27
Exposure Description	Elev. 9350 ft. S-facing hillslope, N side North Thompson Creek and Baylor Park, 0.55 km NW of FS Rds. 300 & 302 intersection. Tiers of low-angle crossbedded sandstone with local lenses of chert-pebble conglomerate; 15 m long x ~25 m high. Tiers weather into rounded shapes parallel to hillslope.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone
Cement	Noncalcareous; very weakly cemented, porous
Color, fresh	Tan
Color, weathered	Light brownish tan
Grain size	Coarse fine- to medium-grained
Grain sorting	Moderately poorly sorted
Grain roundness	Angular to subrounded
Bed Orientation	Subhorizontal
Bed Thickness	1.5 m
F2C Orientation	N80W/80NE (n=6)
Spacing	Variable
Height	>1.5 m
Length	Not determined
Structures	Large twist hackle fringe, probable arrest lines
Shape	Subplanar; undulatory and broadly curved
Termination	None seen
Mineralization	None seen
F3C Orientation	N73E/86SE (n=14)
Spacing	0.25-8 m (tr); 3 m (avg)
Height	>1.5 m
Length	11 m (max)
Structures	Probable arrest lines; large, coarse twist hackle
Shape	Subplanar; broadly curved strike, undulatory dip
Termination	One against an F2
Mineralization	None seen
Remarks	The F3 fractures are the largest and dominate the outcrop. The F2 fractures generally occur where the F3 are absent; where together, terminating relations are obscured by brush. The joints and the outcrop are weathered and joint-set designation was difficult to determine. One F3 fracture terminated at an F2.
Geologist(s)	MAB
Data Date	06/02/85

Station 556

n = 20



x F2C n = 6
o F3C n = 14

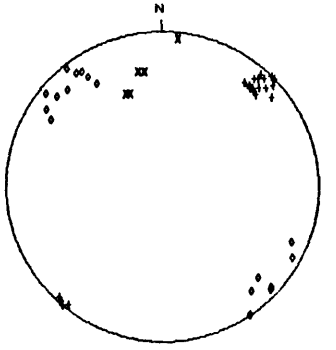
Schmidt net, lower hemisphere projection

556F2C	556F3C
N83W80NE	N70E83SE
N89W83SW	N76E69SE
N87W82NE	N76E85SE
N78W77SW	N70E88NW
N66W75NE	N70E90NW
N62W75NE	N86E87SE
	N71E73SE
	N79E90SE
	N72E85SE
	N76E89SE
	N70E87SE
	N75E81SE
	N69E89SE
	N75E79SE

Station Number	558
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T8S, R90W, SW1/4 NW1/4 SE1/4 sec 23 (unsurveyed)
Exposure Description	Elev. 9250 ft. Sandstone ledge and erosional pavement, a few m W of E Park Creek, 1/4 km upstream from Park Creek. 1-2 m h x 20 m l, SE- facing ledge, partly obscured by brush; locally pavement exposed above ledge. SW end is slumped. Weathers into platy layers.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Noncalcareous; very well indurated
Color, fresh	Medium gray
Color, weathered	Medium olive gray and maroon
Grain size	Very fine to fine-grained
Grain sorting	Moderately sorted
Grain roundness	Subangular to subrounded
Bed Orientation	N71W/14.5 NE (n=4)
Bed Thickness	1-2 m
F2C Orientation	N48W/87NE (R) (n=21)
Spacing	0.01-1.2 m (tr); 0.25-0.75 m (cr)
Height	>2 m
Length	>2 m
Structures	Delicate plumes, arrest lines and twist hackle
Shape	Planar; locally hooked along strike
Termination	None seen
Mineralization	Thin films of quartz
F3A Orientation	N81E/78SE (R) (n=5)
Spacing	Variable
Height	1.5 m or less
Length	2 m
Structures	Plumose structure, arrest lines, and twist hackle
Shape	Subplanar; undulatory in strike, less so in dip
Termination	Against F2
Mineralization	None seen
F4 Orientation	N44E/85SE (n=17)
Spacing	Not determined
Height	<1-1 m
Length	0.01-1.2 m (tr); 0.25-0.75 m (cr)
Structures	None seen
Shape	Nonplanar; broadly curved, undulatory in strike
Termination	Against F2 and F3
Mineralization	None seen
Remarks	The F2 fractures are large, planar, abundant, and dominate the outcrop. Their surfaces contain delicate, but well formed and prominant plumose structures that are coated with films of quartz. F1 fractures are more closely spaced on the pavement. Few F3 fractures occur; all were measured. They dip only moderately steeply, are subplanar, and abut the F2. The F4 fractures are crudely shaped and terminate at both the F2 and F3 fractures.
Geologist(s)	MAG
Data Date	06/03/85

Station 558

n = 43



♦ F2C n = 21
x F3A n = 5
♦ F4 n = 17

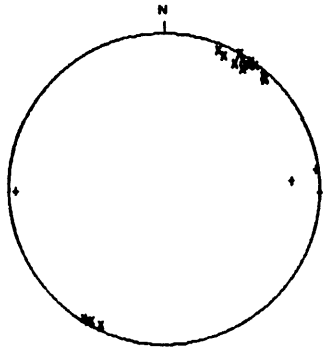
Schmidt net, lower hemisphere projection

558F2C	558F3A	558F4
N47W87NE	N78E65SE	N31E72SE
N49W85SW	N71E53SE	N24E79NW
N50W80SW	N69E54SE	N56E89NW
N44W90SW	N81E64SE	N41E78SE
N50W75SW	N84W85SE	N56E74SE
N49W74SW		N51E87SE
N50W90NE		N53E81SE
N47W74SW		N58E67SE
N48W75SW		N46E76SE
N49W88NE		N44E74NW
N46W78SW		N43E84NW
N40W80SW		N50E77NW
N46W90SW		N29E84NW
N47W85SW		N34E78SE
N44W81SW		N39E85SE
N50W80SW		N55E79SE
N52W87NE		N44E85NW
N45W73SW		
N49W82SW		
N52W74SW		
N43W86SW		

Station Number	559
Quadrangle	Center Mountain 7.5'
Twp, Range, Section	T8S, R90W, SW1/4 NE 1/4 NW1/4 NE1/4 sec 1 (unsurve
Exposure Description	Elev. 9100 ft. Sandstone ledge, 0.1 km E of FS Rd 300, E side of N-draining tributary to Beaver Crk. 1 km S of Fourmile Park, on steep, W-facing slope. 2 m h x 20 m l, discontinuously exposed, planar to broad, low-angle, and locally medium-angle, cross-bedded. Much of ledge is obscured by colluvium.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone
Cement	Moderately calcareous; moderately indurated
Color, fresh	Light grayish tan
Color, weathered	Light brownish tan to light orangish tan
Grain size	Very fine to fine-grained
Grain sorting	Moderately well sorted
Grain roundness	Subangular to subrounded
Bed Orientation	Subhorizontal
Bed Thickness	0.25->2m
F1C Orientation	N3W/89SW (n=4)
Spacing	Not determined
Height	>1.25 m
Length	>1.5 m
Structures	Eroded
Shape	Fairly planar; undulatory along strike
Termination	None seen
Mineralization	None seen
F2C Orientation	N61W/89SW (n=18)
Spacing	0.15-2 m (tr); 0.33-1.5 m (cr)
Height	0.25-2 m
Length	Not determined
Structures	Prominent twist hackle
Shape	Fairly planar
Termination	Against F1
Mineralization	None seen
Remarks	The F1 fractures are undulatory along strike. They are not abundant, parallel the hillslope, are weathered and obscured by colluvium. The F2 fractures are at a high angle to the hillslope, are more abundant, and better exposed than the F1 fractures, but also are weathered. The true dimensions of fractures of both sets, therefore, could not be obtained.
Geologist(s)	MAG
Data Date	06/04/85

Station 559

n = 22



+ F1C n = 4
x F2C n = 18

Schmidt net, lower hemisphere projection

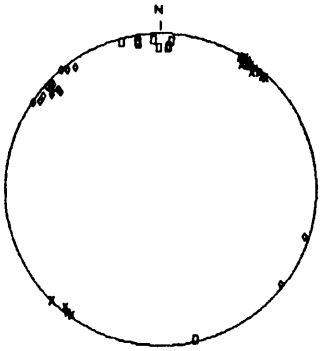
559F1C	559F2C
N01E90NW	N56W86SW
N08W88SW	N48W85SW
N02W85NE	N66W86NE
N04W71SW	N61W89SW
	N57W81SW
	N59W88NE
	N61W88NE
	N48W86SW
	N61W90SW
	N61W88NE
	N54W89SW
	N56W89SW
	N49W87SW
	N62W87NE
	N69W85SW
	N66W83SW
	N61W82SW
	N59W87SW

Station Number	566
Quadrangle	Stony Ridge 7.5'
Twp, Range, Section	T8S, R89W, SW1/4 NE1/4 SE1/4 NE1/4 sec 30
Exposure Description	Elev. 8980 ft. Sandstone ledge, ~35 m below rim of steep, SW-facing canyon wall, N side N Thompson Creek, exposed for >1.6 km to the W. 2 m thick. Fines upwards; fine to coarse grained, planar cross- to planar-ripple bedded and locally massive appearing. Measured along ~30 m.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Siliceous; very well indurated
Color, fresh	Light maroon to grayish pink
Color, weathered	Pinkish maroon
Grain size	Fine to coarse grained
Grain sorting	Moderately poorly to poorly sorted
Grain roundness	Angular to subangular
Bed Orientation	N42W/5NE (n=5)
Bed Thickness	0.15-1.5 m
F2C Orientation	N55W/89SW (n=21)
Spacing	0.02-0.5 (tr); 0.1-0.5 (cr)
Height	0.15-1.5 m
Length	>2m; probably >7 m
Structures	Delicate but prominent plumes and twist hackle
Shape	Planar; locally broadly curved
Termination	None seen
Mineralization	Siliceous coatings in coarser grained sandstone
F3C Orientation	N87E/86SE (n=9)
Spacing	Variable
Height	0.15-1.5 m
Length	>1.5 m
Structures	Plumes, twist hackle, and arrest lines
Shape	Subplanar; undulatory in both strike and dip
Termination	At or across mineralized F2
Mineralization	None seen
F4 Orientation	N44E/86SE (n=17)
Spacing	0.08-1.5 m (tr); 0.33-1.5 m (cr)
Height	0.15-1 m
Length	0.02-0.5 m (tr); 0.1-0.5 m (cr)
Structures	Coarse plumes
Shape	Subplanar; broadly curved, hooked
Termination	Against F2 and F3
Mineralization	None seen
Remarks	The F2 joints are superbly developed, planar, and dominate the outcrop. They are very long; one talus block was 7 m long, but are exposed for only 2 m on the ledge. All are cemented with quartz. F3 occur only locally; all were measured. They are most prominent in the coarser grained sandstone layers and where the F2 do not occur. The F3 fractures either abut the F2 fractures or cut a few cm across their mineralized, cemented surfaces. F4 fractures are layer-confined, terminate

Station Number	566 (contd)

at the F2 and F3 fractures, and curve broadly in strike. All fracture surfaces contain structures that are prominent but delicately formed. They are best formed on the F2 set.

Geologist(s)	MAG
Data Date	06/16/85
n =	47



x F2C n = 21
■ F3C n = 9
◊ F4 n = 17

Schmidt net, lower hemisphere projection

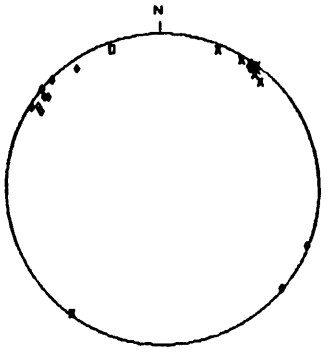
566F2C	566F3C	566F4
N55W89NE	N75E87SE	N36E86SE
N57W85SW	N86W85SW	N44E79SE
N51W87NE	N81E84SE	N44E81SE
N58W89SW	N77E88NW	N18E87NW
N59W89SW	N81E86SE	N42E88SE
N52W85SW	N87W80SW	N38E86SE
N57W90SW	N87W81SW	N34E89SE
N56W90SW	N89E80SE	N44E80SE
N48W87SW	N87E86SE	N55E85SE
N57W89SW		N43E86SE
N47W88SW		N42E84SE
N54W89SW		N44E86SE
N55W87SW		N41E82SE
N54W87SW		N44E88SE
N52W88SW		N38E88NW
N56W90SW		N52E87SE
N53W89NE		N50E90SE
N50W88SW		
N55W88SW		
N46W90NE		
N50W88SW		

Station Number	567
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T8S, R89W, SW1/4 SW1/4 NW1/4 NW1/4 sec 30
Exposure Description	Elev. 9480 ft. Steep, S-facing promontory above N. Thompson Creek canyon containing thick sequence of sandstone that continues >1.6 km to the E. Same ledge as Sta. 566, ~35 m below mesa. Fines upwards; fine to coarse grained, low-angle cross- to planar-ripple bedded.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Siliceous; very well indurated
Color, fresh	Light maroon to grayish pink
Color, weathered	Pinkish maroon
Grain size	Fine to coarse grained
Grain sorting	Moderately poorly to poorly sorted
Grain roundness	Angular to subangular
Bed Orientation	N38W/7NE (n=1)
Bed Thickness	0.15-1.5 m
F2C Orientation	N54W/87SW (n=13)
Spacing	0.08-0.15 m (cr)
Height	0.15-1.5 m
Length	>2 m
Structures	Delicate but prominent plumes and twist hackle
Shape	Planar; locally broadly curved
Termination	None seen
Mineralization	Siliceous coatings in coarser grained sandstone
F3C Orientation	N71E/85SE (n=1)
Termination	Against F2
Mineralization	None seen
F4 Orientation	N39E/87SE (n=10)
Spacing	0.33-1.5 m (cr)
Height	0.15-1 m
Length	0.08-0.15 m (cr)
Structures	Coarse plumose structure
Shape	Subplanar; broadly curved, hooked
Termination	Against F2
Mineralization	None seen
Remarks	This station was studied as a comparison with Sta. 566, for both are located along the same ledge, about 1.6 km apart. Little difference exists between comparable joint sets of the two stations, with the exception that the F2 fractures of this station are more closely spaced in the finer grained sandstones. Consequently, the lengths of the F4 fractures are correspondingly shorter here than at Sta. 566. More than one F3

Station Number	567 (contd)
	fracture occurs here but they were not measured.
Geologist(s)	MAG
Data Date	06/16/85

Station 567

n = 24



x F2C n = 13
♦ F3C n = 1
♦ F4 n = 10

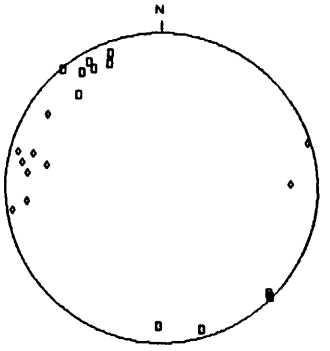
Schmidt net, lower hemisphere projection

567F2C	567F3C	567F4
N51W87SW	N71E85SE	N39E83SE
N58W87SW		N40E90SE
N55W88SW		N55E84SE
N52W90SW		N22E89NW
N54W89NE		N33E81SE
N53W87SW		N38E85SE
N47W82SW		N45E89SE
N51W84SW		N32E88SE
N53W86SW		N34E85SE
N54W88SW		N40E89NW
N68W86SW		
N54W88SW		
N53W88SW		

Station Number	577
Quadrangle	Flatiron Mountain 7.5'
Twp, Range, Section	T9S, R92W, NW1/4 SW1/4 SW1/4 SE1/4 sec 24
Exposure Description	Elev 8320 ft. Streamcut, W side Owens Creek, 0.5 km N of confluence with Dry Owens Creek. SE-facing sandstone ledge, 4 m h x 35 m long, 6 m above creek. Massive appearing; ripple bedded at base; local small-pebble conglomerate and concretionary mudstone lenses. Overlies red mudstone.
Stratigraphic Unit	Basal Wasatch Fm
Lithology (General)	Sandstone; small-pebble conglomerate
Cement	Calcareous; moderately indurated
Color, fresh	White
Color, weathered	White
Grain size	Coarse- to very coarse grained; small pebbles
Grain sorting	Poorly sorted
Grain roundness	Subangular; subangular to subrounded pebbles
Bed Orientation	N37E/10NW (n=3)
Bed Thickness	4 m
F3C Orientation	N53E/88NW (R) (n=11)
Spacing	4 m; sparse data
Height	4 m
Length	4-14 m (tr); 7-8 m (cr)
Structures	Too weathered for data collection
Shape	Subplanar; very undulatory in strike and dip
Termination	As hairline cracks or at MV2
Mineralization	None seen
F4 Orientation	N8E/84SE (n=10)
Spacing	7-8 m (cr)
Height	<1-4 m (tr)
Length	<1->4 m
Structures	None seen
Shape	Subplanar; undulatory especially in dip
Termination	Against F3
Mineralization	None seen
Remarks	A few fractures that appear to predate the F3 set occur in the outcrop; the F3 fractures terminate against them. There were few and may correlate with the MV2 set. The F3 fractures are numerous, long, and dominate the outcrop. The underlying mudstone also contains fractures of this set. F4 fractures terminate agasint the F3 fractures, are crudely formed, and of varying size. They also occur in the underlying mudstone, but are most numerous in the concretionary lenses.
Geologist(s)	MAG
Data Date	06/28/85

Station 577

n = 21



● F3C n = 11
◊ F4 n = 10

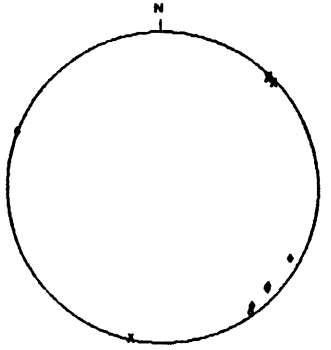
Schmidt net, lower hemisphere projection

577F3C	577F4
N48E69SE	N18W88SW
N60E83SE	N06W76NE
N55E79SE	N09W86NE
N45E89NW	N10E80SE
N69E82SE	N15E74SE
N44E86NW	N02W72NW
N89W78NE	N33E76SE
N50E89SE	N11E64SE
N60E77SE	N14E84SE
N74E84NW	N06E75SE
N67E76SE	

Station Number	579
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T8S, R91W, SE/4 SE/4 NW/4 NE1/4 sec 36
Exposure Description	Elev. 9825 ft. NE-facing roadcut, WSW side FS Rd 801, ~ 40m NNW of Sun Oil No. 17 between Mosquito and Baldy Mts. Sandstone, 1.5 h x 8 m l, low-angle crossbedded and massive bedded. Interbedded with and overlain by mudstone and shale. NW end of cut has slumped.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone
Cement	Noncalcareous; very well cemented
Color, fresh	Grayish tan
Color, weathered	Medium tan to olive-gray tan
Grain size	Fine- to fine coarse-grained
Grain sorting	Poorly sorted
Grain roundness	Angular to subrounded
Bed Orientation	Subhorizontal
Bed Thickness	1.5 m
F2C Orientation	N46W/88SW (n=4)
Spacing	0.3 m (sparse data)
Height	1.5 m
Length	>3.5 m
Structures	Large, well-formed plumes; local arrest lines
Shape	Planar
Termination	None seen
Mineralization	None seen
F4 Orientation	N44E/83NW (n=6)
Spacing	0.25-1 m (tr); 0.3-0.75 m (cr)
Height	<1.5 m
Length	Not determined
Structures	Coarse plumose structure
Shape	Subplanar, locally planar; undulatory in strike
Termination	Against F2
Mineralization	None seen
Remarks	F2 fractures are large, very planar, and dominate the outcrop. The major suface structures are large, coarse plumes. The F2 fractures are very well formed for such coarse-grained sandstone. The F4 fractures, although undulatory in strike, are overall quite planar and also contain coarse plumose structure. They terminate against F2.
Geologist(s)	MAG
Data Date	06/30/85

Station 579

n = 10



x F2C n = 4
♦ F4 n = 6

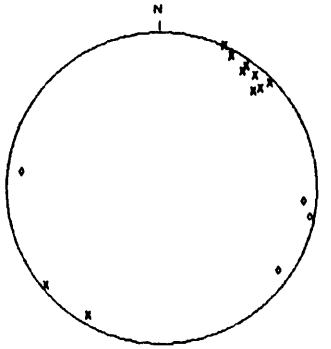
Schmidt net, lower hemisphere projection

579F2C	579F4
N70W89NE	N43E82NW
N46W88SW	N29E83NW
N46W89SW	N53E84NW
N43W88SW	N55E87NW
	N44E83NW
	N21E90SE

Station Number	580a
Quadrangle	Flatiron Mountain 7.5'
Twp, Range, Section	T8S, R91W, SW1/4 SE1/4 NW1/4 SW1/4 sec 36
Exposure Description	Elev. 9770 ft. SW-facing, vertical roadcut, 0.6 km S of crest of Mosquito Mtn. Locally slumped, ~30 m l x 6-8 m h. Measured layers are ~3-5 m above rd, immediately underlying Sta. 580b, in a sequence of thinly bedded sandstones with interbedded carbonaceous mudstone partings.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone
Cement	Moderately to very calcareous; well indurated
Color, fresh	Light grayish brown
Color, weathered	Light grayish brown
Grain size	Very fine to fine-grained
Grain sorting	Moderately well sorted
Grain roundness	Subrounded
Bed Orientation	Subhorizontal
Bed Thickness	0.15-0.8 m
F2C Orientation	N53W/85SW (n=10)
Spacing	0.25-0.33 m (cr)
Height	0.15-0.8 m (tr)
Length	Not determined
Structures	Plumes, arrest lines; thin, long twist hackle
Shape	Subplanar to locally planar
Termination	None seen
Mineralization	Carbonate coatings on those parallel to slope
F4 Orientation	N6E/85NW (n=4)
Spacing	Not determined
Height	0.15-0.8 m (tr)
Length	0.25-0.33 m (cr)
Structures	Coarse plumes, arrest lines, local twist hackle
Shape	Subplanar
Termination	Against F2
Mineralization	None seen
Remarks	The F2 fractures are more planar and strike more northerly in the thinner, finer grained sandstone layers of this station than the thicker, coarser grained layers of Station 580b. Most are layer confined, but some cut across muddy partings into underlying or overlying lenses. The F4 fractures are layer confined, more irregularly shaped than the F2 fractures, and terminate against them.
Geologist(s)	MAB
Data Date	06/30/85

STATION 580a

n = 14



x 580AF2 n = 10
◊ 580AF4 n = 4

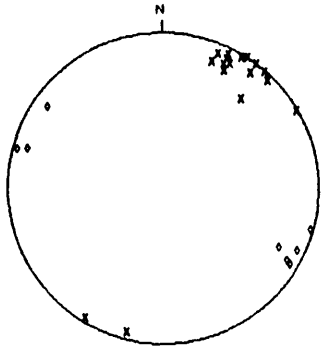
Schmidt net, lower hemisphere projection

580AF2	580AF4
N44W87SW	N07E80SE
N45W80SW	N11E87NW
N60W84NE	N05E81NW
N55W85SW	N35E81NW
N62W86SW	
N50W84SW	
N46W75SW	
N66W90SW	
N55W81SW	
N40W87NE	

Station Number	580b
Quadrangle	Flatiron Mountain 7.5'
Twp, Range, Section	T8S, R91W, SW1/4 SE1/4 NW1/4 NW1/4 sec 36
Exposure Description	Elev. 9770 ft. SW-facing, vertical roadcut, 0.6 km S of crest of Mosquito Mtn. Locally slumped; ~30 m l x 8 m h. Measured layer is ~3-5 m above road, immediately overlying Sta. 580a. Massive-appearing but ripple laminated near base. Over-lain and underlain by gray mudstone.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone
Cement	Calcareous; well cemented, porous
Color, fresh	Light grayish brown
Color, weathered	Light orangish brown
Grain size	Fine to medium grained
Grain sorting	Fairly poorly sorted
Grain roundness	Subrounded to subangular
Bed Orientation	Subhorizontal
Bed Thickness	1.5-2.75 m
F2C Orientation	N59W/85SW (n=17)
Spacing	0.75-1.5 m (cr)
Height	1.5->2.75 m
Length	>3 m
Structures	Coarse plumes, arrest lines, thin elongated hackle
Shape	Subplanar; undulatory in strike and dip
Termination	None seen
Mineralization	Carbonate coatings on those parallel to slope
F4 Orientation	N26E/84NW (n=8)
Spacing	0.33-1 m (cr); 0.3-2 m (tr)
Height	1.5-2.75 m
Length	0.75-1.5 m
Structures	Coarse plumes, arrest lines, local twist hackle
Shape	Subplanar; very undulatory in dip across partings
Termination	Against F2
Mineralization	None seen
Remarks	The F2 fractures are the best formed at the cut, but are undulatory. Most are layer confined, but some cut across thin mudstone partings into under-lying or overlying lenses. F4 fractures are layer confined and more irregularly shaped than the F2 fractures and terminate against them.
Geologist(s)	MAG
Data Date	06/30/85

STATION 580b

n = 25



x 580BF2 n = 17
◊ 580BF4 n = 8

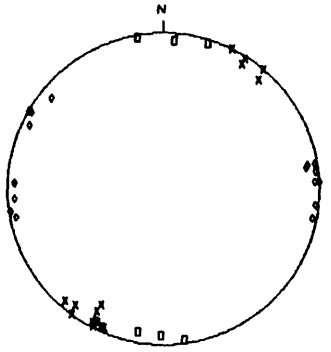
Schmidt net, lower hemisphere projection

580BF2	580BF4
N59W87NE	N30E81NW
N69W76SW	N31E84NW
N49W89SW	N25E84NW
N76W85NE	N15E87SE
N57W90SW	N27E72NW
N46W86SW	N16E80SE
N63W74SW	N35E80SE
N64W82SW	N16E88NW
N59W88SW	
N30W89SW	
N64W78SW	
N53W90SW	
N49W65SW	
N62W80SW	
N64W85SW	
N68W83SW	
N53W82SW	

Station Number	581
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T8S, R90W, SE 1/4, NW 1/4, SW1/4, NE1/4 sec 30
Exposure Description	Elev. 9000 ft. WNW-facing steep, forested, sandstone promontory, E side East Divide Creek, 0.15 km S of Reservoir Park. Discontinuously exposed for 50 m. 7-m thick; very low-angle crossbedded and conglomeratic. Overlain by Pleistocene unconsolidated basalt cobbles and other gravels.
Stratigraphic Unit	Basal Wasatch Fm
Lithology (General)	Sandstone; local pebble conglomerate
Cement	Noncalcareous; very well indurated
Color, fresh	Medium gray and pink
Color, weathered	Medium gray and pink
Grain size	Fine- to medium-grained; local pebbles
Grain sorting	Fairly poorly sorted
Grain roundness	Subangular to subrounded
Bed Orientation	N34W/8NE (n=2)
Bed Thickness	0.3-3 m
F2C Orientation	N62W/86NE (n=16)
Spacing	0.75-1.5 m (cr); 0.5-2.5 m (tr)
Height	2-2.5 m (cr); 1.5-3 m (tr)
Length	>3m
Structures	Twist hackle; plumose structure on some
Shape	Subplanar; undulatory and forked along strike
Termination	None seen
Mineralization	None seen
F3C Orientation	N89W/90 (n=6)
Spacing	Variable
Height	0.25->2 m
Length	>3 m
Structures	Arrest lines and twist hackle
Shape	Planar to nonplanar; locally undulatory or forked
Termination	Against F2 or originated at F2
Mineralization	None seen
F4 Orientation	N3W/90 (n=16)
Spacing	Not determined
Height	0.3-3 m (tr)
Length	0.5-2.5 m
Structures	None seen
Shape	Subplanar; undulatory or broadly curved and forked
Termination	Against F2 and F3
Mineralization	None seen
Remarks	The F2 fractures are large but found only in the upper 3 m of the layer. Many terminate as hairline cracks within this layer; several others do no cut through a prominent silty parting and are shorter. Many of the F3 fractures occur in a part of the outcrop where F2 fractures do not and are similar in appearance to them. Where they occur together, the F3 either terminate at an open F2 fracture or originate from an already formed F2 fracture. Although some F2 and F3 fracture orientations overlap, the E-W-striking fractures are younger than

Station Number	581 (contd)
	the NW-striking fractures elsewhere in the basin. The F4 fractures generally are layer confined, but some are as high as the F2 or F3 fractures. Several fork laterally along bedding planes.
Geologist(s)	MAG
Data Date	07/01/85

n = 38



x F2C n = 16
■ F3C n = 6
♦ F4 n = 16

Schmidt net, lower hemisphere projection

581F2C	581F3C	581F4
N62W79NE	N80W82NE	N10W88SW
N58W88SW	N86W85SW	N04W85NE
N62W87NE	N73W87SW	N09W89NE
N64W90SW	N89W84NE	N11E87NW
N64W85NE	N82E87NW	N07W88SW
N58W84SW	N80E88SE	N03W90SW
N63W89NE		N30E88SE
N62W74NE		N09W82SW
N63W85NE		N25E85SE
N49W86NE		N03W87SW
N66W86NE		N39E82SE
N54W90NE		N10W83SW
N67W87NE		N06E88NW
N49W82SW		N02E85SE
N53W83NE		N11W86NE
N50W90SW		N30E90SE

Station Number	582
Quadrangle	Center Mountain 7.5'
Twp, Range, Section	T7S, R90W, SW1/4 NW1/4 NW1/4 NW1/4 sec 31
Exposure Description	Elev. 7760 ft. SSW-facing roadcut, NE side of rd and East Divide Creek, ~6 m high; exposed discontinuously for several 10s of m. Locally slumped. Massive-appearing sandstone overlain by planar beds with mud-filled polygons and ripples at base. Underlain by very weakly indurated mudstones.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Noncalcareous; moderately indurated, very porous
Color, fresh	Medium tan
Color, weathered	Light orangish tan to light brownish tan
Grain size	Fine- to medium-grained
Grain sorting	Moderately poorly sorted
Grain roundness	Subrounded to subangular
Bed Orientation	N35W/9 NE (n=2)
Bed Thickness	1-5 m
F1C Orientation	N38W/90 (n=7)
Spacing	Variable
Height	1-5 m (tr)
Length	3-5 m (cr)
Structures	Arrest lines, plumes common; local twist hackle
Shape	Subplanar; undulatory and broadly curved
Termination	None seen
Mineralization	None seen
F2C Orientation	N65W/85SW (n=12)
Spacing	0.5-1 m
Height	1-5 m (tr)
Length	1.5->5 m (tr); 3-5 m (cr)
Structures	Arrest lines, plumes common; local twist hackle
Shape	Subplanar; undulatory and broadly curved
Termination	None seen
Mineralization	None seen
F3C Orientation	N90E/83S (n=3)
Spacing	Variable
Height	>1.5 m
Length	>2.5 m
Structures	Plumes, arrest lines, local twist hackle
Shape	Subplanar; undulatory and broadly curved
Termination	Against F2
Mineralization	None seen
F4 Orientation	N10E/88SE (n=3)
Termination	Against F1, F2, and F3
Mineralization	None seen
Remarks	The F1, F2, and F3 fractures all have a similar appearance but different orientations. Many are large but their sizes are variable. All are subplanar with prominent coarse plumose structure and arrest lines. In the thinner layers, the fractures are more planar. All joint surfaces are weathered, however. The F1 fractures generally occur where the F2 and F3 do not; the F2 fractures are the most abundant. The F3 fractures either

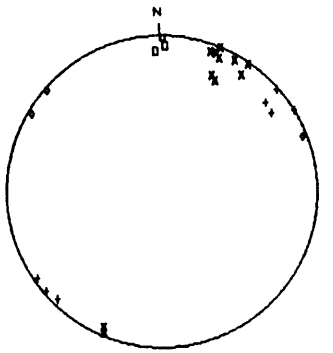
Station Number	582 (contd)

terminate against the F2 planes or originate from one end of an F2 fracture; these planes meet at angles of ~25 degrees. The largest fractures are composed of several coalesced planes as shown by the plumose strucutre, arrest lines, and twist-hackle fringes. The F4 fractures are short, layer confined, and irregularly shaped. The most planar fractures were measured.

Geologist(s)	MAG
Data Date	07/01/85

STATION 582

n = 25



+ 582F1C n = 7
x 582F2C n = 12
* 582F3C n = 3
◊ 582F4 n = 3

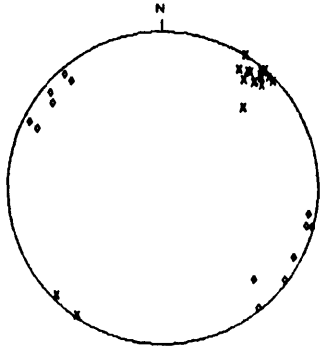
Schmidt net, lower hemisphere projection

582F1C	582F2C	582F3C	582F4
N31W90SW	N68W85SW	N88E79SE	N21W87SW
N40W77SW	N67W90SW	N89W89SW	N31E87SE
N45W86NE	N66W82SW	N88W83SW	N42E88SE
N34W87NE	N70W84SW		
N41W89SW	N68W85SW		
N35W76SW	N60W86SW		
N40W88NE	N67W88NE		
	N55W88SW		
	N66W70SW		
	N66W84NE		
	N64W68SW		
	N55W80SW		

Station Number	583
Quadrangle	Gibson Gulch 7.5'
Twp, Range, Section	T7S, R91W, SW1/4 SW1/4 SW1/4 SW1/4 sec 6
Exposure Description	Elev. 6080 ft. 8-m-thick sequence of SW-facing sandstone ledges, NE side rd and WNW-draining gulch, 0.2 km E of East Divide Creek. Exposed discontinuously for ~30 m. Massive-appearing. Abandoned road bed on lower moist exposed ledge.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Moderately calcareous; mod. indurated, porous
Color, fresh	Grayish tan
Color, weathered	Pinkish tan gray
Grain size	Very fine to fine-grained
Grain sorting	Moderately sorted
Grain roundness	Subrounded to subangular
Bed Orientation	N80W/7NE (n=1)
Bed Thickness	1 m
F2C Orientation	N49W/85SW (n=19)
Spacing	0.75-2 m (cr)
Height	0.25-1 m
Length	0.5-15 m (tr); 3-8 m (cr)
Structures	Abundant arrest lines, coarse plumes; local hackle
Shape	Subplanar; undulatory in strike, less so in dip
Termination	None seen
Mineralization	None seen
F4 Orientation	N37E/89NW (n=13)
Spacing	3-8 m (cr)
Height	0.25-1 m
Length	A few cm to ~2 m (tr); 0.75-2 m (cr)
Structures	Abundant coarse plumes, arrest lines; local hackle
Shape	Nonplanar; undulatory strike, broadly curved dip
Termination	Against F2
Mineralization	None seen
Remarks	F1 fractures are long, sinuous, and parallel to outcrop face. Several F1 fractures are compound; composed of several coalesced planes, as shown by the arrest lines, plumose structure and twist-hackle fringes. F4 fractures are crudely formed, irregularly shaped, and layer-confined.
Geologist(s)	MAG
Data Date	07/01/85

STATION 583

n = 32



x 583F2C n = 19
♦ 583F4 n = 13

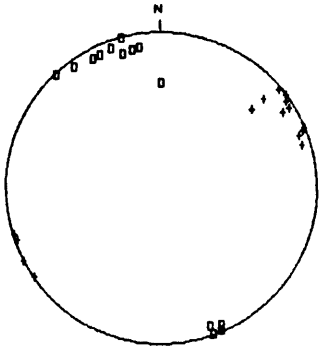
Schmidt net, lower hemisphere projection

583F2C	583F4
N53W82SW	N37E78SE
N53W75SW	N37E88NW
N49W78SW	N25E78SE
N49W79SW	N51E88NW
N46W88SW	N40E84SE
N57W79SW	N28E85NW
N49W88SW	N49E79SE
N56W88NE	N10E85NW
N50W88SW	N15E85NW
N44W85SW	N26E85SE
N46W81SW	N15E89NW
N49W85SW	N45E72NW
N48W84SW	N49E86SE
N45W87NE	
N49W90SW	
N58W90SW	
N53W82SW	
N54W82SW	
N45W62SW	

Station Number	584
Quadrangle	Flatiron Mountain 7.5'
Twp, Range, Section	T8S, R91W, SW1/4 SE1/4 NE1/4 NW1/4 sec 22
Exposure Description	Elev. 9300 ft. S-facing sandstone ledge on steep, SW side Coal Ridge, ~100m S of Sun Oil No. 9. Both slope and outcrop partly slumped; measured where in place. Massive-appearing; thins to the W and E. 3.5 m h (max) x ~20 m l.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone
Cement	Very calcareous; well indurated, porous
Color, fresh	Grayish tan
Color, weathered	Orangish tan
Grain size	Fine- to fine medium-grained
Grain sorting	Moderately sorted
Grain roundness	Subrounded to subangular
Bed Orientation	Subhorizontal
Bed Thickness	3.5 m
F1C Orientation	N30W/87SW (n=15)
Spacing	0.5-2 m (cr)
Height	3.5 m
Length	>2.5 m
Structures	Coarse plumes; local arrest lines and twist hackle
Shape	Subplanar; broadly curved in strike and dip
Termination	None seen
Mineralization	Cryptocrystalline, medium-brown calcite coatings
F3C Orientation	N70E/84SE (n=14)
Spacing	Not determined
Height	<3.5 m
Length	0.5-2 m (cr)
Structures	None seen
Shape	Subplanar; broadly curved in strike and dip
Termination	Against F1
Mineralization	Cryptocrystalline, medium-brown calcite coatings
Remarks	The F1 fractures are large and dominate the outcrop. The F3 fractures are smaller, and several are confined vertically by muddy partings within the sandstone layers. The broadly curved fracture planes of both sets are so undulatory in profile they appear to be "lumpy". The surfaces of the fractures of both sets also are coated with dripstone, indicating deposition of the coating following formation of the last-formed, F3 fracture set.
Geologist(s)	MAG
Data Date	07/02/85

STATION 584

n = 29



+ 584F1C n = 15
• 584F3C n = 14

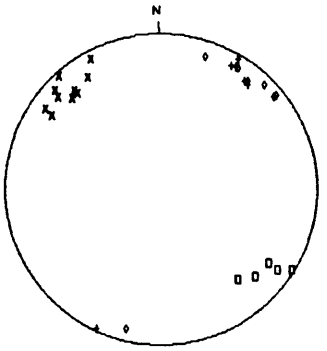
Schmidt net, lower hemisphere projection

584F1C	584F3C
N40W88SW	N65E83SE
N32W86SW	N67E89NW
N22W88SW	N70E83NW
N37W90SW	N47E89SE
N35W89NE	N78E79SE
N17W84SW	N74E78SE
N20W88NE	N54E85SE
N41W76SW	N81E80SE
N18W89NE	N62E83SE
N21W84SW	N70E84SE
N35W87SW	N66E85NW
N28W90NE	N70E89NW
N32W81SW	N75E89SE
N23W90SW	N90E57SE
N41W66SW	

Station Number	617
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T8S, R90W, NW 1/4 NE 1/4 SE1/4 NW 1/4 sec 15
Exposure Description	Elev. 10080 ft. Steep SW-facing ledge near top of The Slides ridge, ~0.35 km S of Garfield/Mesa Cnty line; a few 10s of m W of Pitkin Cnty line. 4-6-m thick sandstone ledge, discontinuously exposed for 40 m; locally tree covered and slumped. Planar ripple bedded to low-angle crossbedded; some coal.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Noncalcareous; moderately well indurated
Color, fresh	Light tannish gray
Color, weathered	Tannish gray
Grain size	Fine- to medium-grained
Grain sorting	Moderately sorted
Grain roundness	Subrounded to subangular
Bed Orientation	N56E/8NW (n=2)
Bed Thickness	2-4 m
F2C Orientation	N59W/85SW (R) (n=6)
Spacing	1.5 m (avg)
Height	>2 m
Length	>5 m
Structures	Arrest lines; twist hackle near upper edge
Shape	Fairly planar; slightly undulatory
Termination	None seen
Mineralization	1-2-mm long clear calcite crystals; brown coating
F3A Orientation	N49E/73SE (n=10)
Spacing	0.5-2 m (cr)
Height	2-4 m
Length	>3 m
Structures	Coarse plumose structure
Shape	Fairly planar; some fork along internal partings
Termination	Against F2
Mineralization	None seen
F3B Orientation	N35E/73NW (n=8)
Spacing	0.5-2 m (cr)
Height	2-4 m
Length	>3 m
Structures	Coarse plumose structure
Shape	Fairly planar; locally planes fork along bedding
Termination	Against F2
Mineralization	None seen
F3C Orientation	N43E/82SE (n=7)
Spacing	0.5-2 m (cr)
Height	2-4 m
Length	>3 m
Structures	Coarse plumose structure
Shape	Fairly planar; locally planes fork along partings
Termination	Against F2
Mineralization	None seen
F5 Orientation	N50W/84SW (n=7)
Spacing	0.75-3 m
Height	1 m
Length	0.5-2 m (cr)
Structures	Coarse plumes, arrest lines, twist hacile
Shape	Subplanar; undulatory in strike and dip, some hook
Termination	Against F3
Mineralization	None seen

Station Number	617 (contd)
Remarks	The F2 fractures are large, terminate against no other fractures, and are sparse; they therefore are widely spaced. The F3 fractures are the most abundant; they therefore are more closely spaced than the F2. The F3 fractures are shorter than the F2 and most terminate against them. Other F3 fractures, however, cut across the probably formerly mineralized F2 fractures; only one F2 now contains thin calcite fill. Unusually, F4 fractures were not found in this outcrop; this may be an artifact of their similarity to F3 fractures. The F5 are the smallest, layer-confined fractures. Their size, however, is large compared to other F5 fractures in the basin. Unusually, visible fracture-surface structures are common.
Geologist(s)	MAG, DBY
Data Date	08/19/85

n = 28



+	F2C	n = 6
x	F3A	n = 10
▪	F3B	n = 5
♦	F5	n = 7

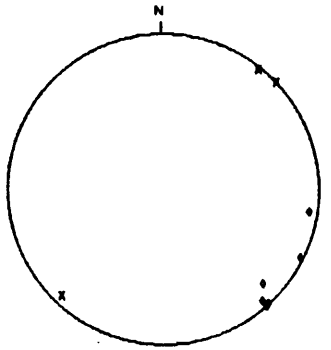
Schmidt net, lower hemisphere projection

617F2C	617F3A	617F3B	617F5
N60W80SW	N34E73SE	N43E71NW	N57W81SW
N50W76SW	N49E73SE	N50E65NW	N76W81NE
N58W81SW	N49E70SE	N35E73NW	N71W79SW
N59W87SW	N46E70SE	N32E88NW	N51W78SW
N52W77SW	N57E74SE	N35E80NW	N39W83SW
N65W88NE	N35E79SE		N45W84SW
	N42E77SE		N39W85SW
	N62E84SE		
	N43E82SE		
	N48E87SE		

Station Number	618
Quadrangle	Flatiron Mountain 7.5'
Twp, Range, Section	T8S, R91W, NW1/4 SE1/4 SE1/4 NW1/4 sec 29
Exposure Description	Elev. 7360 feet. NE side of West Divide Creek and FS Road 800, across from gauging station, at head of recent slump above dissected slope of mudstone. Vertical cut of siltstone lenses with micaceous and fine silty partings; possible local root casts. ~6 m h x 20 m l; measured at SE end.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Siltstone
Cement	Slightly calcareous; well indurated
Color, fresh	Light brown to light reddish brown
Color, weathered	Reddish brown
Grain size	Sandy silt with micaceous partings
Grain sorting	Moderately well sorted
Grain roundness	Subrounded to rounded
Bed Orientation	Subhorizontal
Bed Thickness	0.3-1.25 m
F2C Orientation	N46W/90 (n=3)
Spacing	0.08->1 m (tr)
Height	0.3-1.25 m
Length	>0.3 m
Structures	Coarse plumose structure and arrest lines
Shape	Subplanar to planar
Termination	None seen
Mineralization	None seen
F4 Orientation	N47E/87NW (n=6)
Spacing	0.1-0.3 m (tr)
Height	<0.3-<1.25 m
Length	0.08->1 m
Structures	Abundant arrest lines
Shape	Nonplanar; quite undulatory in dip
Termination	Against F2
Mineralization	None seen
Remarks	F2 fractures are the most planar and the best formed in the outcrop, but difficult to reach for measurement. The F4 fractures are much more irregular in shape, layer-confined, and definitely terminate against the F2 fractures.
Geologist(s)	MAG, DBY
Data Date	08/20/85

Station 618

n = 9



x F2C n = 3
♦ F4 n = 6

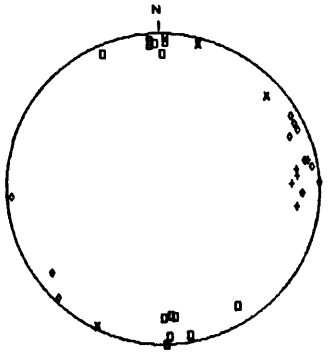
Schmidt net, lower hemisphere projection

618F2C	618F4
N46W84NE	N27E88NW
N51W88SW	N48E90NW
N43W90SW	N44E77NW
	N49E90NW
	N49E85NW
	N09E84NW

Station Number	619
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T9S, R91W, SE1/4 NW1/4 SE1/4 SE1/4 sec 1
Exposure Description	Elev. 9920 feet. WSW-facing discontinuous sandstone ledge on steep, aspen-covered slope, S side Baldy Mtn., 1.35 km SSE of Sun Oil No. 18, ~60 m below Ohio Creek Cgl. Massive; contorted basal ripple laminations. 7 m thick; flaggy weathering in lower 2/3 of outcrop.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone; coarsens upward
Cement	Slightly calcareous; moderately to well indurated
Color, fresh	Very light brownish tan
Color, weathered	Light brownish tan
Grain size	Fine to medium grained
Grain sorting	Moderately well sorted
Grain roundness	Subrounded to subangular
Bed Orientation	N82W/8SW (n=1)
Bed Thickness	1.5-4m
F1A Orientation	N5W/75SW (n=5)
Spacing	1-2 m
Height	2.5-7 m
Length	> 2.5 m
Structures	Too weathered for data collection
Shape	Subplanar; undulatory in dip
Termination	Against no other joint
Mineralization	None seen
F2C Orientation	N64W/85SW (n=3)
Spacing	1-2 m
Height	2.5 m
Length	2 m (max)
Structures	Too weathered for data collection
Shape	Subplanar; slightly undulatory in strike and dip
Termination	Against F1A
Mineralization	None seen
F3C Orientation	N88E/88SE (n=14)
Spacing	1-1.5 m (cr); 1-2 m (tr)
Height	1.5-7 m
Length	6 m
Structures	coarse plumes; local arrest lines, twist hackle
Shape	Subplanar; undulatory
Termination	Against F2C or F1A
Mineralization	Patchy brown, cryptocrystalline calcite on one
F4 Orientation	N22W/84SW (n=11)
Spacing	Variable
Height	1.5-4 m
Length	0.75-2 m
Structures	Coarse plumes, arrest lines; local twist hacile
Shape	Nonplanar; very undulatory, many lateral hooks
Termination	Against F2C and F3C
Mineralization	Patchy, brown cryptocrystalline calcite on one

Remarks	F1 joints are few, but large; most dip moderately steeply. F2 fractures abut the F1 fractures and also are few. F3 are the most abundant, also are large, and are more planar in the finer grained sandstone than the coarser grained. Some F3 fractures in the finer grained sandstone are in vertical zones comprised of two discontinous fracture planes spaced a few cm apart. The F4 joints are crudely formed, layer-confined, and most planar and abundant in the flaggy sandstones in the lower part of the ledge.
Geologist(s)	MAG, DBY
Data Date	08/21/85

n = 33



+ F1A n = 5
x F2C n = 3
▮ F3C n = 14
♦ F4 n = 11

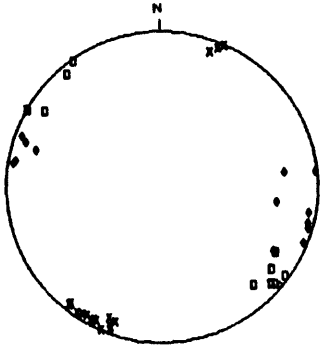
Schmidt net, lower hemisphere projection

619F1A	619F2C	619F3C	619F4
N0BE75NW	N75W85SW	N67E84SE	N29W84SW
N0BW75SW	N64W88NE	N88W84SW	N11W82SW
N11W84SW	N41W79SW	N86E85SE	N23W84SW
N05W75SW		N86E82SE	N02W90SW
N02W71SW		N88E85NW	N37W79NE
		N85E72NW	N02E78NW
		N5BE78NW	N26W84SW
		N90E72NW	N03W87NE
		N8VE85NW	N46W87NE
		N89W76SW	N08W86SW
		N89E90NW	N22W77SW
		N88W87SW	
		N88E83SE	
		N87E71NW	

Station Number	620
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T9S, R90W, SE 1/3 NW1/4 SE1/4 NW1/4 sec 2
Exposure Description	Elev. 10160 ft. Sandstone ledge, 8m x 8m on steep slope 1.35 km W of Twin Peaks, ~8 m above stream, ~24 m below Gasco well No. 68, 0.1 km E of FS Rd 300. Underlain by conglomerate and interbedded mudstone; overlain by 6 m-thick conglomerate. Massive; local horizontal beds and ripple laminations
Stratigraphic Unit	Basal Wasatch Fm
Lithology (General)	Sandstone and conglomerate
Cement	Noncalcareous; moderately well to well indurated
Color, fresh	Olive gray
Color, weathered	Pinkish gray
Grain size	Medium-grained with pebbles 1.5-2 cm in dia
Grain sorting	Moderately to poorly sorted
Grain roundness	Subrounded to angular
Bed Orientation	N25E/0.5SE (n=2)
Bed Thickness	0.02-2.5 m
F2C Orientation	N65W/86NE (n=16)
Spacing	0.04-0.7 m (tr); 0.15-0.6 m (cr)
Height	>2 m
Length	>4 m
Structures	Very fine plumose structure; delicate twist hackle
Shape	Planar; slightly undulatory in strike
Termination	None seen
Mineralization	Calcite; thin films to 1 mm-thick
F3C Orientation	N40E/85NW (n=10)
Spacing	1.25-1.33 m
Height	0.05-0.75 m
Length	0.3->1 m
Structures	Coarse plumose structure; local twist hackle
Shape	Subplanar
Termination	Against F2 or across min F2
Mineralization	None seen
F4 Orientation	N15E/88NW (n=14)
Spacing	0.05-1.25 m (cr)
Height	0.05-0.75 m
Length	0.04-1.75 m
Structures	Too weathered for data collection
Shape	Subplanar; very undulatory or broadly curved
Termination	Against F2, F3; across min. F2
Mineralization	None seen
Remarks	F2 fractures are prominent and numerous in the outcrop; their surfaces are stained purple and contain delicate surface structures which are calcite coated, accounting for their unusual smoothness. The F3 fractures are sparse. The F4 fractures are crudely formed, irregular in shape, layer confined, and either terminate against the older fractures of the F2 and F3 sets or cut across the mineralized F2 fractures. Many of the F4 fractures are taller than they are long because the F2 fractures are relatively closely spaced.
Geologist(s)	MAG, DBY
Data Date	08/22/85

Station 620

n = 40



x F2C n = 16
▪ F3C n = 10
♦ F4 n = 14

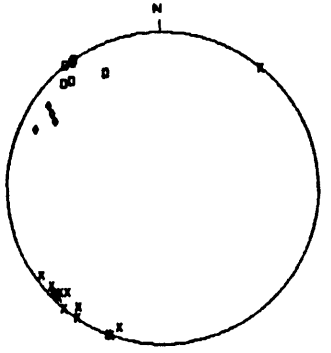
Schmidt net, lower hemisphere projection

620F2C	620F3C	620F4
N70W81SW	N37E77NW	N16E87NW
N62W87NE	N41E85NW	N30E71NW
N52W85NE	N42E83NW	N09E86SE
N70W87NE	N36E87NW	N20E85SE
N52W86NE	N50E84SE	N08E63NW
N67W90NE	N55E88SE	N16E73SE
N64W85NE	N30E90SE	N18E81SE
N58W86NE	N47E75NW	N07W68SW
N60W85NE	N30E73NW	N14E86NW
N68W86SW	N33E79SE	N10E85NW
N71W81NE		N22E87NW
N63W85NE		N06W89SW
N66W89SW		N40E88NW
N70W85NE		N10E85SE
N68W80NE		
N56W87NE		

Station Number	621
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T9S, R90W, NE1/4 NW 1/4 SW1/4 SW1/4 sec 1
Exposure Description	Elev. 10360 ft. Stream cut, head of SW-draining gulch to Middle Thompson Creek, 0.4 km south of (west) Twin Peaks, 0.25 km N of unmapped road. Measured on bottom and both sides of 1.5-m wide gulch for ~30 m. Horizontally and trough cross-bedded; sets to 0.1 m; small-pebble conglomerate.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Conglomeratic sandstone
Cement	Slightly calcareous; moderately well indurated
Color, fresh	Olive gray
Color, weathered	Medium olive gray to light-brownish gray
Grain size	Fine- to coarse-grained
Grain sorting	Moderately to poorly sorted
Grain roundness	Subangular to subrounded
Bed Orientation	N19W/8.5SW (n=2)
Bed Thickness	0.03-0.1 m
F2C Orientation	N50W/88NE (n=15)
Spacing	0.4-1.5 m (cr); 0.08-2 m (tr)
Height	0.4-1.5 m (individual joints); 3-4 m (zones)
Length	1.5 (avg, individual joints); 0.4-1.6 m (zones)
Structures	Coarse plumose structure; few surfaces exposed
Shape	Subplanar; broadly undulatory in dip
Termination	None seen
Mineralization	2-mm dia white calcite and pink opaque crystals
F3C Orientation	N54E/83SE (n=6)
Spacing	2.25-3 m
Height	>0.3 m
Length	0.5-1.5 m
Structures	Very coarse plumose structure
Shape	Nonplanar
Termination	Against F2
Mineralization	None seen
F4 Orientation	N32E/76SE (n=4)
Spacing	2.25-3 m
Height	>0.3 m
Length	0.5-1.5 m
Structures	Very coarse plumose structure
Shape	Nonplanar
Termination	Against F2
Mineralization	None seen
Remarks	F2 fractures are prominent, but sinuous in profile. Most F2 are in 10-50 cm wide zones composed of several fractures; the zones therefore attain greater heights than individual F2 fractures. Mineralization obscures the fracture-surface structures. The mineralized F2 and bedding planes are iron oxide stained. The F3 and F4 fractures are unstained and both are very similar in style; these 2 sets therefore are differentiated only by their orientation. Both sets occur only in the lower half of the exposure. All of the most planar and the largest joints were measured in the streamcut.
Geologist(s)	MAG, DBY
Data Date	08/22/85

Station Number 621 (contd)

n = 25



x F2C n = 15
x F3C n = 6
♦ F4 n = 4

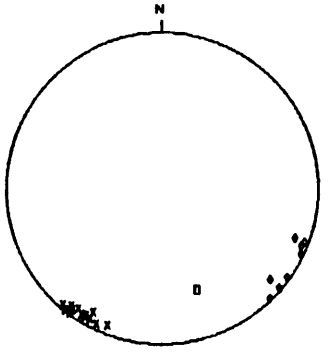
Schmidt net, lower hemisphere projection

621F2C	621F3C	621F4
N50W90NE	N47E81SE	N32E70SE
N72W83NE	N50E79SE	N34E74SE
N41W85NE	N55E89SE	N25E79SE
N69W90NE	N64E71SE	N36E79SE
N44W86NE	N52E90SE	
N46W87NE	N56E90SE	
N45W84NE		
N43W87NE		
N47W80NE		
N35W86NE		
N70W90NE		
N54W83NE		
N50W90NE		
N50W90SW		
N56W89NE		

Station Number	622
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T9S, R90W, SE 1/4 NE 1/4 SW1/4 NW1/4 sec 13
Exposure Description	Elev. 10360 ft. NE- and NW-facing ledges on steep slope, SE side, near head of Miner Basin, in N-draining gulch to basin. Conglomeratic sandstone, horizontally to planar-crossbedded; sets to 0.5 m Locally trough crossbedded: sets to 1 m. Measured along ~50 m of 7->8 m high ledge.
Stratigraphic Unit	Basal Wasatch Fm
Lithology (General)	Conglomeratic sandstone
Cement	Slightly calcareous; moderately well indurated
Color, fresh	Pinkish gray to grayish pink
Color, weathered	Medium grayish pink
Grain size	Medium- to very coarse grained; imbricated pebbles
Grain sorting	Poorly sorted
Grain roundness	Subrounded sand grains; rounded pebbles
Bed Orientation	Subhorizontal
Bed Thickness	2-3 m
F2C Orientation	N59W/85NE (n=16)
Spacing	1.25-2 m (tr for zones)
Height	2 m (individual joints); 7->8 m (zones)
Length	8-15 m (tr)
Structures	Fracture origins, coarse plumes, and twist hackle
Shape	Planar; slightly undulatory in strike or forked
Termination	None seen
Mineralization	0.5 to 1-cm thick white calcite; median suture
F3A Orientation	N70E/58NW (n=1)
F4 Orientation	N36E/88NW (n=9)
Spacing	1-15 m
Height	2-3 m
Length	1.25-2 m
Structures	Coarse plumes on two; most surfaces very weathered
Shape	Subplanar
Termination	Against F2
Mineralization	None seen
Remarks	The F2 fractures are in large, 0.3-0.4 m wide zones composed of several fractures unconfined by the height of individual beds. Individual fractures also cut through the pebbles in the conglomerate. Irregularly shaped, jagged fractures that are prependicular to the F2 surfaces die out within the rock face a few mm; they apparently formed on weathering of the rock face. Only one F3 fracture was found; it terminates against an F2. The F4 fractures are confined by bed-parallel partings and by the F2 fractures.
Geologist(s)	MAG, DBY
Data Date	08/23/85

Station 622

n = 26



▪ F2C n = 16
▪ F3A n = 1
♦ F4 n = 9

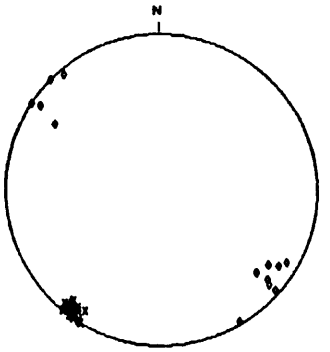
Schmidt net, lower hemisphere projection

622F2C	622F3A	622F4
N62W85NE	N70E58NW	N20E87NW
N69W84NE		N40E89NW
N60W85NE		N40E88NW
N54W86NE		N25E88NW
N53W84NE		N35E88NW
N62W80NE		N45E88NW
N60W84NE		N40E80NW
N54W89NE		N22E86NW
N62W85NE		N20E80NW
N56W83NE		
N50W87NE		
N65W86NE		
N52W89NE		
N59W85NE		
N53W84NE		
N58W85NE		

Station Number	623
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T9S, R90W, NW1/4 SE1/4 NW1/4 NW1/4 sec 13
Exposure Description	Elev. 9980 ft. Streamcut, ESE-side Miner Basin in NW-draining tributary to basin, 0.35 km downstream from Sta. 622. Measured in stream bed and on both banks for ~30 m. Fine ripple and parallel laminated; locally, small-scale trough crossbedded with calcareous concretions and pebble conglomerate.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone
Cement	Noncalcareous; very well indurated
Color, fresh	Light greenish gray
Color, weathered	Light medium gray and tan
Grain size	Fine grained
Grain sorting	Well sorted
Grain roundness	Subrounded to subangular
Bed Orientation	N11E/2NW (n=2)
Bed Thickness	0.05-3 m
F2C Orientation	N55W/87NE (n=18)
Spacing	0.1-0.75 m (cr); 0.05-1.5m (tr)
Height	3-6 m
Length	10 m
Structures	Large, delicate arrest lines; plumose structrue
Shape	Planar; slightly undulatory
Termination	None seen
Mineralization	Barite as cryptocrystalline films, >1-mm dia xtals
F4 Orientation	N40E/87NW (n=13)
Spacing	0.25-1 m (cr); 0.5-4 m (tr)
Height	0.05-2 m
Length	0.1-0.75 m (cr); 0.05-1.5 m (tr)
Structures	Coarse plumose structure very common
Shape	Nonplanar; curve broadly in dip or hook into F2
Termination	Against F2
Mineralization	None seen
Remarks	F2 fractures are superbly developed, prominent, and large with abundant, large but delicate surface structures. The F4 fractures are smaller, less planar, and terminate laterally against the F2 fractures. There are several small (<1 m sq) fractures similar in orientation to F2 fractures that were not measured. They are subplanar and terminate laterally against the F4 fractures, establishing their relative age as post F4 ; they therefore most probably are F5 fractures. Nonplanar, irregularly shaped, short fractures that are perpendicular to the F2 fracture surfaces and die out within a few cm in the rock are assumed to be weathering joints. They were not measured.
Geologist(s)	MAG, DBY
Data Date	08/23/85

Station 623

n = 31



▪ F2C n = 18
♦ F4 n = 13

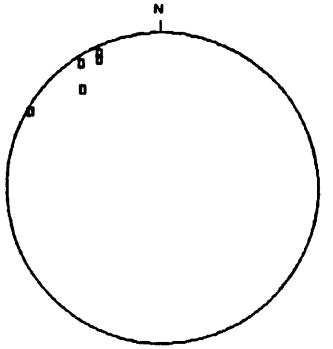
Schmidt net, lower hemisphere projection

623F2C	623F4
N59W90NE	N32E69SE
N56W87NE	N30E82NW
N50W85NE	N35E84SE
N58W89NE	N34E90SE
N55W86NE	N40E78NW
N52W87NE	N33E79NW
N52W82NE	N41E70NW
N58W81NE	N59E88NW
N56W87NE	N45E90SE
N52W84NE	N50E86SE
N55W82NE	N41E81NW
N55W89NE	N41E87NW
N52W80NE	N35E73NW
N54W90NE	
N56W84NE	
N56W90NE	
N51W89NE	
N51W89NE	

Station Number	624
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T9S, R90W, NW1/4 NE1/4 SW1/4 SE1/4 sec 6
Exposure Description	Elev. 9300 ft. Steep, 60-m thick, ESE-facing ledge of sandstone, SE side Baldy Mtn, 0.5 km W of Little Rock Creek, SE side Divide Creek anticline. 0.5-m thick forset-bedded sandstone overlain by subhorizontally to planar-bedded sandstone with limonite concretions.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone
Cement	Sl. calcareous; moderately well indurated, porous
Color, fresh	Light grayish tan
Color, weathered	Medium tan
Grain size	Coarse fine- to fine medium-grained
Grain sorting	Moderately well sorted
Grain roundness	Subrounded to subangular
Bed Orientation	Subhorizontal
Bed Thickness	0.5-10 m
F3C Orientation	N54E/85SE (n=6)
Spacing	1->3 m
Height	6->10 m
Length	10->15 m
Structures	Coarse plumose structure and arrest lines
Shape	Subplanar; broadly curve or undulatory in strike
Termination	None seen
Mineralization	Cryptrocrystalline calcite film on some
Remarks	The F3 fractures are very large and dominate the outcrop. Measurements could only be taken from near the top of the nearly vertical exposure; much of the data therefore are estimates. Other fractures are nearly perpendicular to the F3 fractures but could not be reached for measurement. They strike about NNW, are layer-confined with maximum heights of 7 m, and terminate laterally against the F3 fractures. They probably belong to the F4 set. All of the fracture surfaces of both sets contain coarse plumose structure and are subplanar. The outcrop weathers into rounded shapes between the joint planes.
Geologist(s)	MAG, DBY
Data Date	08/24/85

Station 624

n = 6



* F3C n = 6

Schmidt net, lower hemisphere projection

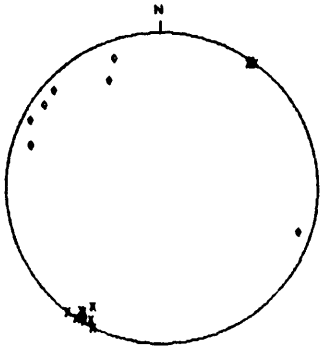
624F3C

N65E85SE
N57E85SE
N64E81SE
N30E88SE
N30E87SE
N51E70SE

Station Number	625
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T9S, R90W, SW 1/4, NE1/4, NE1/4, NW1/4 sec 18
Exposure Description	Elev. 8280 ft. 0.1 km N of West Divide Creek on steep, SSW-end of ledge-capped cliff that extends up slope for tens of m. 1.2 km NW of Haystack Mtn. Ledge is ~ 7 m high x 30 m long. Locally an erosion pavement. Ledge is exposed laterally and across the creek. Slightly metamorphosed arenite.
Stratigraphic Unit	Basal Wasatch Fm
Lithology (General)	Very low grade schist and porphoritic monzonite Porphyritic aphanitic monzonite dike
Cement	Noncalcareous, silica rich; local magnetic bands
Color, fresh	Greenish gray; local black bands
Color, weathered	Greenish gray; local black bands
Grain size	Fine- to coarse-grained; local pebbles to 5-cm dia
Grain sorting	Phenocrysts in dike, 1-2 mm long dimension
Grain roundness	
Bed Orientation	N38W/20SW (n=3)
Bed Thickness	5-7 m
F2C Orientation	N60W/90 (n=15)
Spacing	0.08-0.9 m (tr); 0.12-0.75 m (cr)
Height	>5 m
Length	>3 m
Structures	Arrest lines; twist-hackle near top of fractures
Shape	Subplanar to planar; broadly undulatory in strike
Termination	None seen
Mineralization	Surfaces are too weathered for data collection
F4 Orientation	N35E/81SE (n=7)
Termination	Against or across F2 (min. ?)
Mineralization	None seen
Remarks	The F2 fractures are nearly vertical despite the 20-degree dip of the altered sandstone beds; they therefore postdate intrusion of the dike, mapped as Miocene. F2 fracture surfaces are large and sinuous along strike, but some are fairly planar. Most of the surfaces are weathered, but arrest lines, and twist-hackle fringes along the upper boundaries of some joints are seen. The F4 fractures are crudely formed, irregular in shape; only the most planar were measured. They are layer-confined and less than 1 sq m in area. In the thinnest, finest grained, and best cemented beds, a few joints are oriented NNE occur; one cuts across several, probably once mineral-filled F2 fractures.
Geologist(s)	MAG, DBY
Data Date	08/25/85

Station 625

n = 22



x F2C n = 15
♦ F4 n = 7

Schmidt net, lower hemisphere projection

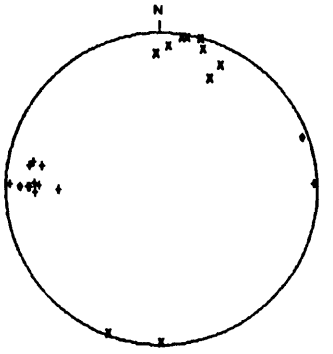
625F2C	625F4
N54W89SW	N1BE77SE
N55W89SW	N1BE81NW
N58W85NE	N64E66SE
N57W90NE	N42E62SE
N53W87SW	N27E84SE
N60W89NE	N70E78SE
N55W90SW	N35E81SE
N60W77NE	
N53W90NE	
N57W84NE	
N64W90NE	
N58W84NE	
N62W86NE	
N60W89NE	
N53W90SW	

Station Number	634
Quadrangle	Hightower Mountain 7.5'
Twp, Range, Section	T8S, R91W, NW1/4 NW1/4 SW1/4 NE1/4 sec 22
Exposure Description	Elev. 7180 feet. NW side Road Gulch, 0.33 km west of confluence with Alkalai Creek, S-facing side of SE-facingpromontory . Horizontally laminated to planar crossbedded, 3-4 m-thick ledge that extends ~100 m laterally. Ledge is rounded by weathering and locally slumped. Underlain by mudstones.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Slightly calcareous; moderately indurated
Color, fresh	Medium grayish orange
Color, weathered	Light grayish tan
Grain size	Coarse fine-grained to medium grained
Grain sorting	Moderately sorted
Grain roundness	Subangular to subrounded
Bed Orientation	N75E/14NW (n=2)
Bed Thickness	3-4 m
F1C Orientation	N8E/77SE (R) n=11
Spacing	0.25-3 m (tr); 2-3 m (cr)
Height	3-4 m
Length	>3 m
Structures	Crude plumose structure common
Shape	Subplanar; broadly undulatory in strike and dip
Termination	None seen
Mineralization	None seen
F2C Orientation	N72W/82NE (R) (n=10)
Spacing	0.5-1.5 m (cr)
Height	1-4 m
Length	0.25-2 m (tr); 2 m (avg)
Structures	Plumes; closely spaced but long twist hackle
Shape	Subplanar; broadly undulatory
Termination	Against F1
Mineralization	None seen
F4 Orientation	N9W/87SW (n=2)
Termination	Against F2
Mineralization	None seen
Remarks	F1 fractures are large and subplanar but gently undulatory along both strike and dip. Coarse plumose structures are common. Many F1 are in 0.25-m wide zones that wedge out near base of the sandstone and form a single fracture. Only one F1 fracture extended into the underlying mudstone. Few F1 fractures occur in the small (<1-m thick) concretionary lenses. F2 fractures also are large but are more abundant in the concretionary lenses.

Station Number	634 (contd)
	Fractures in both sets contain surface structures, commonly coarse plumes. F4 fractures occur only in the concretionary lenses and terminate against the F2 fractures; they therefore all are small and the youngest regional fractures to form in these sandstones.
Geologist(s)	MAG, DBY
Data Date	03/25/86

Station 634

n = 23



♦ F1C n = 11
x F2C n = 10
♦ F4 n = 2

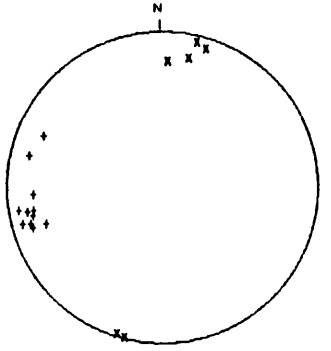
Schmidt net, lower hemisphere projection

634F1C	634F2C	634F4
N01E74SE	N80W88SW	N20W86SW
N12E73SE	N90W88SW	N01E80SE
N02E87SE	N66W66SW	
N02E68SE	N88E76SE	
N01E75SE	N87W81SW	
N02W88SW	N75W89SW	
N03E71SE	N70W88NE	
N00E56SE	N64W77SW	
N11E67SE	N82W87SW	
N10E75SE	N73W83SW	
N01W70NE		

Station Number	635
Quadrangle	Hightower Mountain 7.5'
Twp, Range, Section	T8S, R92W, NW1/4 SW1/4 NE1/4 SE1/4 sec 10
Exposure Description	Elev. 6880 feet. ESE-facing ledge above W side Alkali Creek, 0.25 km N of Reservoir Gulch. Ledge is ~5 m thick and extends laterally for several tens of meters. Planar crossbedded in 0.5 m thick sets; locally horizontally and trough crossbedded.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Calcareous; moderately well indurated
Color, fresh	Light greenish to gray tan
Color, weathered	Light orange brown
Grain size	Fine to medium grained
Grain sorting	Fairly well sorted
Grain roundness	Subrounded to subangular
Bed Orientation	N6W/6SW (n=4)
Bed Thickness	3-5 m
F1A Orientation	N10W/73NE (n=11)
Spacing	0.25-4 m (tr); 1-3 (cr)
Height	3-5 m
Length	4-7 m (tr); 4-6 m (cr)
Structures	Crude plumes, twist hackle, arrest lines
Shape	Fairly planar; locally forked laterally
Termination	None seen
Mineralization	None seen
F2C Orientation	N76W/85SW (n=6)
Spacing	0.05-3 m (tr)
Height	3 m (max)
Length	1-3 m (cr)
Structures	None seen
Shape	Subplanar; broadly undulatory in strike and dip
Termination	Against F1A
Mineralization	None seen
Remarks	F1 fractures are very well developed, large, and dominate the outcrop. They are very closely spaced for such large fractures in this type of sandstone but do not quite cut the full height of the layer. Surfaces are fairly planar but finely sinuous; some fork along bedding. Surface structures include twist-hackle fringes, plumes, and arrest lines that indicate lateral propagation. Locally, some F1 fractures propagated vertically. The F2 fractures are fairly crudely formed, sparse, broadly undulatory, and layer-confined, which may be due to the close spacing of the F1 fractures.
Geologist(s)	MAG, DBY
Data Date	03/25/86

Station 635

n = 17



+ F1A n = 11
x F2C n = 6

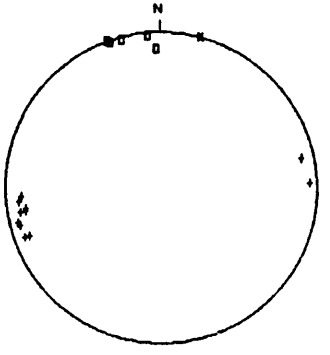
Schmidt net, lower hemisphere projection

635F1A	635F2C
N17W76NE	N72W82SW
N17W67NE	N78W73SW
N12W74NE	N75W89NE
N10W77NE	N87W70SW
N10W73NE	N72W88NE
N09W83NE	N76W85SW
N15W77NE	
N03W72NE	
N24E72SE	
N14E77SE	
N14W82NE	

Station Number	641
Quadrangle	Hightower Mountain 7.5'
Twp, Range, Section	T8S, R92W, NW1/4 SW1/4 NW1/4 NW1/4 sec 22
Exposure Description	Elev. 7860 feet. SSE-facing ledge of sandstone at top of ridge, 1.3 km WNW of confluence of Road Gulch and Alkalai Creek. Ledge is ~8 m high and extends discontinuously for tens of m to the NE. Trough crossbedded, sets 0.4 m thick; locally planar bedded with pebble conglomerate lenses.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Calcareous; moderately indurated, porous
Color, fresh	Light olive tan
Color, weathered	Light brownish-pink tan
Grain size	Fine medium- to medium-grained
Grain sorting	Moderately to moderately poorly sorted
Grain roundness	Subangular to subrounded
Bed Orientation	N30E/12NW (n=1)
Bed Thickness	3-4 m
F1C Orientation	N11W/89SW (R) (n=12)
Spacing	0.65-5 m (tr); 2-4 m (avg)
Height	3-4 m; zones, 7-8 m
Length	Not determined
Structures	Abundant coarse plumes; some arrest lines
Shape	Fairly planar; several ends curved into hooks
Termination	None seen
Mineralization	Noncalcareous secondary mineral coatings
F2C Orientation	N74W/86SW (R) (n=1)
F3C Orientation	N75E/88SE (R) (n=5)
Spacing	Not determined
Height	3-4 m (cr)
Length	0.65-3 m (cr)
Structures	Coarse plumes, arrest lines, twist hackle common
Shape	Broadly arcuate along strike and dip
Termination	Against F1
Mineralization	None seen
Remarks	F1 fractures are very large and dominate the outcrop. Most F1 are in zones a few mm to cm wide composed of several individual fractures 3 m or less high, the height of the internally bedded units. The zones cut the full 7- to 8-m thick bed. Only one well-formed F2 fracture occurs. The F3 fractures are numerous, layer-confined, subplanar, and terminate laterally against the F1 fractures. Surface structures, such as coarse plumes and arrest lines are common on joints of all three sets.
Geologist(s)	MAG, DBY
Data Date	03/27/86

Station 641

n = 18



+ F1C n = 12
x F2C n = 1
* F3C n = 5

Schmidt net, lower hemisphere projection

641F1C	641F2C	641F3C
N12W81SW	N75W90SW	N71E89SE
N20W82NE		N70E90SE
N04W79NE		N88E78SE
N02W85SW		N75E88SE
N15W83NE		N85E88SE
N10W77NE		
N10W81NE		
N06W81NE		
N09W77NE		
N14W84NE		
N10W81NE		
N20W79NE		

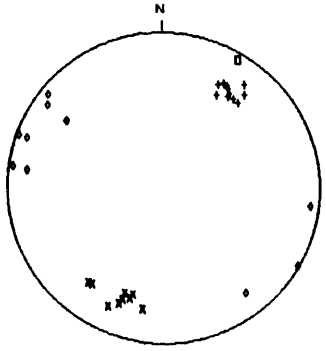
Station Number	642
Quadrangle	Gibson Gulch 7.5'
Twp, Range, Section	T7S, R92W, NW1/4 SE1/4 SE1/4 NW1/4 sec 24
Exposure Description	Elev. 6220 ft. Vertical roadcut, immediately E of W. Divide Creek and 311 Rd., ~milepost 10.5. WSW-facing, 20-m long cut with 2.5-m thick, trough crossbedded sandstone ledge underlain by non-jointed variegated mudstone. Ledge is weathered enough to obscure bedding structures.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Slightly calcareous; poorly indurated, very porous
Color, fresh	Greenish gray
Color, weathered	Greenish gray
Grain size	Fine medium- to medium-grained
Grain sorting	Moderately sorted
Grain roundness	Subangular to subrounded
Bed Orientation	N31E/4SE (n=1)
Bed Thickness	2-2.5 m
F2A Orientation	N55W/64SW (n=11)
Spacing	0.1-1.25 m
Height	1-2.5 m
Length	>1 m
Structures	Plumose structure
Shape	Planar
Termination	Locally against F2B
Mineralization	None seen
F2B Orientation	N70W/66NE (n=9)
Spacing	0.1-1.5 m
Height	1-2.5 m
Length	>1 m
Structures	Plumose structure
Shape	Planar
Termination	Locally against F2A
Mineralization	None seen
F2C Orientation	N60W/85SW (n=1)
F4 Orientation	N25E/87SE (n=10)
Spacing	Not determined
Height	1-2 m
Length	0.1-1.5 m
Structures	Plumose structure, arrest lines, and hooks
Shape	Subplanar; curved broadly along dip
Termination	Against F2A and F2B
Mineralization	None seen
Remarks	Moderately dipping fractures that predate the vertical F2 set dominate the outcrop. The SW-dipping set is prominant near the middle of the ledge

Station Number	642 (contd)

and the NE-dipping set at the N and S ends. There is only one vertical F2C fracture which is confined vertically by the moderately dipping fractures. Where the moderately dipping fractures are in the same part of the outcrop, the SW-dipping set will terminate against the NE dipping set, or the converse is true. Vertical F4 fractures are a crudely formed set of cross joints.

Geologist(s)	MAG, DBY
Data Date	03/27/86

n = 31



♦ F2A n = 11
x F2B n = 9
▲ F2C n = 1
● F4 n = 10

Schmidt net, lower hemisphere projection

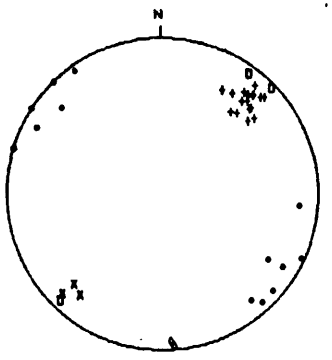
642F2A	642F2B	642F2C	642F4
N60W67SW	N80W68NE	N60W85SW	N35E64SE
N49W68SW	N70W66NE		N39E84SE
N52W62SW	N70W62NE		N52E74NW
N52W73SW	N73W64NE		N20E88SE
N60W58SW	N52W67NE		N36E80SE
N57W65SW	N65W73NE		N20E82SE
N58W66SW	N54W66NE		N07E77SE
N55W63SW	N74W61NE		N30E89NW
N55W61SW	N69W69NE		N07E84NW
N62W64SW			N08E87SE
N49W62SW			

Station Number	644
Quadrangle	Gibson Gulch 7.5'
Twp, Range, Section	T7S, R91W, SE1/4 NW1/4 NW1/4 NE1/4 sec 15
Exposure Description	Elev. 6960 ft. SSW-facing ledge, SW side of mesa between Gibson Gulch and East Divide Creek, 0.75 km NE of road, ~milepost 1.4, above head of SW-draining tributary to East Divide Creek. Ledge, ~10 m thick, discontinuously extends several tens of m along ridge. Planar to trough crossbedded.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone with local pebble conglomerate
Cement	Calcareous; moderately to well indurated
Color, fresh	Light brownish-pink tan
Color, weathered	Light brownish tan
Grain size	Coarse fine-grained
Grain sorting	Moderately well sorted
Grain roundness	Subangular to subrounded
Bed Orientation	N35E/4NW (n=3)
Bed Thickness	3.5-6 m
F2A Orientation	N47W/68SW (n=18)
Spacing	0.25-3 m (tr); 0.5 m avg
Height	1.5-2 m (individual); 5-6 m (zones)
Length	>2.5 m
Structures	Arrest lines, coarse plumes, crude twist hackle
Shape	Fairly planar; zones are undulatory in dip
Termination	Locally against F2B
Mineralization	Siliceous fibers, oriented down dip
F2B Orientation	N46W/72NE (n=3)
Spacing	Too variable; sparse data
Height	>0.25-0.33 m (individual); 5-6 m (zones)
Length	>0.6 m
Structures	Crude twist hackle
Shape	Subplanar; more undulatory in dip than F2A
Termination	Against F2A; locally none seen
Mineralization	None seen
F2C Orientation	N54W/86SW (n=4)
Spacing	Too variable; sparse data
Height	1 m
Length	>0.33 m
Structures	Crude twist hackle
Shape	Subplanar; curve broadly in dip, less so in strike
Termination	Against F2A and F2B
Mineralization	None seen
F3C Orientation	N86E/85NW (n=2)
F4 Orientation	N33E/88NW (n=13)
Spacing	0.5-2.5 m (tr)
Height	1-3.5 m
Length	0.25-3 m
Structures	Plumose structure, twist hackle
Shape	Subplanar; curve broadly in dip and hook in strike
Termination	Against F2A, F2B, and F2C
Mineralization	None seen
Remarks	The moderately steeply dipping fractures predominate; those with a SW dip are the largest. Both are local sets that strike parallel to the trace of the anticline and apparently formed during extension of the outer arc of the fold. They predate the vertical F2 fractures. Most of the moderately steeply dipping fractures are in long, 5-10-cm wide zones composed of several individual fractures of smaller dimension. The zones are undulatory in profile because the fractures in the zones are rarely connect and instead overlap. All of these fractures propagated laterally, parallel to bedding. Only two large F3 fractures occur. F4 fractures terminate against fractures of all other sets.

Station Number 644 (contd)

Geologist(s)	MAJ, DBY
Data Date	03/28/86

n = 40



♦ F2A n = 18
▪ F2B n = 3
▮ F2C n = 4
◆ F3C n = 2
● F4 n = 13

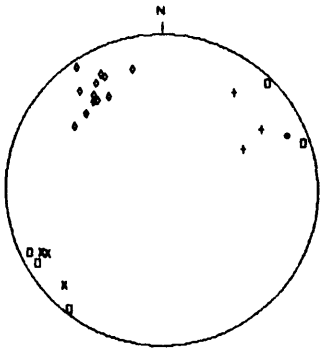
Schmidt net, lower hemisphere projection

644F2A	644F2B	644F2C	644F3C	644F4
N49W73SW	N51W72NE	N46W84NE	N86E88NW	N41E83NW
N51W72SW	N46W70NE	N44W87SW	N87E84NW	N46E89SE
N39W65SW	N45W80NE	N54W84SW		N55E86SE
N49W80SW		N54W84SW		N31E79NW
N47W60SW				N25E88NW
N49W80SW				N20E90SE
N44W77SW				N05E77NW
N43W79SW				N41E74SE
N55W67SW				N33E89SE
N47W74SW				N47E84NW
N47W75SW				N50E78NW
N50W58SW				N32E69NW
N40W61SW				N28E80SE
N47W69SW				
N44W68SW				
N60W66SW				
N44W67SW				
N49W67SW				

Station Number	645
Quadrangle	Gibson Gulch 7.5'
Twp, Range, Section	T7S, R91W, NW1/4 NE1/4 SE1/4 NW1/4 sec 20
Exposure Description	Elev. 6620 ft. Roadcut, N side East Divide Creek and road, immediately SW of milepost 3. SW-facing roadcut, ~5 m high x ~30 m long. 3-m thick, horizontally interbedded sandstones and siltstones, and local carbonaceous fragments and lenses (see Station 646).
Stratigraphic Unit	Basal Wasatch Fm
Lithology (General)	Sandstone
Cement	Noncalcareous; moderately indurated, porous
Color, fresh	Light tan to light brownish gray
Color, weathered	Orangish brown to brownish gray
Grain size	Fine- to coarse medium-grained
Grain sorting	Moderately sorted
Grain roundness	Subrounded to subangular
Bed Orientation	N48E/7SE (n=3)
Bed Thickness	1.25-2.5 m
F1A Orientation	N32W/64SW (n=3)
Spacing	Irregular
Height	2.5 m
Length	>1.5 m
Structures	Plumose structure
Shape	Subplanar; finely undulatory and hummocky appearing
Termination	None seen
Mineralization	None seen
F1B Orientation	N30W/75NE (n=3)
Spacing	Irregular
Height	1.2
Length	>0.33 m
Structures	Plumose structure
Shape	Subplanar; finely undulatory (hummocky appearing)
Termination	Against F1A, generally
Mineralization	None seen
F1C Orientation	N31W/85NE (n=5)
Spacing	0.25-0.5 m (in thinner beds)
Height	0.5-1 m
Length	>0.33 m
Structures	Plumose structure, local arrest lines
Shape	Subplanar; broadly curved in dip
Termination	None seen
Mineralization	None seen
F3A Orientation	N54E/66SE (n=12)
Spacing	Variable
Height	1-2.5 m
Length	0.25-0.5 m (cr)
Structures	Crude plumose structure
Shape	Subplanar
Termination	Against F1A, F1B, and F1C
Mineralization	None seen
F4 Orientation	N24W/77SW (n=1)

Station Number	645 (contd)
Remarks	The moderately steeply dipping fractures are older than the F1 set, are the largest in the roadcut, but are not well exposed. The SW-dipping fractures are found mainly near the southeast end of the cut. The vertical F1 fractures are more abundant and occur mainly in the better cemented beds near the bottom of the cut and in the thinner beds near the NE end. The F3 fractures are sparse, terminate against the F1 fractures, and most dip to the SE. There is only one vertical F3 fracture and only one F4 fracture. All of the vertical fractures occur chiefly in the better cemented parts of the sandstone layers.
Geologist(s)	MAG, DBY
Data Date	03/28/86

n = 24



♦ F1A n = 3
x F1B n = 3
■ F1C n = 5
◊ F3A n = 12
• F4 n = 1

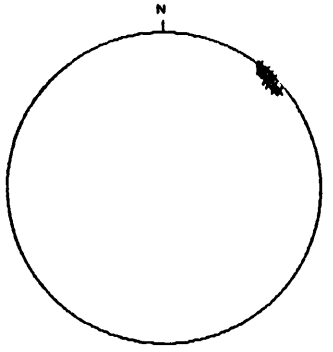
Schmidt net, lower hemisphere projection

645F1A	645F1B	645F1C	645F3A	645F4
N54W67SW	N30W73NE	N26W83NE	N76E69SE	N24W77SW
N27W49SW	N28W76NE	N53W87NE	N54E60SE	
N32W64SW	N45W77NE	N46W86SW	N54E64SE	
		N19W85SW	N60E58SE	
		N31W82NE	N45E58SE	
			N50E71SE	
			N58E69SE	
			N62E72SE	
			N63E70SE	
			N36E58SE	
			N52E61SE	
			N55E85SE	

Station Number	646
Quadrangle	Gibson Gulch 7.5'
Twp, Range, Section	T7S, R91W, NW1/4 NE1/4 SE1/4 NW1/4 sec 20
Exposure Description	Elev. 6620 ft. Same roadcut as Sta. 645. Small stringers, concretions, and blebs of carbonaceous material. Largest concretion is 18 l x 8 cm h. Estimated vitrain, 20%; estimated durain, 60%. Subbituminous to bituminous.
Stratigraphic Unit	Basal Wasatch Fm
Lithology (General)	Carbonaceous material
Cement	Noncalcareous
Color, fresh	Black
Color, weathered	Black
Grain size	
Grain sorting	
Grain roundness	
Bed Orientation	N48E/7SE (n=3)
Bed Thickness	0.02-0.08 m
Orientation	N47W/87SW (n=16)
Spacing	0.001-0.012 m (cr)
Height	0.02-0.08 m
Length	0.005-0.015 m (tr)
Structures	Not determined
Shape	Planar
Termination	As hairline cracks
Mineralization	None seen
Remarks	The coal face cleats appear to correlate with local sets that strike parallel to the trace of the Divide Creek anticline and formed during extension of the outer arc of the fold. Some face cleats extend a few mm above and below the coal lens. A crude set of butt (end) cleats are perpendicular to the face cleats; they were not measured. All cleats are perpendicular to regional bedding, despite the orientation of the coal lens, except for the smallest blebs, where the cleats are perpendicular to the long dimension of the bleb.
Geologist(s)	MAG, DBY
Data Date	03/28/86

Station 646

n = 16



x n = 16

Schmidt net, lower hemisphere projection

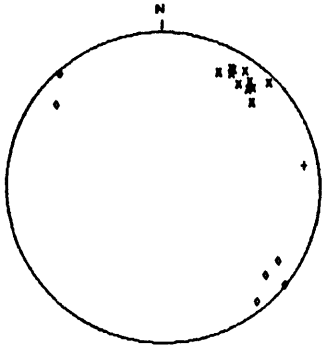
646

N43W86SW
N42W84SW
N51W88SW
N51W87SW
N50W87SW
N49W87SW
N47W84SW
N47W89SW
N52W90SW
N47W90SW
N46W87SW
N50W88SW
N49W90SW
N40W86SW
N45W90SW
N45W84SW

Station Number	647
Quadrangle	Bibson Gulch 7.5'
Twp, Range, Section	T7S, R91W, SE1/4 SE1/4 NE1/4 NW1/4 sec 22
Exposure Description	Elev. 7180 ft. Ledge on S-facing, prominent knob, 0.15 km N of East Divide Creek and road, 0.35 km W of Spruce Crossing Gulch. Sandstone, 4-5 m thick, ~30 m long. Horizontally to planar bedded with gentle trough crossbeds and climbing ripple beds. Much of ledge has slumped slightly; locally more.
Stratigraphic Unit	Basal Wasatch Fm
Lithology (General)	Sandstone
Cement	Slightly calcareous; moderately well indurated
Color, fresh	Light greenish gray to brownish tan
Color, weathered	Brownish tan
Grain size	Coarse fine-grained
Grain sorting	Moderately well sorted
Grain roundness	Subangular to subrounded
Bed Orientation	N15W/10NE (n=2)
Bed Thickness	4-5 m
F1C Orientation	N9W/90(R) (n=1)
F2C Orientation	N52W/84SW (R) (n=11)
Spacing	0.5-5 m (tr); 1.5-2.5 m (cr)
Height	2-4 m
Length	Not determined
Structures	Coarse twist hackle and plumose structure
Shape	Subplanar; forked locally along internal partings
Termination	One propagated from an F1
Mineralization	None seen
F4 Orientation	N40E/89SE (R) (n=6)
Spacing	Not determined
Height	1.5-2.25 m
Length	0.5-5 m (tr); 1.5-2.5 m (cr)
Structures	None seen
Shape	Nonplanar; broadly curved in strike and in dip
Termination	Against F2
Mineralization	None seen
Remarks	Only one F1 fracture was found; an F2 propagated from it. The F2 fractures dominate the outcrop, which is weathered, spalled, and slumped. Only that part of the outcrop which appeared intact was measured. The F2 fractures generally are subvertical, but near the E end of the outcrop they dip moderately steeply, both SW and NE. They were not measured for that part of the ledge was slumped. The F4 fractures are layer-confined, broadly curved both in strike and dip, and crudely formed.
Geologist(s)	MAG, DBY
Data Date	03/29/86

Station 647

n = 18



♦ F1C n = 1
x F2C n = 11
♦ F4 n = 6

Schmidt net, lower hemisphere projection

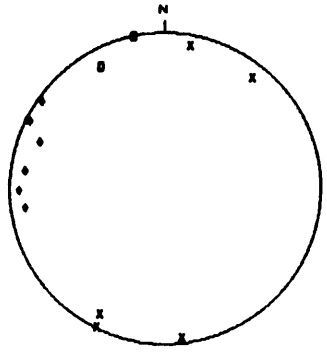
647F1C	647F2C	647F4
N09W80SW	N44W68SW	N38E75SE
	N49W72SW	N51E84NW
	N48W75SW	N33E76NW
	N51W77SW	N39E89NW
	N55W81SW	N48E88SE
	N45W85SW	N41E75NW
	N59W77SW	
	N60W77SW	
	N59W74SW	
	N64W71SW	
	N54W71SW	

Station Number	657
Quadrangle	Hightower Mountain 7.5'
Twp, Range, Section	T8S, R92W, NW1/4 SE1/4 NW1/4 NE1/4 sec 31
Exposure Description	Elev. 7980 feet. SSE-facing, discontinuous ledge, 0.25 km NW of Road Gulch and FS road 270, 1.35 km N of mouth of Middleton Creek. Sandstone, massive appearing, local trough cross-beds; 4 m high x ~30 m long. Pebble conglomerate near base. Erosional pavement at top; weathered, rounded cliff face.
Stratigraphic Unit	Basal Wasatch Fm.
Lithology (General)	Sandstone
Cement	Calcareous; moderate to moderately well indurated
Color, fresh	Light buff to light gray
Color, weathered	Light buff to light medium gray
Grain size	Coarse medium to coarse grained
Grain sorting	Moderately to poorly sorted
Grain roundness	Subangular
Bed Orientation	N75E/3NW (n=1)
Bed Thickness	3.5-4 m
F2C Orientation	N64W/89NE (n=5)
Spacing	5-9 m
Height	>3.5-4 m
Length	>5 m
Structures	Probable arrest lines, but obscured by weathering
Shape	Subplanar; undulatory in strike
Termination	None seen
Mineralization	None seen
F3C Orientation	N70E/84SE (n=2)
Termination	None seen
Mineralization	None seen
F4 Orientation	N20E/82SE (n=7)
Spacing	2.5-6 m
Height	3.5-4 m
Length	5-9 m
Structures	Large arrest lines, but obscured by weathering
Shape	Subplanar; undulatory in strike
Termination	Against F2
Mineralization	None seen
Remarks	F2 fractures dominate the outcrop, but are difficult to measure because they are perpendicular to the weathered, spalled, brush-covered outcrop face. The F3 fractures could only be seen on the erosional pavement, which was sparsely exposed, and the set was established on the basis of orientation alone. F4 fractures are the most numerous, parallel the ledge face, and are similar in style and orientation to the F4 fractures studied

Station Number	657 (contd)
	throughout the basin.
Geologist(s)	MAG, DBY
Data Date	06/05/86

Station 657

n = 14



x F2C n = 5
▪ F3C n = 2
♦ F4 n = 7

Schmidt net, lower hemisphere projection

657F2C	657F3C	657F4
N80W82SW	N62E78SE	N26E89SE
N52W80SW	N78E90SE	N26E87SE
N63W80NE		N35E87SE
N83E86NW		N08W80NE
N64W89NE		N07E80SE
		N01W83NE
		N20E75SE

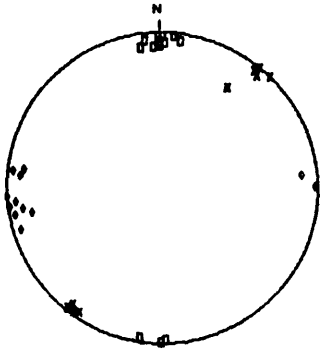
Station Number	658
Quadrangle	Flatiron Mountain 7.5'
Twp, Range, Section	T8S, R92W, NW1/4 NE1/4 NW1/4 NW1/4 sec 36
Exposure Description	Elev. 8340 feet. S-facing prominent ledge, S side NW-SE-trending ridge at head of N fork of Alkali Creek. Sandstone, massive, 8-9 m thick. Moderately large trough and planar cross-beds; local climbing ripple beds and pebble conglomerate. Local 8-15-cm thick sandstone lenses; silty partings.
Stratigraphic Unit	Wasatch Fm.
Lithology (General)	Sandstone
Cement	Calcareous; moderately to well indurated
Color, fresh	Light tan and light gray
Color, weathered	Orange tan and red purple
Grain size	Medium to coarse grained and very fine grained
Grain sorting	Moderately to well sorted
Grain roundness	Subangular to subrounded
Bed Orientation	Horizontal
Bed Thickness	0.08-7.5 m
F2C Orientation	N51W/90 (n=9)
Spacing	0.33-0.75 m
Height	0.25-0.33 m
Length	>0.5 m
Structures	Plumose structure
Shape	Planar to subplanar
Termination	None seen
Mineralization	None seen
F3C Orientation	W/86S (n=13)
Spacing	0.5-4.5m (tr); 3 m (avg)
Height	0.08->6 m
Length	4.5-16 m (cr); 10 m (avg)
Structures	Well formed plumose structure; large twist hackles
Shape	Subplanar; broadly undulatory in strike
Termination	Against F2 in thin lenses
Mineralization	None seen
F4 Orientation	N5W/86NE (n=12)
Spacing	1-16 m (tr)
Height	0.08-5 m (tr)
Length	0.05-4.5 m (tr); 0.5-4.5 (cr)
Structures	Plumose, arrest lines, poorly formed twist hackle
Shape	Subplanar, broadly curved in dip; locally planar
Termination	Against F2 and F3
Mineralization	None seen
Remarks	F2 fractures occur only in the thin, red-purple weathering, very fine grained sandstone lenses. The F3 fractures, however, occur in all beds, are very large and dominate the outcrop. Many F3

Station Number 658 (contd)

fractures have caused the rock to weather into large, rounded, elongate shapes subparallel to the cliff face. Large twist hackle on F3 faces cut across the thin sandstone lenses and originated at the F2 fractures within the lenses. Locally F3 fractures are in 10-20 cm-wide zones of as many as 3 discontinuous fractures. F4 fractures occur in all beds, are confined by the silty partings and broadly curved in dip. Unlike most F4 fractures in the basin, however, some F4 fractures are very planar.

Geologist(s) MAG, DBV
Data Date 06/06/86

n = 34



▪ F2C n = 9
▪ F3C n = 13
♦ F4 n = 12

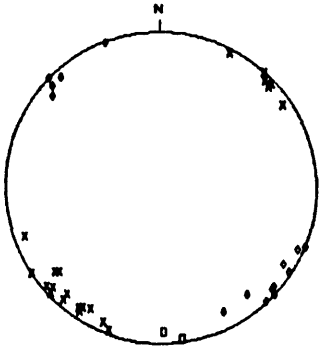
Schmidt net, lower hemisphere projection

658F2C	658F3C	658F4
N51W88NE	N89E87SE	N08E79SE
N56W66SW	N85W88SW	N03W90NE
N54W88NE	N89W87SW	N07E86SE
N50W90SW	N87E80SE	N00W88SW
N56W86NE	N82W85SW	N10W86NE
N45W90SW	N88W83SW	N05W79SW
N51W86SW	N84E85SE	N10W74NE
N52W84NE	N81W87NE	N05E81SE
N49W84SW	N89E87NW	N05W84NE
	N90E84SE	N16W84NE
	N89W89NE	N07W89NE
	N82E80SE	N08W80NE
	N90E81SE	

Station Number	659
Quadrangle	Hightower Mountain 7.5'
Twp, Range, Section	T8S, R92W, NW1/4 NE1/4 SW1/4 NW1/4 sec 26
Exposure Description	Elev. 7360 feet. N-facing slump scar, S side Bear Gulch, above slumped jeep trail, 0.5 km E of FS road 816 and Alkalai Creek, 20 m long x 5 m high. Lowermost 2-3 m-thick sandstone lens of gently dipping trough and planar cross-beds and laminations. Overlain by variegated mudstone.
Stratigraphic Unit	Wasatch Fm.
Lithology (General)	Sandstone
Cement	Slightly calcareous; well indurated
Color, fresh	Light olive tan
Color, weathered	Pink brown
Grain size	Fine grained
Grain sorting	Moderately well sorted
Grain roundness	Subangular
Bed Orientation	N9E/3SE (n=1)
Bed Thickness	2-3 m
F2C Orientation	N46W/86NE (n=21)
Spacing	0.2-1.5 m (tr); 0.75 m (avg)
Height	2-3 m
Length	>2 m
Structures	Local twist hackle
Shape	Subplanar
Termination	None seen
Mineralization	Local fibrous calcite; caliche coats all surfaces
F3C Orientation	N87E/84NW (n=2)
Termination	Against F2
Mineralization	Caliche coats all surfaces
F4 Orientation	N43E/88NW (n=15)
Spacing	0.2-1.25 m (tr); 0.25 m (avg)
Height	1-3 m
Length	0.33-1.5 m; 0.75 m (avg)
Structures	Obscured by caliche
Shape	Subplanar; broadly undulatory in profile
Termination	Against F2 and F3; local hooks
Mineralization	Fibrous caliche coats surfaces
Remarks	The F2 fractures are the largest and best formed, but terminate vertically against a thin silt unit. Many F2 fractures occur in 0.1-0.25 m-wide zones composed of several discontinuous fractures. Few F3 fractures are present, but terminate agasint F2 fractures. F4 fractures are numerous and also layer-confined. Surface features of all of the fractures are obscured by coatings of caliche.
Geologist(s)	MAG, DBY
Data Date	06/06/86

Station 659

n = 38



x F2C n = 21
• F3C n = 2
◊ F4 n = 15

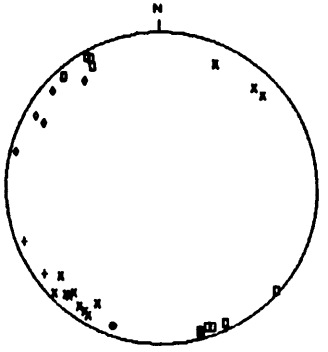
Scheidt net, lower hemisphere projection

659F2C	659F3C	659F4
N41W87NE	N89E82NW	N63E78NW
N34W84SW	N82E87NW	N22E90NW
N43W84NE		N69E89SE
N48W90SW		N47E89NW
N39W76NE		N44E90SE
N49W85NE		N48E85SE
N44W88NE		N32E82NW
N46W86SW		N42E86NW
N56W83NE		N43E90NW
N57W81NE		N41E86NW
N70W87NE		N40E80SE
N60W79NE		N43E85SE
N57W85NE		N24E86NW
N43W87SW		N33E88NW
N67W84NE		N51E77NW
N49W81NE		
N20W82NE		
N40W74NE		
N43W84SW		
N63W87SW		
N34W90NE		

Station Number	660
Quadrangle	Hightower Mountain 7.5'
Twp, Range, Section	T8S, R92W, SW1/4 NW1/4 NE1/4 NE1/4 sec 33
Exposure Description	Elev. 8040 feet. SE-facing ledge near top of NE-SW trending knob between head of East Road Gulch and a NE-flowing tributary to Alkali Creek, ~25 m W of high tension lines. Horizontal to low-angle trough cross-bedded sandstone lens, 3-5 m high x ~60 m long. Underlain by variegated mudstone.
Stratigraphic Unit	Wasatch Fm.
Lithology (General)	Sandstone, micaceous
Cement	Slightly calcareous; moderately indurated
Color, fresh	Light gray
Color, weathered	Orange brown to tan
Grain size	Fine grained to fine medium grained
Grain sorting	Moderately well sorted
Grain roundness	Subangular to subrounded
Bed Orientation	N19E/14NW (n=1)
Bed Thickness	3-5 m
F1C Orientation	N28W/84NE (n=2)
Termination	None seen
Mineralization	None seen
F2C Orientation	N49W/84NE (n=12)
Spacing	1.5-several m (tr); 2-2.5 m (cr)
Height	3-5 m
Length	Not measured
Structures	Crude arrest lines; coarse twist hackle near base
Shape	Subplanar; broadly undulatory in strike
Termination	None seen
Mineralization	None seen
F3C Orientation	N64E/86NW (n=10)
Spacing	0.33-6 m (tr); 0.33-3 m (cr)
Height	3-5 m
Length	4 m
Structures	Large arrest lines
Shape	Subplanar; broadly undulatory in strike
Termination	Against F2
Mineralization	Caliche
F4 Orientation	N30E/82SE (n=5)
Spacing	Not measured
Height	3-5 m
Length	0.33-2.5 m
Structures	None seen
Shape	Subplanar; broadly undulatory in strike and dip
Termination	Against F2 and F3
Mineralization	None seen
F5 Orientation	N70W/82NE (n=1)
Termination	Against F1 and F4
Mineralization	None seen

Remarks	F2 fractures are the most planar and dominate the outcrop. Several closely-spaced F2 fractures comprize mm- to cm-wide zones, along which the ledge weathers. F3 fractures are best developed where the F2 fractures are not present, but are broadly curved and subplanar with "lumpy" surfaces. F4 fractures are best formed where the two older sets are absent; otherwise they are layer confined, non-planar, and crudely formed. All of the F4 fractures, however, are broadly undulatory in profile. Only one fracture of the F5 set and two of the F1 set were measured; their set designation was based on their lateral terminations with other fractures.
Geologist(s)	MAG, DBY
Data Date	06/08/86

n = 30



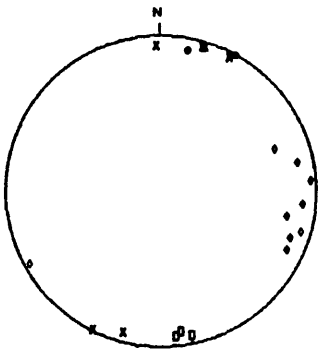
+	F1C	n = 2
x	F2C	n = 12
▪	F3C	n = 10
♦	F4	n = 5
●	F5	n = 1

Schmidt net, lower hemisphere projection

660F1C	660F2C	660F3C	660F4	660F5
N36W83NE	N66W76SW	N75E84NW	N29E75SE	N70W82NE
N21W84NE	N42W77SW	N62E84SE	N42E82SE	
	N47W77SW	N61E79SE	N55E73SE	
	N61W74NE	N61E86SE	N30E82SE	
	N48W81NE	N75E86NW	N14E86SE	
	N58W83NE	N49E84SE		
	N60W84NE	N42E88NW		
	N49W80NE	N65E85NW		
	N55W82NE	N70E84NW		
	N41W75NE	N72E83NW		
	N44W86NE			
	N50W77NE			

Station Number	661
Quadrangle	Hightower Mountain 7.5'
Twp, Range, Section	T9S, R92W, SW1/4 NW1/4 NW1/4 NE1/4 sec 18
Exposure Description	Elev. 7600 feet. SW-facing roadcut, N side Buzzard Creek and road, 2.5 km SE of Road Gulch, 3 m above road, ~25 m long. Sandstone lens, 0.3-0.5 m thick with mudstone partings. Overlain and underlain by very poorly indurated variegated mudstones. The sandstone surfaces are moderately weathered.
Stratigraphic Unit	Wasatch Fm.
Lithology (General)	Sandstone
Cement	Slightly calcareous; moderately well indurated
Color, fresh	Light olive tan
Color, weathered	Light olive tan
Grain size	Fine grained to coarse fine grained
Grain sorting	Moderately well sorted
Grain roundness	Subangular to subrounded
Bed Orientation	Subhorizontal
Bed Thickness	0.3-0.5 m
F2C Orientation	N73W/86SW (n=6)
Spacing	0.15-0.4 m
Height	0.3-0.5 m
Length	>0.4 m
Structures	Rough surfaces but no structures visible
Shape	Subplanar; somewhat undulatory in strike and dip
Termination	None seen
Mineralization	Caliche on all surfaces
F3C Orientation	N82E/82NW (n=3)
Spacing	Variable; not measured
Height	0.3-0.5 m
Length	>0.33 m
Structures	Surfaces are rough but structures not visible
Shape	Subplanar; quite undulatory in both strike and dip
Termination	None seen
Mineralization	Caliche on most surfaces
F4 Orientation	N5E/79NW (n=9)
Spacing	Not measured
Height	<0.3-<0.5 m
Length	0.15-0.55 m
Structures	Surfaces are rough but structures not visible
Shape	Nonplanar; several hook laterally to other F4
Termination	Against F2, F3, and some F4
Mineralization	Caliche
F5 Orientation	N70W/85SW (n=2)
Termination	Against F4
Mineralization	None seen

Station Number	661 (contd)
Remarks	Fractures of the F2 set are the best formed and the most planar. Their heights are not controlled by prominent partings within the sandstone layers. F3 fractures are best developed where the F2 fractures are not present and are much less planar than the F2 fractures. F4 fractures are nonplanar, confined by the mudstone partings, and terminate against the F2 and F3 fractures. Some nonplanar F5 fractures are present but are so irregular in shape and so variable in other characteristics that few were measured. The fractures of all of the sets are undulatory in both strike and dip; their surfaces therefore appear to be "lumpy".
Geologist(s)	MAG, DBY
Data Date	06/08/86
	n = 20



x F2C n = 6
F3C n = 3
◆ F4 n = 9
● F5 n = 2

Schmidt net, lower hemisphere projection

661F2C	661F3C	661F4	661F5
N64W89NE	N84E83NW	N25E78NW	N79W81SW
N75W83NE	N70E84NW	N11E71NW	N62W90SW
N74W86SW	N82E80NW	N20E77NW	
N63W86SW		N20W67SW	
N73W86SW		N16E83SW	
N88E83SE		N05E81NW	
		N12W79SW	
		N04W86SW	
		N29W86NE	

Station Number	662
Quadrangle	Hightower Mountain 7.5'
Twp, Range, Section	T9S, R92W, NW1/4 NW1/4 NW1/4 NE1/4 sec 29
Exposure Description	Elev. 7920 ft. WSW-facing slump scar, 0.75 km SSE of Buzzard Creek Campground, E side Buzzard Creek and FS road 265, ~35 m above road, ~30 m long x 10 m high. Sandstone lens, low-angle planar cross-bedded to planar bedded, 1.5-2.5 m thick. Overlain by poorly indurated variegated silty mudstone.
Stratigraphic Unit	Wasatch Fm.
Lithology (General)	Sandstone
Cement	Slightly calcareous; moderately indurated
Color, fresh	Light orange tan
Color, weathered	Orange tan
Grain size	Fine medium grained
Grain sorting	Moderately well sorted
Grain roundness	Subangular to subrounded
Bed Orientation	N51E/6SE (n=1)
Bed Thickness	1.5-2.5 m
F4 Orientation	N3W/77SW (n=9)
Spacing	0.03-1m
Height	1.5-2.5 m
Length	Not determined
Structures	Arrest lines common
Shape	Subplanar; broadly undulatory along strike
Termination	Against no other joint
Mineralization	Caliche and local gypsum
F5 Orientation	N80W/88SW (n=7)
Spacing	0.15-0.75 m
Height	1.5-2.5 m
Length	0.03-1 m
Structures	Arrest lines common
Shape	Subplanar; broadly undulatory in strike
Termination	Against F4
Mineralization	None seen

Remarks

The F4 fractures are best formed at the N end of the exposure and are exceptionally planar for only a moderately indurated rock. The F5 fractures are best formed at the S end of the exposure. Weathering fractures (w) are poorly formed, nonplanar, and only their orientations and terminations were measured. Concave-shaped fractures, subparallel with the strike of the slump scar, cut small promontories along the scar. They resemble sheeting joints but also are subparallel to the orientation of the slump scar and some may be reactivated F5 fractures. The weathering (w) fractures also are thought to have formed upon exposure of the land

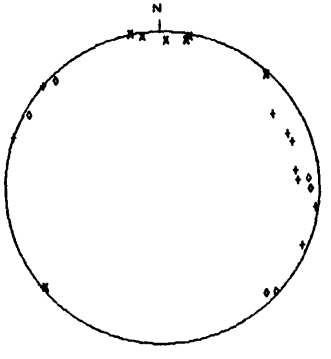
Station Number 662 (contd)

surface.

Geologist(s) MAG, DBY
Data Date 06/08/86

Station 662

n = 22



♦ 662F4 n = 9
x 662F5 n = 7
◊ 662W n = 6

Schmidt net, lower hemisphere projection

662F4	662F5	662W
N19E90SE	N83E87SE	N03W83SW
N23W76SW	N88W84SW	N01E84NW
N08E88NW	N79E90SE	N29E86SE
N03W76SW	N40W88NE	N46E86SE
N33W74SW	N79W88SW	N43E88NW
N41E90SE	N80W85SW	N46E84NW
N07W75SW	N47W88SW	
N23E86NW		
N19W77SW		

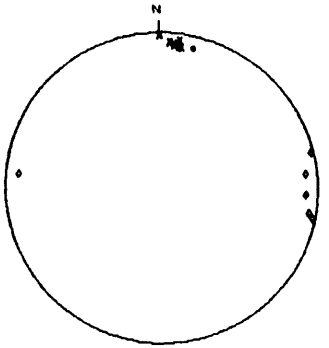
Station Number	667
Quadrangle	Hightower Mountain 7.5'
Twp, Range, Section	T9S, R92W, NW1/4 NW1/4 NW1/4 sec 16, unsurveyed
Exposure Description	Elev. 7800 feet. SSE-facing slump scar, W end, N side Hightower Creek and road, 1.7 km NE of Hightower Guard Station. Vertical exposure of several sandstone lenses with interbedded muddy partings. Overlain and underlain by nonindurated planar-bedded mudstones. Measured along ~10 m = 2.5 high.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone, micaceous partings
Cement	Very calcareous; moderately well indurated
Color, fresh	Light medium gray
Color, weathered	Light pink gray
Grain size	Fine medium- to coarse medium-grained
Grain sorting	Moderately sorted
Grain roundness	Subangular to subrounded
Bed Orientation	Subhorizontal
Bed Thickness	0.33-1.25 m
F2C Orientation	N84W/83SW (n=7)
Spacing	0.05-0.33 m (tr)
Height	0.33-1.25 m
Length	<0.5->5 m
Structures	Crude plumose structure and arrest lines
Shape	Subplanar; broadly undulatory in profile
Termination	Some hook into other F2
Mineralization	None seen
F4 Orientation	N5E/85NW (n=6)
Spacing	0.25->5 m (tr)
Height	0.33-1.25 m
Length	0.05-0.33 m
Structures	None seen
Shape	Nonplanar
Termination	Against F2C
Mineralization	None seen
F5 Orientation	N77W/83SW (n=1)
Termination	Against F4
Mineralization	None seen
Remarks	Fractures of the F2 set are quite closely spaced but parallel the cut face; it is not certain that true spacings were obtained. Lengths are extremely variable. F4 fractures are typically crudely formed and layer-confined, similar to the F4 fractures measured elsewhere in the basin. In the thickest sandstone layer the F4 fractures are so widely spaced that they appear to not be present.

Station Number 667 (contd)

Geologist(s) MAG
Data Date 06/18/86

Station 667

n = 14



x F2C n = 7
♦ F4 n = 6
● F5 n = 1

Schmidt net, lower hemisphere projection

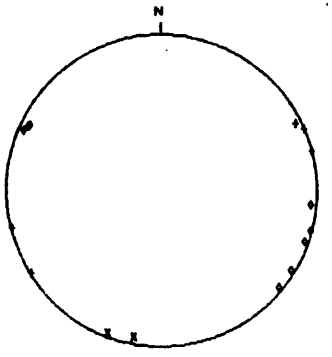
667F2C	667F4	667F5
N82W85SW	N13W88SW	N77W83SW
N83W83SW	N12E88NW	
N81W80SW	N06E81SE	
N90E88SE	N10E85NW	
N84W81SW	N05W82SW	
N82W81SW	N03E82NW	
N86W83SW		

Station Number	668
Quadrangle	South Mamm Peak 7.5'
Twp, Range, Section	T9S, R93W, SE1/4 NW1/4 NE1/4 SW1/4 sec 15
Exposure Description	Elev. 7270 ft. SE-facing, slumped roadcut scar, NW side Buzzard Creek and FS Rd 270, 1.4 km NE of Carter Gulch. Sandstone lens, 6-16 cm thick, within 2.5-m thick, nonindurated, weathered sandstone; overlain and underlain by variegated mudstone. Cut is approx. 10 m long by 2.5 m high.
Stratigraphic Unit	Wasatch Fm.
Lithology (General)	Sandstone, micaceous
Cement	Moderately calcareous; well indurated
Color, fresh	Light pink tan
Color, weathered	Light pink-gray brown
Grain size	Very fine to coarse fine-grained
Grain sorting	Moderately well sorted
Grain roundness	Subangular to subrounded
Bed Orientation	N44W/25W (n=2)
Bed Thickness	0.06-0.16 m
F1C Orientation	N24W/90 (n=5)
Spacing	Not determined; very irregular
Height	0.06-0.5 m
Length	Not determined
Structures	Not visible due to weathered surfaces
Shape	Subplanar, locally planar; undulatory profile
Termination	None seen
Mineralization	None seen
F2C Orientation	N75W/86NE (n=2)
Termination	None seen
Mineralization	None seen
F4 Orientation	N23E/88NW (n=8)
Spacing	0.05-0.25 m
Height	0.06-0.3 m
Length	Determined by F2 spacing
Structures	Not visible due to weathered surfaces
Shape	Nonplanar, undulatory; locally planar or forked
Termination	Against F2
Mineralization	None seen
F5 Orientation	N78W/87SW (n=4)
Spacing	Irregularly spaced
Height	0.06-0.16 m
Length	Not determined
Structures	None seen
Shape	Nonplanar; irregular profile
Termination	Against F4
Mineralization	None seen

Station Number	668 (contd)
Remarks	F1 fractures are the largest in the exposure, are fairly planar but irregularly spaced. F2 fractures terminate against no other joints but are not in the same part of the lens as F1 fractures. The F4 fractures are the most abundant and terminate against the F2 fractures. Fractures of all three sets generally are as high as the lens, but some extend as much as 0.25 m above or below the lens. F5 fractures parallel the F2 set in orientation but are lens confined and terminate against the F4 fractures.
Geologist(s)	MAG
Data Date	06/18/86

Station 668

n = 19



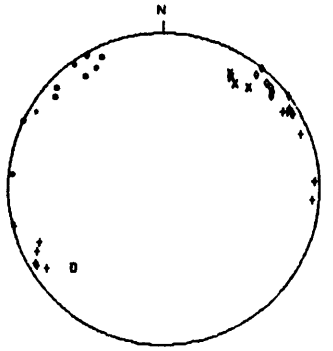
♦ F1C n = 5
▪ F2C n = 2
● F4 n = 8
· F5 n = 4

Schmidt net, lower hemisphere projection

668F1C	668F2C	668F4	668F5
N33W89NE	N80W85NE	N05E86NW	N85W84SW
N24W90SW	N70W87NE	N19E87NW	N88W79SW
N15W90SW		N25E84SE	N65W90SW
N15W89NE		N26E84SE	N70W89NE
N27W86SW		N31E87NW	
		N23E86SE	
		N15E89NW	
		N39E87NW	

Station Number	752
Quadrangle	Flatiron Mountain 7.5'
Twp, Range, Section	T8S, R91W, NE1/4 NE1/4 NW1/4 SW 1/4 sec 9
Exposure Description	Elev. 8600 feet. Steep, W side Uncle Bob Mountain on discontinuous, WSW-facing, 6-m thick ledge of massive-appearing to very low angle, planar cross-bedded sandstone with local broad, low amplitude ripple beds. Measured along ~30 m of locally brush-obscured, nearly vertical ledge.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone
Cement	Sl. to non-calcareous; mod. indurated, porous
Color, fresh	Medium tan
Color, weathered	Grayish tan; locally orangish tan
Grain size	Coarse very fine grained
Grain sorting	Fairly well sorted
Grain roundness	Subangular to subrounded
Bed Orientation	Subhorizontal
Bed Thickness	0.25-1.5 m
F1C Orientation	N31W/87SW (n=15)
Spacing	0.75-1.75 m (cr)
Height	>1.5 m
Length	3->6 m
Structures	Large arrest lines, crude twist hackle
Shape	Subplanar, locally planar; many forks along bedding
Termination	Against no other fractures
Mineralization	None seen
F2A Orientation	N57W/72SW (n=4)
F2B Orientation	N42W/66NE (n=1)
F2C Orientation	N45W/84SW (n=6)
Spacing	0.75-1.75 m (cr)
Height	1.5 m
Length	3-6 m
Structures	Large arrest lines, crude twist hackle
Shape	Subplanar; more irregular in shape than F1
Termination	None seen
Mineralization	White crystalline calcite in thin patches on talus
F4 Orientation	N49E/84SE (n=10)
Spacing	0.05-3 m (tr)
Height	0.25-1.5 m
Length	0.75-1.75 m
Structures	Crude plumose structure
Shape	Nonplanar
Termination	Against F1 and F2
Mineralization	None seen
Remarks	Fractures of the F1 and F2 set are very similar in appearance except that some F2 are locally irregular in shape; some dip only moderately steeply. Set designation therefore was mainly by strike orientation. The sizes of both sets were obtained on blocks from the slope below, for much of the ledge is brush covererd. Calcite-filled, closely spaced, large fractures occur in these

Station Number	752 (contd)
	blocks. They probably are F2 fractures, for mineralization occurred most frequently in the F2 set throughout the basin. The F4 fractures are layer-confined, crudely formed, and terminate against joints of the other sets.
Geologist(s)	MAG, REM
Data Date	08/04/86
	n = 36



+	F1C	n =	15
x	F2A	n =	4
*	F2B	n =	1
♦	F2C	n =	6
·	F4	n =	10

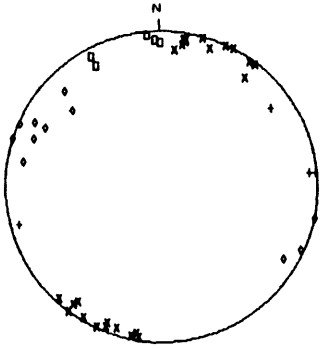
Schmidt net, lower hemisphere projection

752F1C	752F2A	752F2B	752F2C	752F4
N35W80NE	N60W74SW	N42W66NE	N41W80SW	N25E89SE
N37W90SW	N59W72SW		N42W82SW	N43E83SE
N31W85NE	N56W70SW		N46W84SW	N31E85SE
N31W85SW	N50W73SW		N51W85SW	N65E82SE
N15W89NE			N44W84SW	N05E87SE
N30W85SW			N51W89SW	N40E80SE
N04E85NW				N60E88SE
N22W84SW				N61E77SE
N32W83SW				N55E76SE
N03W87SW				N54E87SE
N33W80SW				
N32W85NE				
N33W85SW				
N24W76NE				
N27W80NE				

Station Number	753
Quadrangle	Gibson Gulch 7.5'
Twp, Range, Section	T7S, R91W, SE1/4 NW1/4 NE1/4 SW 1/4 sec 32
Exposure Description	Elev. 7380 feet. SSW-facing, 10-m thick sandstone ledge, N side Clear Creek, ~30 m above FS Rd 807, ~2.5 km E of West Divide Creek. Extends upvalley, discontinuously, ~1.5 km. Massive-appearing to distorted low- to medium-angle crossbedded sandstone. Weathers into rounded ledges.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone with local concretionary lenses
Cement	Highly calcareous
Color, fresh	Light grayish tan
Color, weathered	Slightly lighter grayish tan
Grain size	Fine medium- to coarse medium-grained
Grain sorting	Poorly sorted
Grain roundness	Subangular to subrounded
Bed Orientation	Subhorizontal
Bed Thickness	1.5-2.5 m
F1C Orientation	N6W/87SW (n=4)
Termination	As hairline cracks in the rock
Mineralization	None seen
F2C Orientation	N68W/90 (n=24)
Spacing	0.1-4 m (tr); 0.5-4 m (cr)
Height	1.5->2.5 m
Length	5->7 m
Structures	Prominent, large arrest lines
Shape	Subplanar; undulatory, some fork laterally
Termination	Against F1
Mineralization	None seen
F3C Orientation	N87E/82SE (n=6)
Termination	Against F1C
Mineralization	None seen
F4 Orientation	N27E/80SE (n=11)
Spacing	Variable
Height	1.5-2.5 m
Length	0.1-4 m (tr); 0.5-4 m (cr)
Structures	Probable crude plumose structures
Shape	Subplanar to nonplanar
Termination	Against F2
Mineralization	None seen
Remarks	Fractures of the F2 set are large, prominent, very planar, and are compound, whereby each F2 face contains several large arrest lines. Fractures of the older F1 and younger F3 sets are sparse in the outcrop, but are concentrated in the concretionary lenses. Fractures of the F4 set are found chiefly in a 2-1/2-m thick sandstone, where they are layer confined and nonplanar. Only the most planar were measured.
Geologist(s)	MAG, REM
Data Date	08/04/86

Station 753

n = 45



+	F1C	n = 4
x	F2C	n = 24
*	F3C	n = 6
◊	F4	n = 11

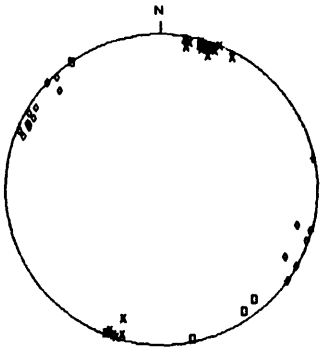
Schmidt net, lower hemisphere projection

753F1C	753F2C	753F3C	753F4
N15W84NE	N80W85SW	N85E88SE	N27E80SE
N05W89SW	N72W85NE	N88E84SE	N31E80NW
N05W85SW	N52W88SW	N62E77SE	N45E76SE
N35W75SW	N47W87NE	N90E82SE	N24E89SE
	N84W77SW	N62E84SE	N25E88NW
	N65W89NE	N62E84SE	N12E90NW
	N81W85SW		N18E90SE
	N59W88NE		N41E64SE
	N80W83SW		N21E76SE
	N54W87SW		N27E72SE
	N52W77SW		N10E79SE
	N62W90SW		
	N53W84NE		
	N65W89SW		
	N81W81SW		
	N78W88NE		
	N53W90NE		
	N81W88NE		
	N68W84NE		
	N54W81NE		
	N80W85NE		
	N74W89SW		
	N70W83SW		
	N68W87NE		

Station Number	754
Quadrangle	Flatiron Mountain 7.5'
Twp, Range, Section	T8S, R 91W, NE 1/4 NE1/4 NW1/4 SW1/4 sec 28
Exposure Description	Elev. 7800 feet. S-facing flank of Flatiron Mountain, NW side of SW-draining tributary to West Divide Creek and 1.2 km upstream. At base of vertical cliff of alternating mudstone, sandy siltstone, and sandstone layers; 60 m h by 0.25 km l.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandy siltstone and sandstone (6 layers)
Cement	Highly calcareous; very well indurated
Color, fresh	Light brownish red to maroon
Color, weathered	Tannish red to maroon
Grain size	Very fine to fine medium-grained
Grain sorting	Moderately poorly sorted
Grain roundness	Subangular to subrounded
Bed Orientation	N5E/10.5 NW (n=1)
Bed Thickness	0.25-1.75 m
F2C Orientation	N73W/87SW (n=23)
Spacing	0.2-2 m (tr); 0.2-0.75 m (cr)
Height	0.25-4 m (tr); 0.25-1.75 m (cr)
Length	2-2.5 m
Structures	Delicate plumose structure
Shape	Planar to subplanar; locally irregular
Termination	As hairline cracks; against F1
Mineralization	None seen
F3C Orientation	N55E/86NW (n=4)
Spacing	Not determined
Height	2 m
Length	1.25 m
Structures	Not measured
Shape	Subplanar
Termination	Against F2C
Mineralization	None seen
F4 Orientation	N28E/88SE (n=17)
Spacing	0.33-2.5 m (tr); 0.33-1.25 m (cr)
Height	0.25-1.75 m
Length	0.2-2 m
Structures	Plumes, local arrest lines; some twist hackle
Shape	Nonplanar; broadly curved in dip, hooked in strike
Termination	Against F2C and F3C
Mineralization	None seen
Remarks	Fractures of the F2 set are very prominent, planar, and the best formed in the outcrop. They extend a few cm into the silty mudstones above and below the measured sandstone layer. Locally, the F2 fractures are spaced a few cm apart in zones that cut across the small, weathered promontories along the cliff face. These F2 fracture zones are enhanced by weathering. Fractures of the older F1 and younger F3 sets occur sparingly and not many measurements could be made. The F4 fractures are subplanar to nonplanar, layer-confined, and abut fractures of all other sets.
Geologist(s)	MAG, REM
Data Date	08/05/86

Station 754

n = 45



♦ F1C n = 1
x F2C n = 23
▪ F3C n = 4
♦ F4 n = 17

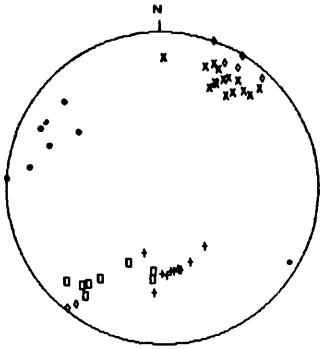
Schmidt net, lower hemisphere projection

754F1C	754F2C	754F3C	754F4
N12W89NW	N74W85SW	N78E88NW	N30E90NW
	N74W76NE	N55E90SE	N29E80NW
	N75W85SW	N50E82NW	N26E84SE
	N62W86SW	N56E84NW	N22E88SE
	N69W85SW		N47E88SE
	N70W86NE		N33E85SE
	N80W82SW		N15E79NW
	N71W80SW		N43E90SE
	N79W86SW		N44E80SE
	N73W89NE		N25E83SE
	N75W88SW		N29E83SE
	N74W83SW		N21E84SE
	N70W88NE		N36E90NW
	N70W85SW		N20E89NW
	N72W86SW		N30E88SE
	N81W88SW		N26E85SE
	N69W89NE		N16E89NW
	N71W87SW		
	N71W87SW		
	N73W85SW		
	N68W90SW		
	N75W86NE		
	N72W88NE		

Station Number	755
Quadrangle	Quaker Mesa 7.5'
Twp, Range, Section	T9S, R90W, NE 1/4 SW 1/4 NE1/4 SE1/4 sec 18
Exposure Description	Elev. 9084 ft. Intrusive rocks, top of Haystack Mtn, S end, 0.5 km SW of West Divide Creek. Crest is 40 m l x 8-10 m w x 10 m high.
Stratigraphic Unit	Middle Tertiary intrusive rocks
Lithology (General)	(1) Quartz monzonite (2) Hornfels
Cement	
Color, fresh	(1) Light medium gray; (2) Dark gray
Color, weathered	(1) Medium gray; (2) Dark brownish gray
Grain size	(1) Porphyritic; (2) Very fine grained
Grain sorting	-
Grain roundness	-
Bed Orientation	-
Bed Thickness	>10 m
MV1 Orientation	N86E/45NW (n=12)
Spacing	(1) 0.02-2 m; (2) <0.01-0.33 m (tr)
Height	(1) >2 m; (2) >1 m
Length	(1) 7 m (avg) (2) 7 m (avg)
Structures	Very delicate plumose structure on hornfels
Shape	Planar
Termination	None seen
Mineralization	Fe-oxide stained hornfels surfaces appear polished
F2A Orientation	N61W/70SW (n=15)
Spacing	0.06-10 m (tr)
Height	5 m (avg)
Length	5-10 m
Structures	Plumes, arrest lines, crudely formed twist hackle
Shape	Planar; locally forked across mineralized (?) MV1
Termination	None seen or cut across MV1
Mineralization	Fe-oxide stained hornfels surfaces appear polished
F2B Orientation	N55W/64NE (n=8)
Spacing	0.05-0.66 m (tr)
Height	3 m (avg)
Length	3 m (avg)
Structures	Plumes, arrest lines, crude twist hackle
Shape	Planar
Termination	Against F2A or cut across MV1
Mineralization	Fe-oxide stained hornfels surfaces appear polished
F2C Orientation	N57W/89SW (n=7)
Mineralization	Fe-oxide stained hornfels surfaces appear polished
F4 Orientation	N27E/74SE (n=8)
Spacing	(1) 0.5-3 m; (2) 0.05-0.3 m; (cr)
Height	1 m (avg)
Length	0.01-5 m (tr)
Structures	None seen
Shape	Subplanar, locally planar; broadly curved in dip
Termination	Against F2A, F2B, and F2C
Mineralization	None seen
Remarks	The fractures designated as MV1 are the largest and best formed at the outcrop. Their surfaces are very smooth, are stained with Fe oxides, and appear to be polished. The average strike of the MV1 fractures is similar to that found in other outcrops in the Hogback, but they dip much more shallowly. It is uncertain if these fractures can be correlated unambiguously with the MV1 set. Moderately steeply dipping F2A fractures are large, planar, and smooth in the hornfels; less so in the monzonite. Their surfaces contain abundant

Station Number	755 (contd)
	structures diagnostic of extension-fracture propagation, and most cut across the MV1 fractures. The moderately steeply dipping F2B and vertical F2C fractures are sparse, but contain similar surface structures. The F4 fractures are the most irregularly shaped, samllest, and terminate against all other fractures.
Geologist(s)	MAG, REM
Data Date	08/05/86

n = 50



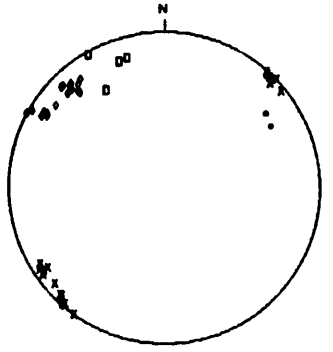
+	MV2	n = 12
x	F2A	n = 15
*	F2B	n = 8
◊	F2C	n = 7
-	F4	n = 8

Schmidt net, lower hemisphere projection

755MV2	755F2A	755F2B	755F2C	755F4
N70E42NW	N54W73SW	N52W67NE	N70W90SW	N09E75SE
N89W46NE	N46W71SW	N65W44NE	N57W80SW	N31E84NW
N79E45NW	N89W72SW	N54W74NE	N53W82NE	N42E72SE
N88E47NW	N62W64SW	N44W75NE	N58W89SW	N05E90SE
N78E45NW	N64W73SW	N55W60NE	N63W79SW	N34E54SE
N8?E45NW	N60W69SW	N50W70NE	N51W88NE	N21E66SE
N85E45NW	N53W65SW	N83W50NE	N47W85SW	N30E74SE
N74W36NE	N63W65SW	N8?W45NE		N27E75SE
N89W46NE	N55W61SW			
N55E38NW	N58W71SW			
N85W57NE	N49W70SW			
N80E44NW	N70W71SW			
	N45W78SW			
	N64W60SW			
	N67W75SW			

Station Number	756
Quadrangle	Gibson Gulch 7.5'
Twp, Range, Section	T7S, R91W, SE1/4 NW 1/4 NE 1/4 SW 1/4 sec 10
Exposure Description	Elev. 7220 feet. SSE-facing, 4-7-m thick sandstone ledge exposed for 100s of m along N side of Gibson Gulch, ~150 ft above Amoco New Castle Unit No. 3. Planar to low-angle crossbedded; local rip-up clasts, coaly stringers. Prominent mudstone partings. Over- and underlain variegated mudstone.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Highly calcareous; well indurated
Color, fresh	Light gray
Color, weathered	Light tannish gray
Grain size	Very fine to coarse fine-grained
Grain sorting	Moderately poorly sorted
Grain roundness	Subrounded to subangular
Bed Orientation	Subhorizontal
Bed Thickness	0.1-4 m
F2C Orientation	N45W/89NE (n=19)
Spacing	0.04-3.5 m (tr)
Height	1-4 m (tr)
Length	4->6 m
Structures	Arrest lines, crude twist hackle; possible plumes
Shape	Subplanar; undulatory in strike, lateral hooks
Termination	As hairline cracks in rock
Mineralization	Elongated, euhedral, small, white calcite crystals
F3A Orientation	N65E/75SE (n=4)
Termination	None seen
Mineralization	None seen
F4 Orientation	N44E/77SE (n=18)
Spacing	<0.01-4 m (tr)
Height	0.25-4 m (tr); 0.25-1 m (cr)
Length	0.02-4 m
Structures	Surfaces too weathered for data collection
Shape	Subplanar to nonplanar; locally large and planar
Termination	Against F2C or across min. F2C
Mineralization	None seen
F5 Orientation	N33W/69SW (n=2)
Termination	Against F4
Mineralization	None seen
Remarks	Fractures of the F2 set are large, prominent, undulatory, and filled with calcite. They dominate the outcrop. Fractures of the layer-confined F4 set either terminate laterally against the F2 set or cut across the calcite-filled F2 fractures. Other, smaller fractures, but not enough to constitute a set, terminate against the F4 fractures; probably the F5 set. Thin stringers of coal contain face cleats that parallel the fractures of the F2 set; butt cleats, intermediate in orientation to that of the F3 and F4 sets, are mostly out

Station Number	756 (contd)
	of reach. The F3 fractures dip moderately steeply and are found only on a corner of the outcrop. It is questionable if they are a regional set; they may have formed upon weathering and relaxation of the outcrop.
Geologist(s)	MAG, REM
Data Date	08/06/86
	n = 43



▮	F2C	n = 19
▮	F3A	n = 4
♦	F4	n = 18
•	F5	n = 2

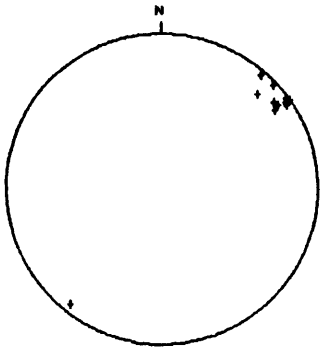
Schmidt net, lower hemisphere projection

756F2C	756F3A	756F4	756F5
N48W88SW	N70E75SE	N30E88SE	N30W68SW
N42W83NE	N74E76SE	N50E75SE	N36W70SW
N47W85NE	N60E88SE	N47E78SE	
N50W89NE	N59E62SE	N30E80SE	
N45W85SW		N31E77SE	
N36W85NE		N32E78SE	
N44W90SW		N32E80SE	
N55W90NE		N28E90SE	
N35W80NE		N44E81SE	
N49W89NE		N44E81SE	
N40W87SW		N37E76SE	
N34W85NE		N48E72SE	
N47W88SW		N48E79SE	
N32W83NE		N44E75SE	
N46W85NE		N46E75SE	
N49W89SW		N52E77SE	
N35W83NE		N45E81SE	
N50W88NE		N48E70SE	
N48W87NE			

Station Number	757
Quadrangle	Center Mountain 7.5'
Twp, Range, Section	T7S, R90W, NW1/4 SE1/4 NW1/4 sec 17
Exposure Description	Elev. 7950 feet. NE-facing vertical cut behind Baldy Creek No. 1-17, SW side Baldy Creek, between Little Baldy and Center Mts. Thick, crossbedded sadnstone overlain by interlayered sequence of sandstone, siltstone, and mudstone. 12 m h x 13 m l. Local carbonaceous interlayers. Partly slumped.
Stratigraphic Unit	Mesaverde Group
Lithology (General)	Sandstone and mudstone
Cement	Slightly to noncalcareous; well indurated
Color, fresh	Light gray
Color, weathered	Tannish gray
Grain size	Silt to very fine grained
Grain sorting	Moderately well sorted
Grain roundness	Subrounded to subangular
Bed Orientation	N10E/5NW (n=1)
Bed Thickness	0.1->2m
F1C Orientation	N36W/86SW (n=13)
Spacing	A few cm to >1m (cr)
Height	0.1->2 m
Length	0.25 m to 5 m (cr)
Structures	Not measured
Shape	Locally planar; forked laterally along crossbeds
Termination	None seen
Mineralization	None seen
Remarks	Only fractures of the F1 set occur in the thick, crossbedded sandstones at the base of the cut. In the overlying, interlayered mudstone-sandstone sequence, two sets of fractures are abundant but only the F1 fractures and one F4 fracture could be reached for measurement. A few F2 fractures are present. Much of the cut is covered with slope wash; some measurements of fracture-surface characteristics could not be obtained.
Geologist(s)	MAG, REM
Data Date	08/06/86

Station 757

n = 13



+ F1C n = 13

Schmidt net, lower hemisphere projection

757F1C

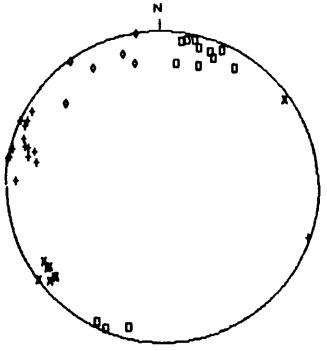
N35W88SW
N35W86SW
N34W86SW
N35W77SW
N43W87SW
N45W75SW
N52W85NE
N38W80SW
N43W87SW
N36W88SW
N49W87SW
N35W90SW
N36W81SW

Station Number	758
Quadrangle	Gibson Gulch 7.5'
Twp, Range, Section	T7S, R91W, SW1/4 NE1/4 SW1/4 SE1/4 sec 23
Exposure Description	Elev. 7800 feet. Two lowermost, 4- and 5-m thick sandstone ledges, S side Crown Peak, near E end. Planar crossbedded; lower 1/3 m is steeply cross-bedded. Exposed for 30 m; lower ledge thins to 2 m on E end. Underlain by variegated mudstone; overlain by thick, massive sandstone.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Sl. to moderately calcareous; moderately indurated
Color, fresh	Light tannish gray
Color, weathered	Light grayish tan; locally, light orangish tan
Grain size	Fine- to fine coarse-grained
Grain sorting	Poorly sorted
Grain roundness	Subangular to subrounded
Bed Orientation	Subhorizontal
Bed Thickness	0.33-5 m
MV2 Orientation	N16E/86SE (n=15)
Spacing	0.75->4 m (tr); 0.75-1.5 m (cr)
Height	0.33-5 m (tr); 3-5 m (cr)
Length	3.5 m
Structures	Delicate plumes; large but delicate arrest lines
Shape	Planar to only locally planar; undulatory in dip
Termination	As hairline cracks in the rock
Mineralization	2-mm thick, white, powdery calcite, weathered
F1C Orientation	N36W/81NE (n=8)
Spacing	4 m (avg)
Height	1-2.5 m
Length	2.25 m
Structures	Arrest lines, probable plumose structure
Shape	Subplanar; broadly curved strike, undulatory dip
Termination	Against MV2
Mineralization	None seen
F2C Orientation	N73W/83SW (n=13)
Spacing	1.5-3 m (cr)
Height	2.25 m
Length	2 m
Structures	Numerous arrest lines
Shape	Subplanar, locally planar; undulatory, some fori
Termination	At, or across mineralized, MV2
Mineralization	None seen
F3C Orientation	N67E/77SE (n=6)
Spacing	0.5-1 m (cr)
Height	0.33-2.25 m
Length	Confined by all other sets
Structures	Surfaces too weathered for data collection
Shape	Subplanar; edges rounded by weathering
Termination	Against MV2, F1, F2
Mineralization	None seen
Remarks	Fractures of the MV2 set are large and prominent. In the upper layer, they occur in narrow zones and are filled with thin seams of calcicte. In the 1/3-m thick lowermost bed, they are very planar but in the more massive, overlying bed, they are only locally planar and occur where fractures of the F1 set do not. Fractures of all other sets terminate laterally against the fractures of the MV2 set, are smaller, and more sinuous or broadly broadly curved in strike. Most F1 or F2 fractures are found between the widest spaced MV2 fractures.

Station Number	758 (contd)
	No terminating relations could be seen between these two sets. In the uppermost layer, F2 fractures cut across the calcite-filled MV2 fracutres. The F3 fractures are sparse and layer confined. A few crudely formed F5 fractures, that are oriented parallel to the F2 fractures, were not measured. Apparently F4 fractures do not occur.
Geologist(s)	MAG, REM
Data Date	08/07/86

Station 758

n = 42



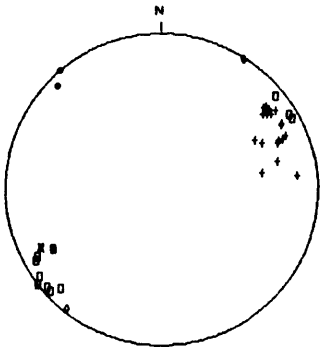
+ MV2 n = 15
x F1C n = 8
* F2C n = 13
◊ F3C n = 6

Schmidt net, lower hemisphere projection

758MV2	758F1C	758F2C	758F3C
N10E90SE	N32W79NE	N70W81SW	N78E70SE
N11E70SE	N35W86SW	N75W82SW	N74E77SE
N20E89NW	N40W79NE	N77W86SW	N81E90SE
N30E85SE	N40W84NE	N64W86NE	N60E76SE
N16E80SE	N40W80NE	N68W78SW	N54E89SE
N16E78SE	N35W78NE	N68W88NE	N41E70SE
N26E85SE	N35W80NE	N83W69SW	
N24E85SE	N37W90NE	N73W70SW	
N19E83SE		N82W84SW	
N25E90SE		N58W78SW	
N15E73SE		N66W85SW	
N12E76SE		N80W85SW	
N14E88SE		N76W82NE	
N02E83SE			
N11E89SE			

Station Number	759a
Quadrangle	Gibson Gulch 7.5'
Twp, Range, Section	T7S, R91W, SE1/4 NW1/4 SW1/4 SE1/4 sec 23
Exposure Description	Elev. 7960 feet. S-facing, uppermost, 10-m thick sandstone ledge, S side Crown Peak, W end. Vertical sequence of crossbedded, planar crossbedded, and massive-appearing sandstones and interbedded mudstones. Also interbedded layers with mudd rip-uo clasts and coaly material. Overlies mudstone.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Calcareous to non-calc.; poorly to well indurated
Color, fresh	Light tannish gray
Color, weathered	Light orangish tan to orange brown
Grain size	Fine to coarse grained
Grain sorting	Subrounded to subangular
Grain roundness	Moderately poorly sorted
Bed Orientation	N66W/11NE (n=1)
Bed Thickness	0.5-5 m
F1A Orientation	N28W/73SW (n=18)
Spacing	1-2 m (cr)
Height	4-6 m (cr)
Length	>5-7 m
Structures	Surfaces too weathered for data collection
Shape	Subplanar; uudulatory in dip
Termination	Against F1B
Mineralization	None seen
F1B Orientation	N27W/72NE (n=3)
Spacing	0.5 m
Height	4-6
Length	>5-7 m
Structures	Too weathered for data collection
Shape	Subplanar; undulatory in dip
Termination	Against F1A
Mineralization	White, crystalline calcite; downdip striations
F1C Orientation	N27W/87NE (n=11)
Spacing	0.25-2 m (tr); 0.75-1.75 (cr)
Height	1.5-3.5 m
Length	Not determined
Structures	Plumose structure; some twist hackle
Shape	Planar; some forked along strike
Termination	None seen
Mineralization	None seen
F2C Orientation	N56W/80NE (n=2)
Mineralization	None seen
F4 Orientation	N47E/83SE (n=2)
Termination	Against F1
Mineralization	None seen
Remarks	The F1 fractures dip moderately steeply to steeply and are large and prominent, especially those of 8W dip in the upper 5 m of the outcrop. They are in narrow, 0.5-m-wide (max), high zones, composed of 10-16 fractures, each 1 m or more high. Most fractures of the NE-dipping set were out of reach and not measured, but one fracture contained crystalline calicte with slickenlines oriented downdip The vertical F1 fractures occur chiefly in the finer grained layers, to the exclusion of the moderately steeply dipping F1 fractures which are

Station Number	759a (contd)
	older. The F2 fractures occur exclusively in the lower 0.5 m of the outcrop, and are not prominent. Their designation is based only on orientation, for no terminations with F1 fractures were seen. Fractures of the F4 set are layer-confined and are the best formed in the finer grained sandstone layers. They terminate against F1 fractures.
Geologist(s)	MAG, REM
Data Date	08/07/86
	n = 36



+	F1A	n = 18
x	F1B	n = 3
*	F1C	n = 11
◆	F2C	n = 2
●	F4	n = 2

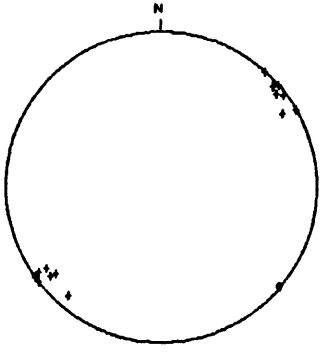
Schmidt net, lower hemisphere projection

759aF1A	759aF1B	759aF1C	759aF2C	759aF4
N29W76SW	N29W68NE	N29W68NE	N58W89SW	N49E90SE
N37W75SW	N27W75NE	N29W85SW	N52W87NE	N45E83SE
N35W78SW	N26W75NE	N43W86NE		
N10W55SW		N41W86NE		
N36W72SW		N29W80NE		
N28W57SW		N38W90NE		
N25W60SW		N45W80NE		
N22W69SW		N31W84SW		
N23W70SW		N30W82NE		
N24W76SW		N36W86NE		
N14W65SW		N40W84SW		
N39W75SW				
N06W76SW				
N35W74SW				
N37W70SW				
N23W73SW				
N29W77SW				
N39W73SW				

Station Number	759b
Quadrangle	Gibson Gulch 7.5'
Twp, Range, Section	T7S, R91W, SE1/4 NW1/4 SW1/4 SE1/4 sec 23
Exposure Description	Elev. 7960 ft. Substation at Station 759a, south side Crown Peak. Coaly stringers and concretionary lenses <1-cm thick in thick sandstones near E end of ledge. Diversely oriented. Many <1 cm sq.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Coaly material
Cement	
Color, fresh	Black
Color, weathered	Black
Grain size	
Grain sorting	
Grain roundness	
Bed Orientation	Diverse
Bed Thickness	<1 cm
F1C Orientation	N38W/88NE (n=15)
Spacing	<0.01 m
Height	<0.01 m
Length	<0.01 m
Structures	None seen
Shape	Planar
Termination	None seen
Mineralization	None seen
F4 Orientation	N40E/89NW (n=1)
Termination	Against F1C
Mineralization	None seen
Remarks	The face cleats in the very thin, diversely oriented lenses of coaly material are designated as F1 for the purposes of classification. They appear to predate the F1 fractures and probably formed as a result of extension of the beds during anticline folding. The cleats are vertical despite the diverse orientations of the lenses. Butt cleats also are numerous but could not be reached for measurement. They are about perpendicular to the face cleats and probably correlate with fractures of the F4 set.
Geologist(s)	MAG, REM
Data Date	08/07/86

Station 759b

n = 16



♦ F1C n = 15
♦ F4 n = 1

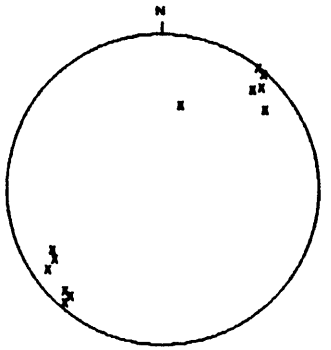
Schmidt net, lower hemisphere projection

759bF1C	759bF4
N30W90SW	N40E89NW
N40W77NE	
N36W80NE	
N50W82NE	
N42W86SW	
N39W84SW	
N39W81NE	
N36W90NE	
N35W86NE	
N48W90SW	
N36W89NE	
N38W90NE	
N37W88SW	
N41W90SW	
N31W80SW	

Station Number	760
Quadrangle	Gibson Gulch 7.5'
Twp, Range, Section	T7S, R91W, NW1/4 SE1/4 SW1/4 SE1/4 sec 17
Exposure Description	Elev. 6820 feet. SE-facing ledge in small, steep, S-draining tributary to Tar Gulch, 0.25 km N of East Divide Creek Rd. 0.5-1-m thick, discontinuously exposed sandstone ledge, underlain and overlain by poorly indurated, variegated mudstones. Blocks of rock litter slope. Weathers to knobs.
Stratigraphic Unit	Wasatch Fm
Lithology (General)	Sandstone
Cement	Highly calcareous; moderately indurated
Color, fresh	Brayish white
Color, weathered	Medium gray
Grain size	Very fine to coarse fine-grained
Grain sorting	Moderately poorly sorted
Grain roundness	Subangular to subrounded
Bed Orientation	Subhorizontal
Bed Thickness	0.5-1 m
F2C Orientation	N48W/90 (n=12)
Spacing	0.01-1.3 m (tr)
Height	0.5-1 m
Length	1.25 m or less
Structures	Cemented shut or too weathered to observe
Shape	Locally planar; hooked or forked along strike
Termination	End as hairline cracks in rock
Mineralization	<1-mm thick, pink, non-calcareous, opague fillings
Remarks	The fractures of the F2 set are the most planar and the most prominent in the outcrop. Some F2 are thinly cemented and shut, and form ridges that stand in relief on the face of the outcrop. Very crudely formed fractures terminate against them, are oriented about NNE, and probably are the F4 set. They were not measured, for the best-formed fractures of this set were in a slumped part of the ledge.
Geologist(s)	MAG, REM
Data Date	08/07/86

Station 760

n = 12



x F2C n = 12

Schmidt net, lower hemisphere projection

760 F2C
N52W89SW
N30W70NE
N50W86NE
N34W72NE
N49W88SW
N50W80NE
N46W80SW
N36W79NE
N48W75SW
N47W80NE
N38W72SW
N78W46SW