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THRUST FAULTS SOUTH OF PARK CITY, UTAH*

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STRUCTUAL CONTROL OF THE PARK CITY DISTRICT, UTAH

By George W. Metcalf

Mining 198

PREFACE

The purpose of this paper has been to relate the structual features of the Park City District to the deposition of ore and to the geologic history. To accomplish this certain general features about the geology, lithology, and mineralogy of the district have been given first to acquaint the reader with the area in general. The majority of this material including the maps and figures have come from the United States Geological Survey's Professional Paper No. 77 written by Mr. John M. Boutwell with contributions by Mr. Lester H. Woolsey.

George W. Metcalf

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STRUCTURAL CONTROL OF THE PARK CITY DISTRICT

General Features:

The Park City district lies on the eastern slope of the Wasatch Range in the north central part of Utah. It is on a prominent spur which extends eastward from the great Uinta Range and is the district which has formed the most extensive and richest ore bodies in the Wasatch Range. This region is bravered diagonally by a north-south arch which is cut by numerous faults with some local folding probably caused by intrusions.

The sediments range in age from Lower Carboniferous to Triassic and have been cut, deformed, and metamorphosed by a series of laccolithic stock-like masses. The largest of these, the Clayton Peak diorite, is the northeast end of the great composite laccolith of the middle Wasatch and occurs in the south west portion of the Park City District. Irregular quartz porphory stocks and dikes predominant in the south eastern region with faulted and folded sediments extensive in the northern part. Andesite flows occur in the northeast section but are extensive throughout the Wasatch Range.

Production: (Minerals Year Book - 1945)

Element	1945	1870-1945
Gold (fine ozs.)	13,822	544,850
Silver (fine ozs)	1,033,830	233,765,278
Copper (lbs.)	740,800	67,744,913
Lead (lbs.)	17,831,500	2,391,698,934
Zinc (lbs.)	14,870,000	668,058,611
Total Value	$4,562,505	$361,639,653

Stratiographic Section:

Symbol	Name	Age	Thickness (feet)
Qal, Qt, Qm, Qg, Qk	Quaternary Deposits	Recent & Pleistocene	0-50
Trn	Nugget Sandstone	Jurassic or Triassic	500 plus
Tra	Ankareh Shale	Lower Triassic	1150 plus
Trt, Trtm	Thaynes Formation	Lower Triassic	1190
Trw, Trwm	Woodside Shale	Lower Triassic	1180
Cpc	Park City Formation	Permian (?)	590
Cw, Cl	Weber Quartzite	Pennsylvanian	1350 plus
			6360

Lithologic Units:

Weber Quartzite - This formation consists of a gray, massively bedded, homogeneous, dense, quartzite with intercalated limestone beds and small patches of chert. The brittle nature of the rock causes it to break into sharp, irregular fragments. It is of Upper Carboniferous or Pennsylvanian age and was deposited in relatively shallow, quiet water upon an uneven constantly sinking sea bottom. It forms the walls of lead-silver lodes.

Park City Formation - This comprises a thick limestone in its lower part, several minor limestones in its upper part and a number of thin calcareous beds near the base, with interbedded quartzites and sandstones. The Park City formation is of Permian age as determined by a few shallow water animal remains. It is conformible with the underlying Weber Quartzite and forms the country rock for the principal bonanza replacement bodies.

Woodside Shale - It is a fine grained dark-red shale and in places grades into a fine grained sandstone which is thinly bedded. The deposition was during the Lower Triassic and the result of a long continued quiescense period following deposition of Park City Formation.

The formation has no direct economic importance but the shale has a great capacity for water making it an important factor in mining operations.

Thaynes Formation - The upper portion consists mainly of a blue limestone with minor sandstone beds and this is separated by a "mid-red" shale member. Sandstones predominate in the basal portions of the Thaynes.

It is Lower Triassic in age and various physical changes during the deposition are causes for the variation in the members, with instability being the main factor.

This country rock is favorable for replacement ore bodies and lodes.

Ankareh Shale - The basal member is a coarse massive sandstone which lies below a red shale witha few intercalated limestones.

The age of the Ankareh shale is presumed to be Lower Triassic and changing conditions point to a fluctuating elevation from beneath deep seas to very high elevations. It is more or less the end of the calcareous deposits and the Ankareh Shale has no economic importance.

Nugget Sandstone - Outcropping only in the extreme northwest corner of the district, it is unimportant to the formation of the major ore deposits.

It is composed of white sandstone with interbedded reddish shales. The age is uncertain but the evidence at hand indicates either Jurassic or Triassic.

Quarternary Deposits - Abundant evidence of glaciation during the Pleistocene is found in this region as noted by the U-shaped valleys covered by glacial moraine and till.

Landslides, gravels, and alluvium complete the sediments of the district.

Igneous Rocks : The Park City district lies in the great zone of eruption of eastern and northern Utah. These intrusives and extrusives extend in an east-west chain entirely across the central Wasatch Range. Three extensive irregular bodies are exposed in the district and all are associated with the formation of ore bodies.

Quartz-diorite - This occupies the south west portion of the Park City district with Clayton Peak as the dominant feature. It is a deeply dissected stock that broke through the overlying sediments, deforming and sending irregular dikes and sills into them.

It is fine, even-grained, and planerocrystalline rock composed of a uniform mixture of light and dark minerals. This cuts all beds with which it comes in contact and can be considered Post-Lower Triassic.

Quartz-diorite Porphory - This is the most widely extended of the igneous bodies and lies in the southeastern portion of the district. The major part of the porphory takes the form of irregular stocks and dikes issuing form a main stock.

The quartz-diorite porphory differs from the quartz-diorite only in the largeness of the phenocrysts., and the slightly higher silica content. Alteration has taken place to a moderate degree with hornblende and biotite altering to chlorite and epidote. Pyritization and silicification are common near the mineralized zone. This quartz-diorite porphory was probably intruded during the Late Triassic time.

Andesite - Small parts of a great extrusive mass of andesite are included in the area mapped by Mr. Boutwell. It appears that an early valley between the Uinta and Wasatch range was filled with outpourings of andesitic material with some bomb-like ejecta.

Alteration is prevalent throughout the andesite with the ferromagnesian minerals affected most. It is of probable Eocene age and the flows lie conformably on Lower Triassic shale.

Contact Metamorphism

Various important changes have taken plave in the sediments near the contact of intrusive bodies. It is greatest in sediments of a calcareous nature and least in siliceous rock.

A chain of intrusives has transected this portion of the Wasatch Range breaking through all the sediments from Pre-Cambrian to Triassic inclusive. The broader features in limestone and shale will be discussed briefly as they have direct bearing on the genesis of the ore and on the structual control of ore deposition.

In general, the limestones and other calcareous formations have undergone intense alteration with a typical

zonal development around the major intrusive bodies. Contact metallic sulfides occur near most of the contacts and outside of this lies coarsely crystalline marble. There is a wide and variable zone of altered limestone with abundant contact silicates beyond the marble zone. This grades into normal unaltered limestones.

Epidote, vesuvianite, and green garnet are the principal contact minerals and associated with these are minor amounts of metallic minerals including specularite, sphalerite, pyrite, chalcopyrite, and magnetite. There is an indication of dynamic metamorphism of limestone near the Frog Valley overthrust as this is quite remote from the major intrusive body.

The contact metamorphism of shale has been less varied and less extensive but is well shown in outcrops of Ankareh and Woodside shales. Locally the red color of the shales given away to olive grenn due to the abundant epidote.

Coarse sandstones have been changed to a solid mass of quartzite near an intrusive contact.

Ore Deposition:

Mineralogy - A brief mention of the principal ore minerals and their associations will be made to acquaint the reader to the type of ores found here.

Gold - small production
Galena - crystalline form is restricted to fissure with the massive, cleavable, and granular forms in the bedded deposits.
Pyrite - minor amounts
Sphalerite - primary and occurs in both gash veins and bedded ores

Massicot - abundant alteration product of lead
Limonite - found abundantly in the oxidized portions of the ore bodies
Quartz - the massive variety is the common gangue in both lode and bedded ores
Cerrusite - main alteration product of galena
Bindheimite - formed by the oxidation of galen-tetrahedrite ore to form amorphous olive-green material
Anglesite - first product of alteration of galena and later going over to cerrusite

Occurences of the Ore:

Types of Ore - The Park City deposits are clearly associated with intrusive rocks and occur as lodes or bedded deposits in or near an intrusive contact.

The principal lodes extend in a northeast-southwest direction across Ontario, Empire, and Woodside canyons and have been mined up to a depth of 2000 feet.

Extensive bedded ores have been mined to a depth of 900 feet and are usually high in the Park City formation.

Character of the lode deposits - The lode deposits are extensive, strong, and valuable and lie in a few continuous master zones, rather then in a large number of small fissures. In general, the upper portions of the lodes are richer and smaller and the lower parts are much larger but with a lower grade. Lead and Copper carbonates and oxides predominate in the upper zone with the sulfides of silver, lead, copper, and zinc in the lower unoxidized zone.

Character of the bedded deposits - The bedded deposits form the bonanzas of this district and many of them are large, continuous, and of very high grade, but of comparatively shallow depth. In general, the ores are sulfides with some oxides of smelting grade. In the oxidized portions you get anglesite, cerrusite, bindheimite, and malachite

while the primary ore from the deeper protions is mainly galena and sphalerite, in a calcite and quartz gangue.

The valuable bedded ores have been found in the Silver King and Daly-West mines which are in the northwestern portion of the map.

Ore Deposition as Related to Fissuring:

The ore deposits of the Park City District are of two main types: Bedded bonanza deposits and lode deposits. Both of these deposits are related to fractures or fissure systems developed during the time of maximum vertical uplift with one major exception. The Ontario-Daly West fracture zone is probably due in most part to gravity subsidence in the waning stages of uplift as a result of the relaxation of the rock body.

Early faulting developed during vertical uplift formed a fracture pattern over the whole region although this pattern is not clear from the surface indications. With the intrusions of large laccolithic stocks, stresses that had built up during the uplift gave way with the development of three major fault zones and renewed movements on the faults formed in the early stages of uplift (Crescent system, Massachusetts system, and minor transverse antithetic faults on the western limb of the Park City arch). As these igneous bodies cooled and solidified there was a period of static equilibrium leading to a readjustment or relaxation of the rock bodies. This produced many openings which were filled with small dikes and tongues from the major intrusive masses. The mineral-

ization came in during this stage of relaxation as suggested by the filling of only portions of fissures developed indication stress action was more or less ended. Localization of the lode ore is shown by structure section through the Daly-West Mine in figures 8.and 9.

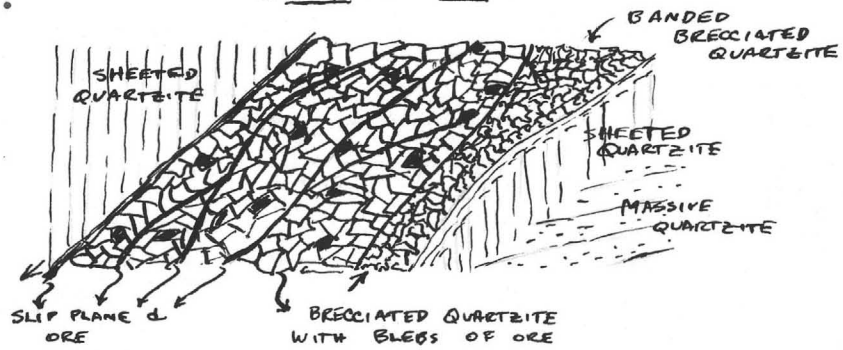
When the fissures were formed the resulting movement shattered and brecciated the quartzites and limestones with some drag along the fault indicating compressional movement. The rocks suffered considerable sheeting with local pyritization as shown in figure 3. Massive quartzite seems to favor strong,even, well-formed fractures while the limestone breaks under stress less readily and more unevenly, and the porphory causes great irregularities.

Numerous planes with a zone of fracture have moved relative to the actual movement thus further breaking and shattering the rocks leaving abundant channelways for the later solutions.

The Ontario lode is a zone of crushed quartzite, two feet wide between parallel fissure walls and the quartz f formed is dull, honey-combed, chalcedonic, milky, and massive. It has been traced for over 2000 feet along the strike and about 1600 feet in depth. The dip changes with depth going from 45° at 800 feet to 75° - 90° from 800-1400 feet and leveling off to 45° around 1500 feet. Actually there is a zone of fracture up to 100 feet wide indicating the intenseness of repeated movements. The ore occurs as a sheet, relatively thin, forming a well-defined ore shoot in the direction of the dip.

The following sketch shows the structure, character, and contents of the Ontario lode and the numerous slippage planes within the zone. The ore is in seams, streaks, and bunches of sulfides filling the small openings in the shattered zone.

ONTARIO LODE



Enlargement of a few lodes takes place at the junction of a pre mineral fault and the major fissure. The lodes tend to widen and become more irregular when cutting through calcareous rocks due to the ease of replacement of limestone and limy sandstones. Quartzitic walls were much narrower and more well-defined. In general the fissures were followed in depth approximately equal to there strike length with little change in the nature of the fissure walls except in the variations noted above.

The bedded ores occur in certain limestone horizons of the Park City Formation with little or no ore in the Woodside or Thaymes shales. The localization of ore in a certain limestone member was studied thoroughly by Mr. Boutwell and important analyses of this member and its hanging and foot wall were made. From these analyses it showed that the ore beds are low in silica and high in lime or magnesium. The hanging and foor walls are high in

silica and low in lime indicating the selective action by the solutions originating from nearby fissures. These ore horizons are usually between cherty sandstones, silicfied limestone, or quartzitic sandstone. These beds generally dip gently towards the main fissure. As lenticular masses they resemble the manto deposits of Pachuca, Mexico. The ore may occur at several different horizons but the most productive usually is the lowest member. These lenses may swell and enlarge or small lobes may project into another horizon.

The relation between bedded deposits and fissures is complex but there is little question that the fissures served as conduits for minerlizing solutions which reached the favorable horizon and subsequently replaced them. Illustrations of this type of replacement is shown in figure 4, taken from Boutwell's paper.

The greater part of the movement on these large fissures or faults took place prior to minerlization as there is little displacement of the ore beds. The later fracturing and displacement of the favorable beds has been mainly by small strike faults in the competent rocks as shown in the structure sections through the Daly-West mine. Some drag along the gash vein due to post mineral faulting is shown in figure 6 .

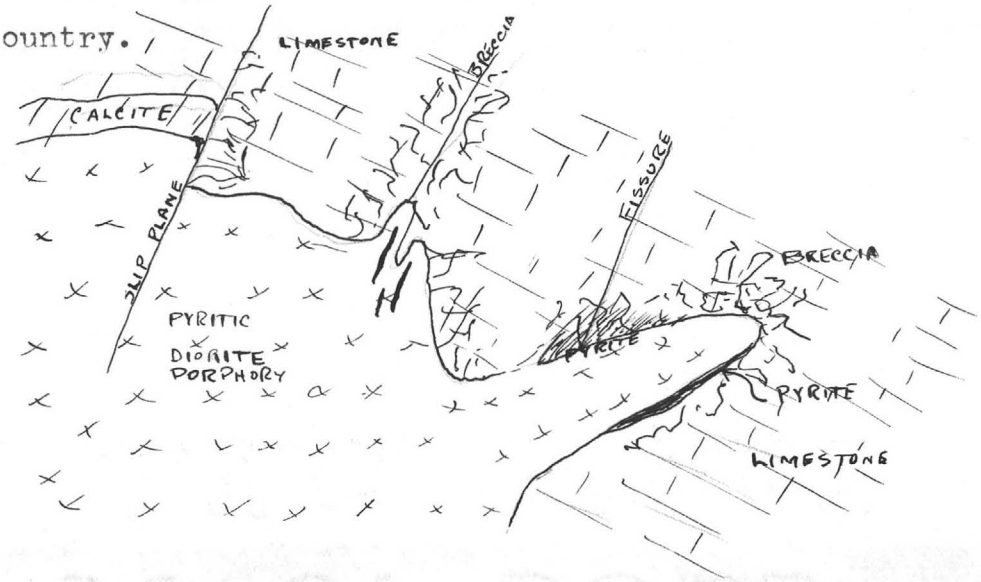
In summary, faults which later served as channelways for mineralizing solutions cut through the sedimentary formations fracturing and shattering the more competent beds with very little gouge formed but silicification of the walls is pronounded. Solutions originating form the

main intrusive bodies rose along these fissures filling and replacing the fracture zone and on reaching favorable limestone beds, diffused along thin limestone laminations and replacing these layers with metallic sulfides. Later faulting, mostly strike slip, fractured and offset the ore beds with a limited displacement.

Ore Genesis:

The ore deposits of the Park City District occurein the sedimentary formations near dioritic intrusions. The rocks adjoining these intrusives are crushed, fractured, fissured, and metamorphosed showing the influence of the intrusions. Excess quartz and pyrite in the gangue, silicification and seritization of the walls, indicates the action of hot alkaline aqueous solutions originating from the dioritic magma.

Ore deposition took place between Early Triassic and Early Tertiary time with the development of the fissures already mentioned. Brecciation and later movements made pathways for supergene solutions to alter and oxidize the primary sulfide ores to rich carbonate and oxide ores. The figure below shows the effects of the intrusive on the country.



Structual Features and Descriptions of Faults:

Fault intersections in the Park City district are rare and because of this the grouping of the faults into a certain system is impossible. But certain relationships can be worked out by the direction of intrusion, movement, and displacement in relation to the amount of folding.

In brief the area has been folded into an anticline with the axis trending about N 15 E and pitching to the northeast. This broad arch has been intruded and faulted a number of times and it is these features which control the ore deposition.

There are six master faults in the region and a number of subsidiaryfaults. These master faults, with one exception,trend east-west while the subsidiary faults trend both north-south and east-west. A short description of these will prove useful in the development of the complex geologic history.

Ontario-Daly West Fault * This fault zone ranges in width from a few inches to a hundred feet and is known along its strike for about two miles and in depth to around 2100 feet. The fault strikes N 60°E and dips on an average 70° NW. The exposures are all underground so the fault is dotted as shown on Plate II. The hanging wall has dropped 230 feet and its economic importance was to raise the ore-bearing limestones. It is later than the intrusion of diorite porphory and earlier then certain minor northwest faults.

Crescent Fault - This fault zone extends for 9000 feet along its strike and was not observed underground. The trend is east-west with a steep dip to the north. With the downthrow side to the south the major movement is laterally with the north block offset to the west about 3000 feet. This is conslusive evidence that the ore-bearing limestones of the Silver-King and Daly West mines are the same formation.

Massachusetts Fault - This well-defined fault strikes N 75°W and dips 70° - 90° to the south. It has produced a horizontal offset of about 2500 feet to the west and is known along its strike for over 3000 feet.

Frog Valley Thrust Fault - This is a remarkable fault zone extending over two miles along its strike and the west side has overridden the east side about 2000 feet. It strikes north-south and dips about 45 to the west. The presence of the dropped Park City limestone on the east allows for further development on this favorable bed for other ore bodies. The Frog Valley fault cuts off the older east-west faults but its intersection with the McHenry Fault was not found.

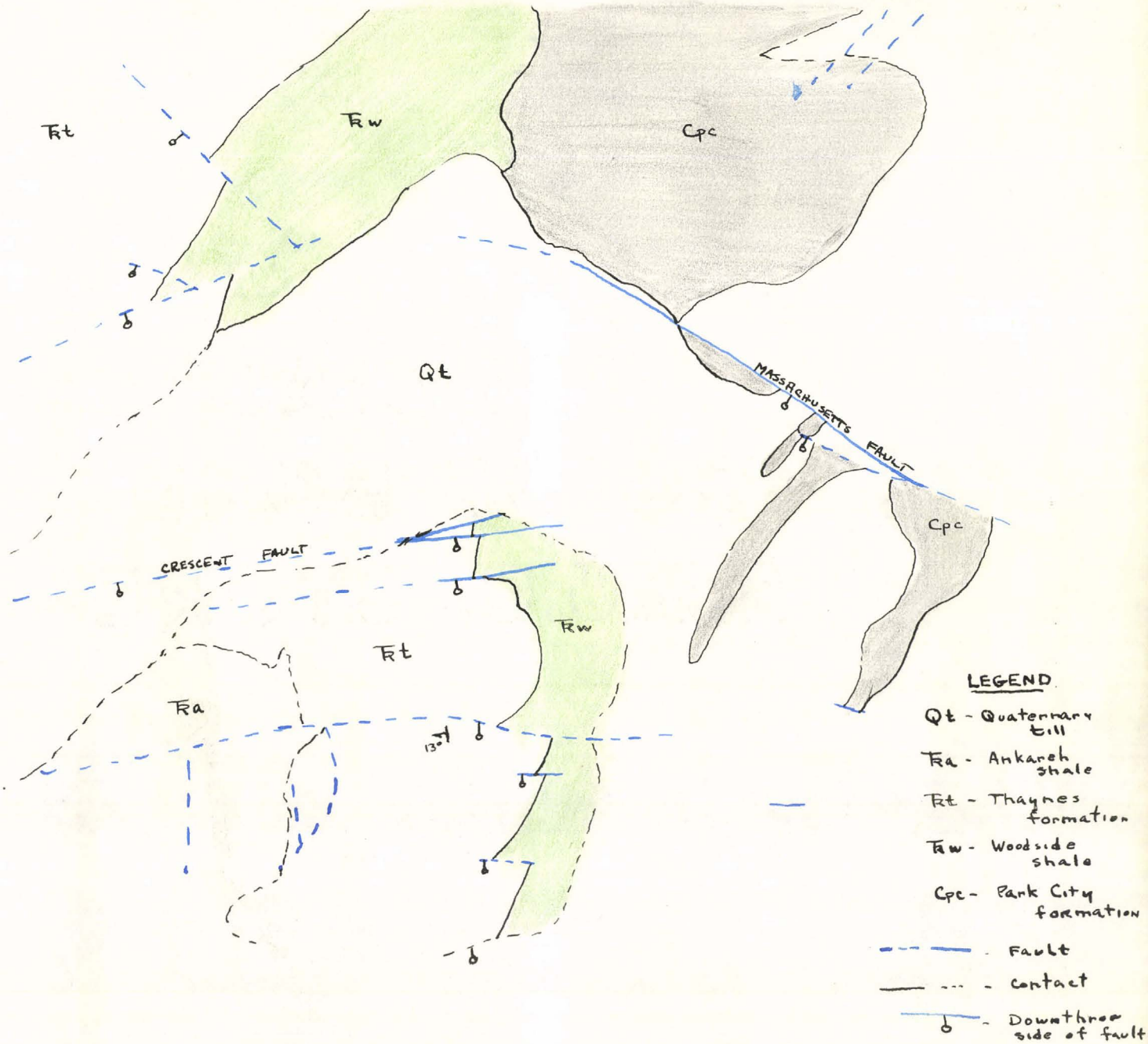
McHenry Fault - This is a zone of intense brecciation striking east-west and dipping 45° to the north. Itis known along its strike for over a mile and many hundred feet in depth. The width varied from a fewwinches to 170 feet indicating intense lateral movement and possible repeated movements. The south side has been offset to the east for at least two miles.

Cottonwood Fault - In the south eastern part of the district is another master fault trending east-west and generally dipping vertically. It has shifted the north side about 4000 feet to the east.

Relations of Structual Features to the Geologic History:

Near the close of Cretaceous time the Park City area was subjected to regional vertical uplift in connection with the elevation of the Wasatch Range. This vertical uplift folded the area into a broad arch trending north-east-southwest and pitching to the northeast. The folded strata include competent quartzites, limestones, and shales but faulting was at a minimum during the early elevation due to the abundance of overlying sediments making plastic deformation possible. Uplift continued with the relieving of stresses stored up by deformation of the overlying sediments but with active and extensive erosion the support for the competent rocks was removed and abundant faulting took place. Antithetic faults (mostly step-faults) were produced on the western flank of the anticline. Included in these are the master faults of the western area namely, the Crescent and Massachusetts fault zones. In general as the uplift continued there was shift along planes of weakness to the west with a corresponding drop to the south. Uplift or tilting of the blocks was necessary to get both rotation and step faulting of the blocks. The sketch of the geology as shown on the next page shows these relations clearly.

Minor longitudinal faults on the pitching anticline shows that there was some compressive action during the



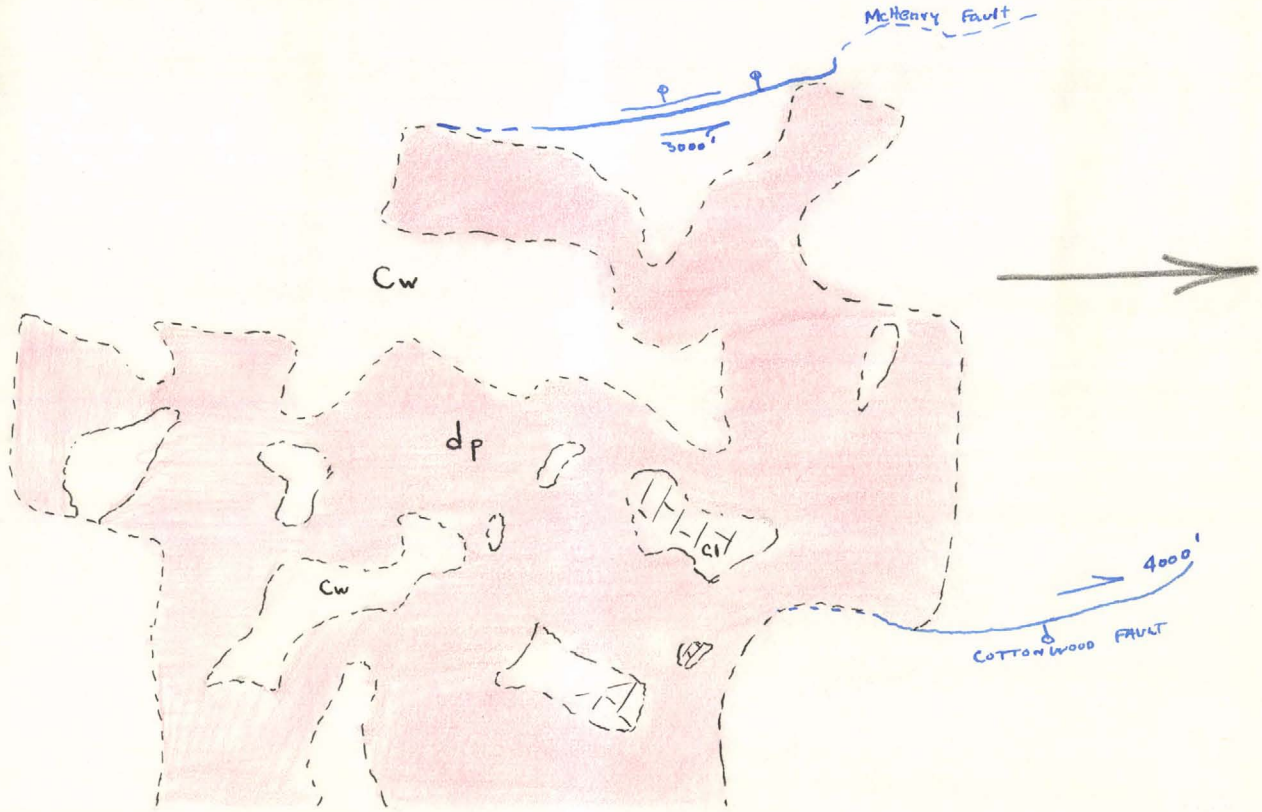
Geologic Map of the Central Portion of the Park City District showing the antithetic Faulting during vertical uplift.

Scale - $\frac{1}{12500}$

uplift.

Along with this Cretaceous deformation there was the intrusion of diorite porphory originating from the west and probably a stock offshoot from a much deeper dioritic magma. Upon invasion of the sediments it deformed them metamorphosed them considerably causing deposition of

metallic sulfides near the contact. Vertical uplift was still going on at the time of the intrusion and the sediments reached a breaking as the stock progressed upward. It induced the development and extension of the Cottonwood and McHenry faults which were near there elastic limit thus moving the block as a unit to the east nearly two miles. The evidence that the deformation was great is shown by the numerous horses and great blocks of limestone and quartzite, even up to 1000 feet long, engulped into the stock as it rose upward. These blocks of limestone can be correlated with others in the Weber quartzite showing that they are several thousand feet higher in the section. Further evidences of doming and fracturing are shown in the following diagramatic sketchs and in Plate III.



Along with this intrusion or shortly after there was the intrusion of the Clayton Peak quartz diorite stock which probably originated from the same magma and had even more far-reaching effects. Originating from the west or southwest, as it progressed upward it domed, fractured, and metamorphosed the overlying sediments. It appears to be instrumental in the formation of the Frog Vally overthrust to the northeast. This northeast block has overridden about 2000 feet of sediments in this region and the Frog Valley fault dips 45° into the heart of the uplift and also in the direction of invasion of the diorite stock. Sedimentary rocks formerly occupied this region so the compressive force of this intrusive must have been extremely great. This intrusive probably also helped in the moving of the block between the McHenry and Cottonwood faults eastward.

Later movements intwaning stages of orogenisis produced the relatively small displacement on the Ontario-Daly West fissure zone. Probably the result of minor vertical uplift with subsequent synthetic faulting. This zone is well exposed underground but exposures are rare on the surface.

Solutions and vapors originating from these igneous masses permiated into the opening and fractures developed thus giving rise to the rich deposits of base metals in the Park City district.

In summary, the general geologic history from the Late Cretaceous is as follows:

1. Near vertical uplift with the resultant formation of the Park City arch.

2. Antithetic faulting, mostly step faulting, on the western limb of the Park City arch.

3. Intrusion of the diorite porphory stock with a resulting shift to the east of a wedge formed between the McHenry and the Cottonwood faults.

4. Intrusion of the Clayton Peak diorite from the west with the formation of the Frog Valley overthrust and displacement to the east of 2000 feet of sediments.

5. In the late stages of uplift, the Ontario-Daly West fault zone formed with minor displacement but of major importance because of the large lode deposits.

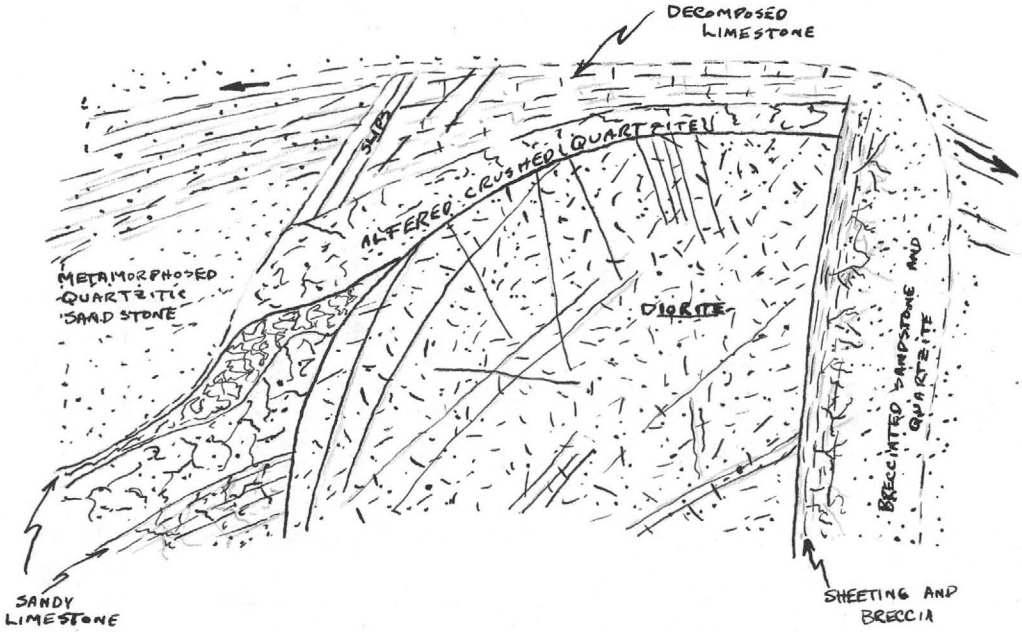


Figure 1 - Dioritic laccolith doming, fracturing, and brecciation of limestones and sandstones which have been notably metamorphosed. Near West Quincy Shaft.

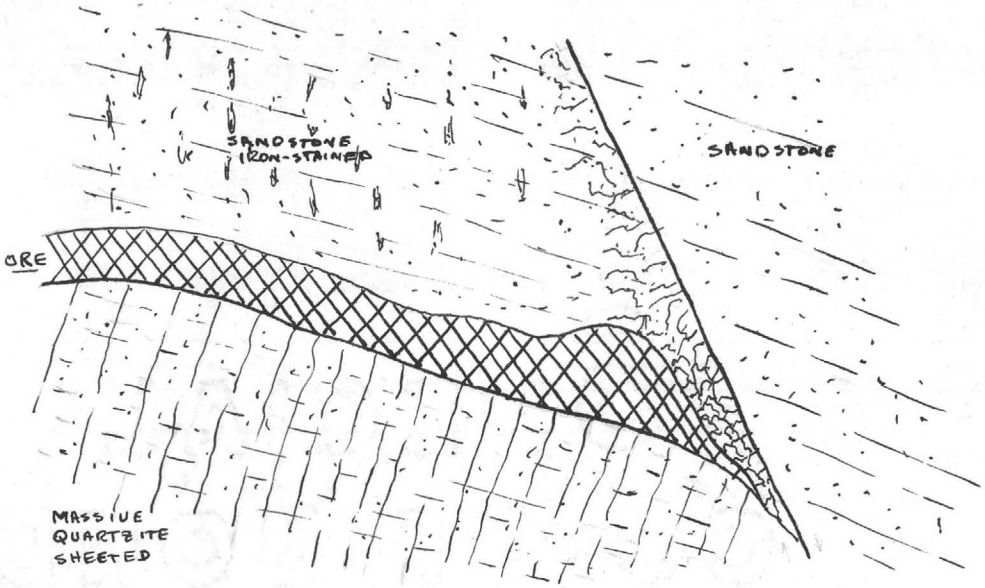


Figure 2 - Bed of rich cupriferous galena between siliceous sediments truncated by N 70 E fault. Ore dragged, brecciated, and thoroughly altered adjacent to fault zone. 1200-foot level west, Silver King Mine.

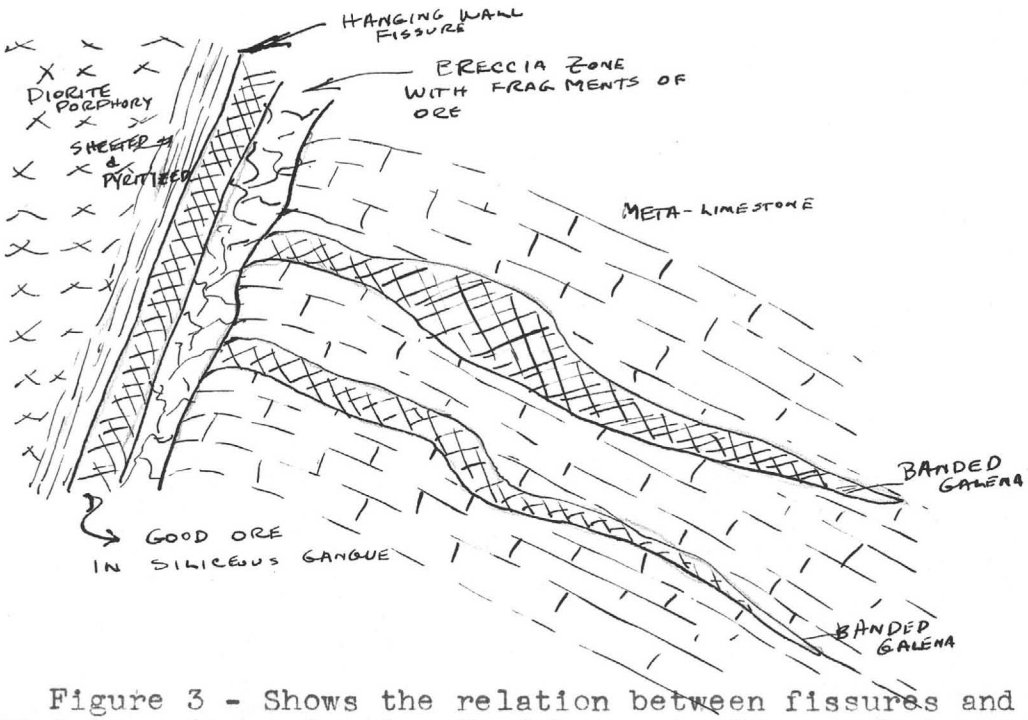


Figure 3 - Shows the relation between fissures and bedded deposits. A vein of rich ore in fissure between porphory hanging wall and metamorphosed limestone footwall. Kearns-Keith Mine

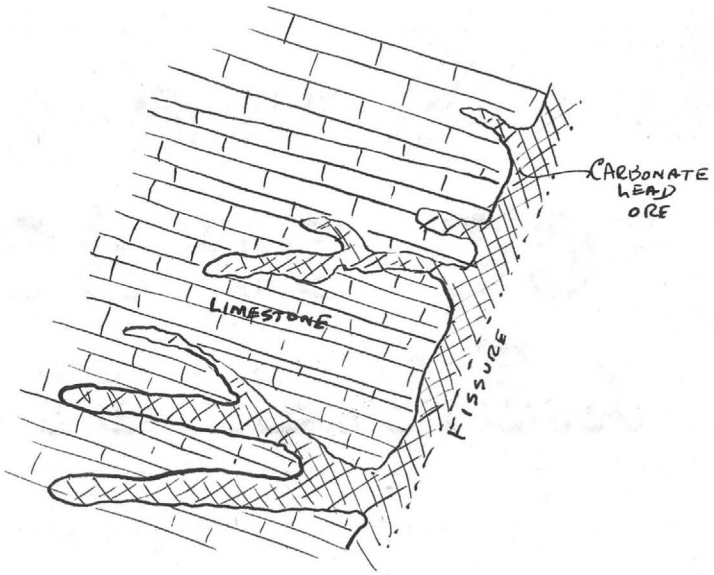


Figure 4 - Selective replacement of certain limestone horizons by mineralizing solutions originating from the main fissure. This is on a small scale (1" equals 2') but is prevalent throughout the Daly West Mine and other mines in the Park City District.

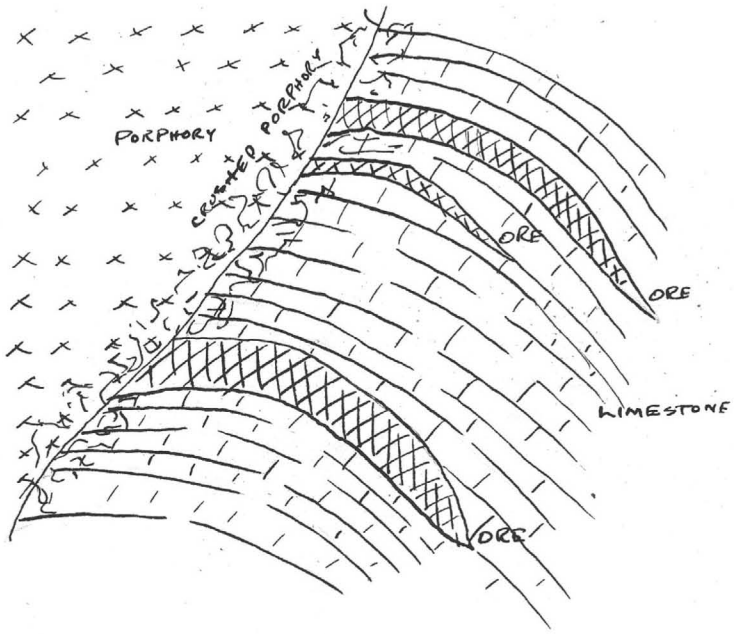


Figure 5 - Bedded ore in limestone cut by post-mineral faulting showing the nature of the contact near an intrusive body. The zone of crushing varys in width but is usually 2-10 feet. Kearns-Keith Mine.

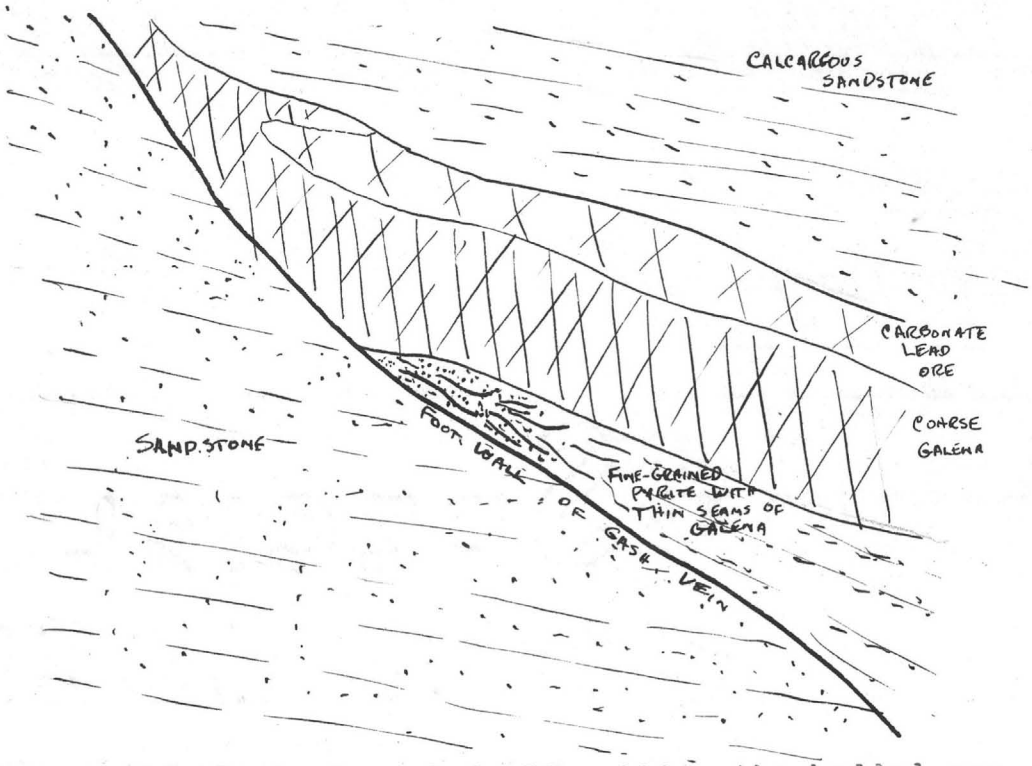


Figure 6 - Post-mineral fault cutting the bedded ore and thus developing secondary sulfides along the contact. This occurs in the Silver King Mine.

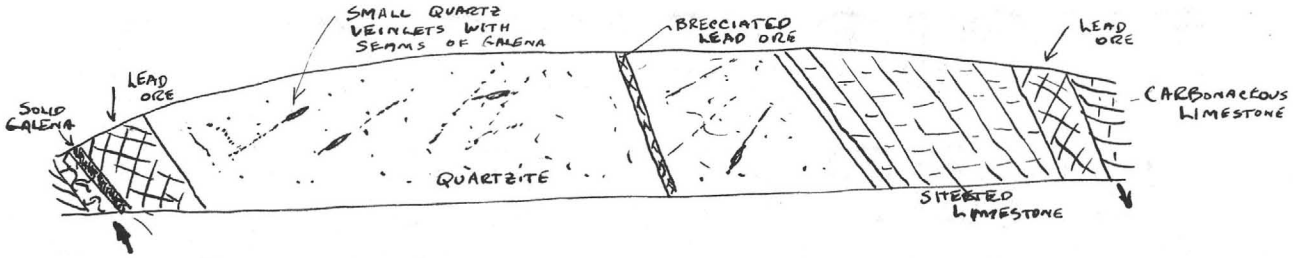


Figure 7 - Transverse section of an ore shoot in a lode about 40 feet across showing the nature of the mineralization, fracturing, and sheeting of the limestone and quartzite. Daly-West Mine.

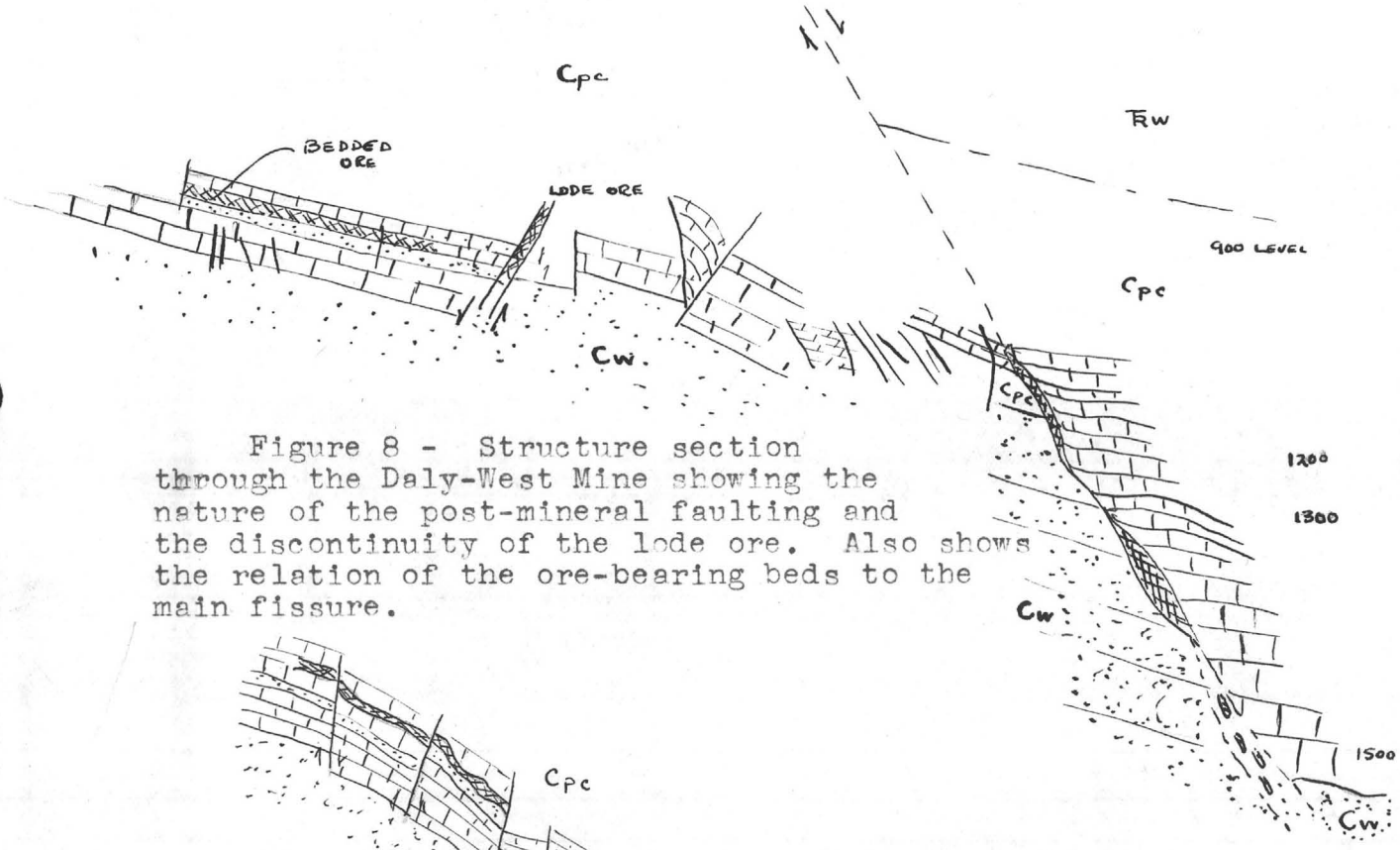


Figure 8 - Structure section through the Daly-West Mine showing the nature of the post-mineral faulting and the discontinuity of the lode ore. Also shows the relation of the ore-bearing beds to the main fissure.

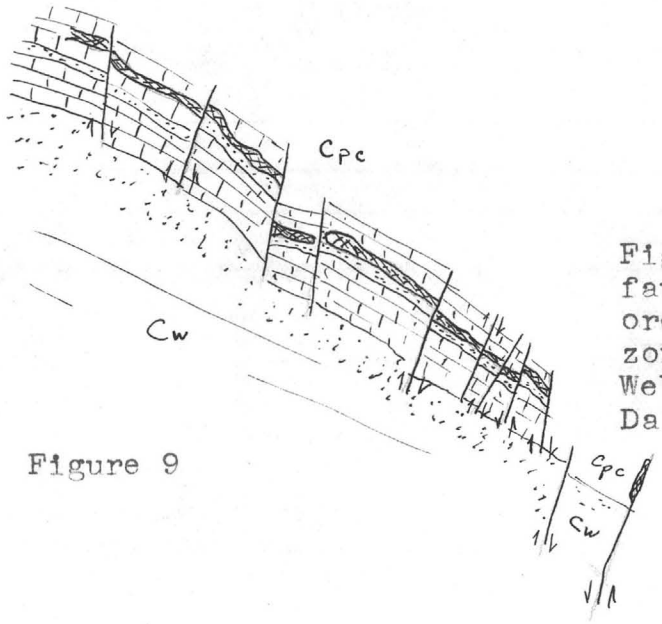


Figure 9

Figure 9 - Shows strike slip faults formed after the bedded ore had formed. The ore horizon is about 40 feet above the Weber quartzite contact in the Daly-West Mine.

Purpose and Description of Maps

Plate I - Geologic Map of the Park City District - This map shows the various stratiographic units and the relation of the sedimentary formations to the igneous rocks. It was prepared from a similar map in the U.S.G.S. professional Paper No. 77 by Mr. Boutwell. (See Bibliography)

Plate II - Tectonic Map of the Park City District - This map shows the fracture systems throughout the district and also the outline of the main intrusive bodies. The directions of movement on the major faults has been put on to suppliment the data already given.

Structual contours of the base of the Park City Formation have been drawn to illustrate the nature of the forces responsible for the Park City Arch and the fracture systems. The structure contours were not continued over the igneous masses because it was thought the extrapolation required here would possibly be a misrepresentation of the actual contour outline.

Plate III - Geologic Structure Sections of the Park City District - These were taken directly from Mr. Boutwell's paper and proved helpful in the preparation of Plates II and IV. It also gives some idea of the amount of force and direction of the forces responsible for the master fault zones. Distinct deformation by quartz diorite porphory of the sediments can be seen in Sections A-A' and F-F'.

Plate IV - Structure Contour Map of the Base of the Park City Formation - This map has been prepared for the purpose of reconstructing the Park City Formation to its

original position after intrusion and uplift but without the faulting. It serves to show the deformation by the major intrusives and even the possibility that the axis of the Park City Arch has been shifted to the east by the Clayton Peak diorite.

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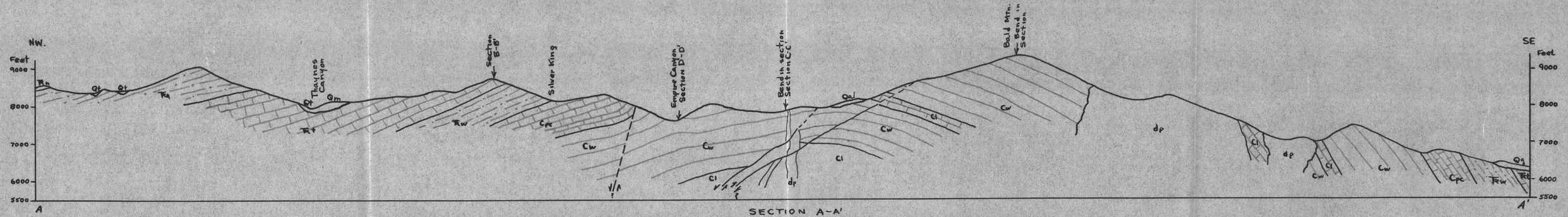
POCKET

Plate I - Geologic Map of the Park City District

Plate II- Tectonic Map of the Park City District

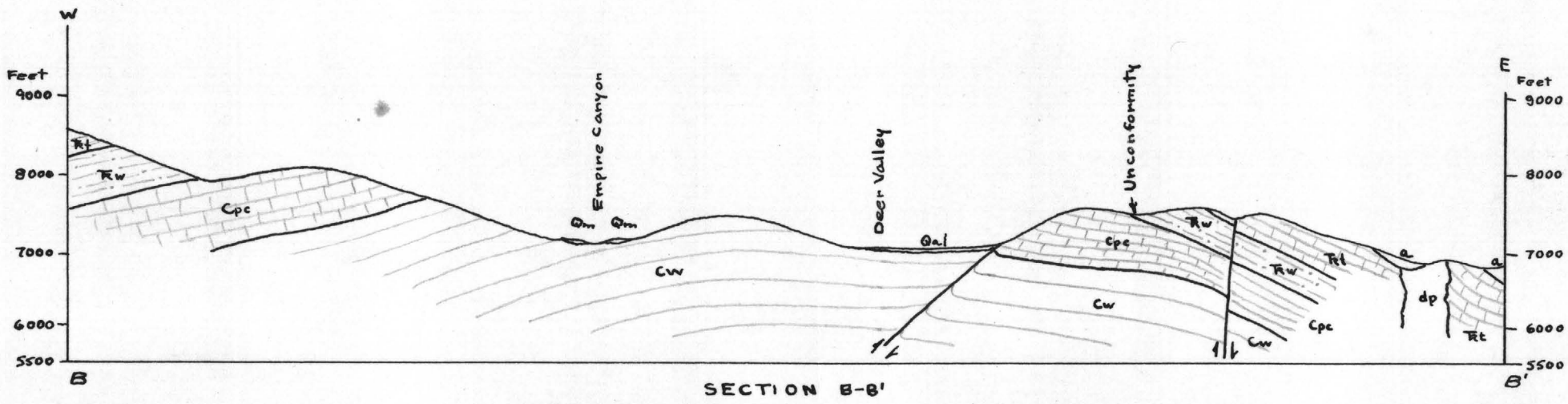
Plate III- Geologic Structures Sections of the Park City District

Plate IV- Structure Contour Map of the Base of the Park City Formation

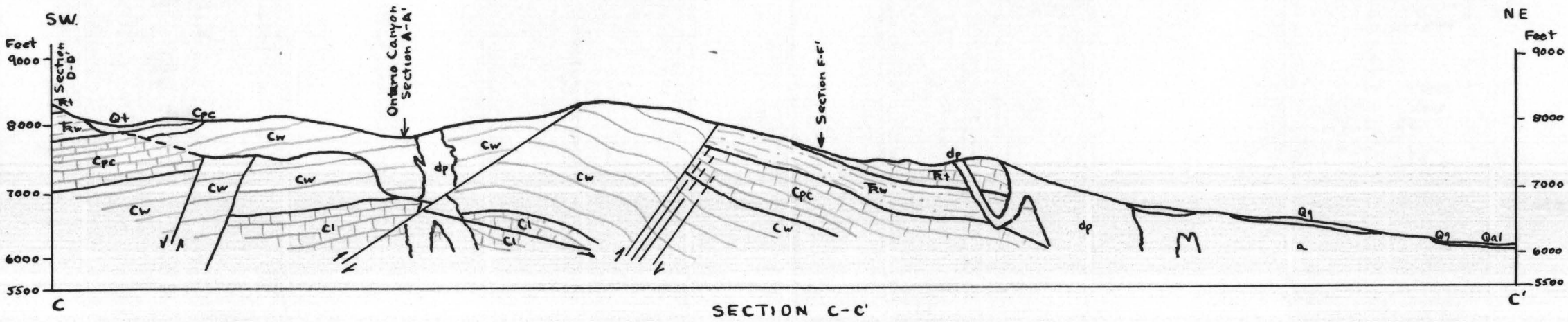


SECTION A-A'

PLATE IIIA



SECTION B-B'



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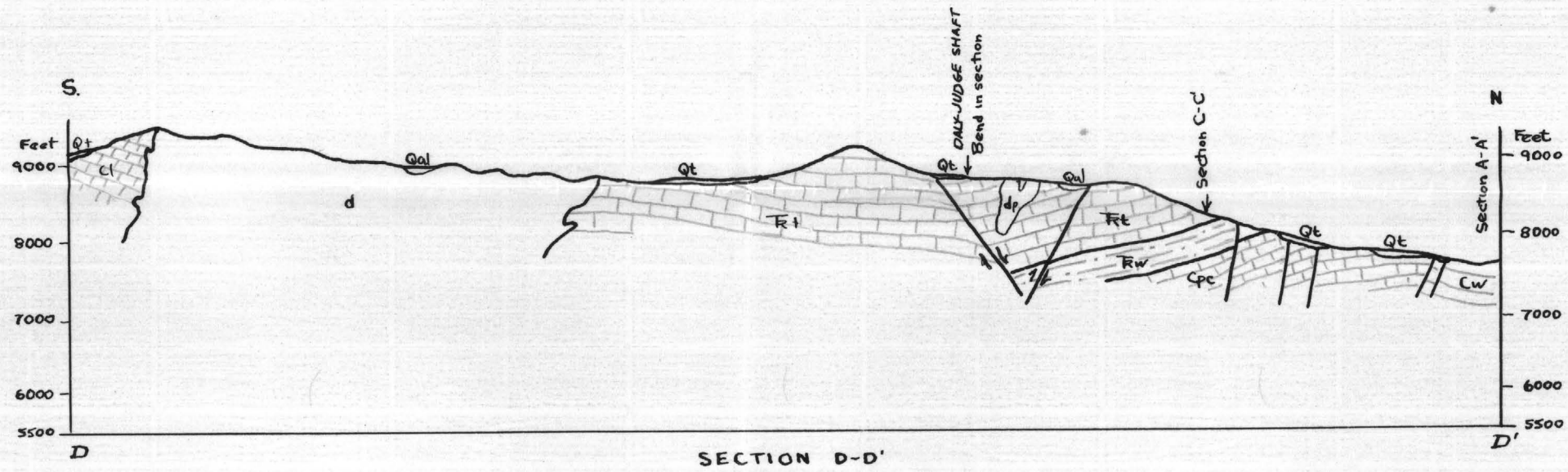
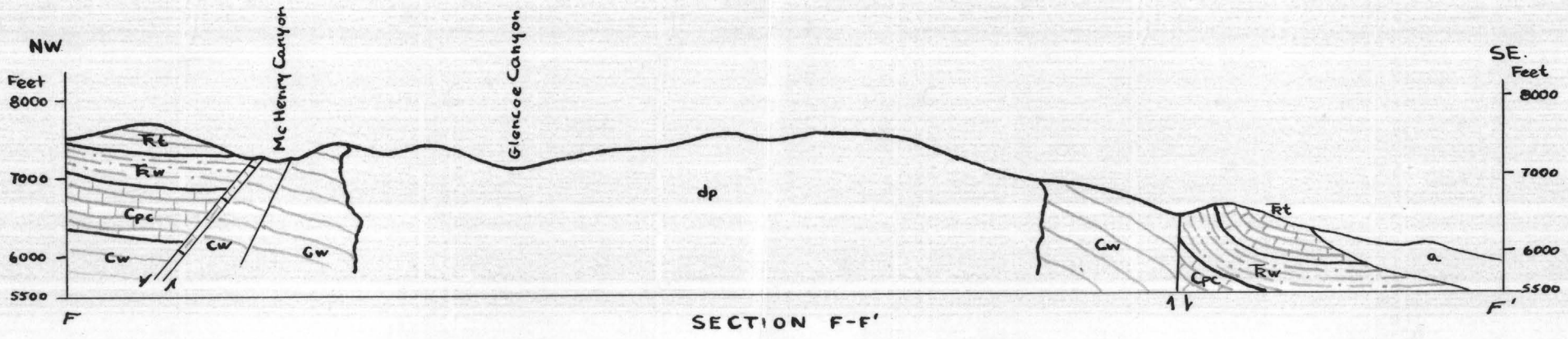


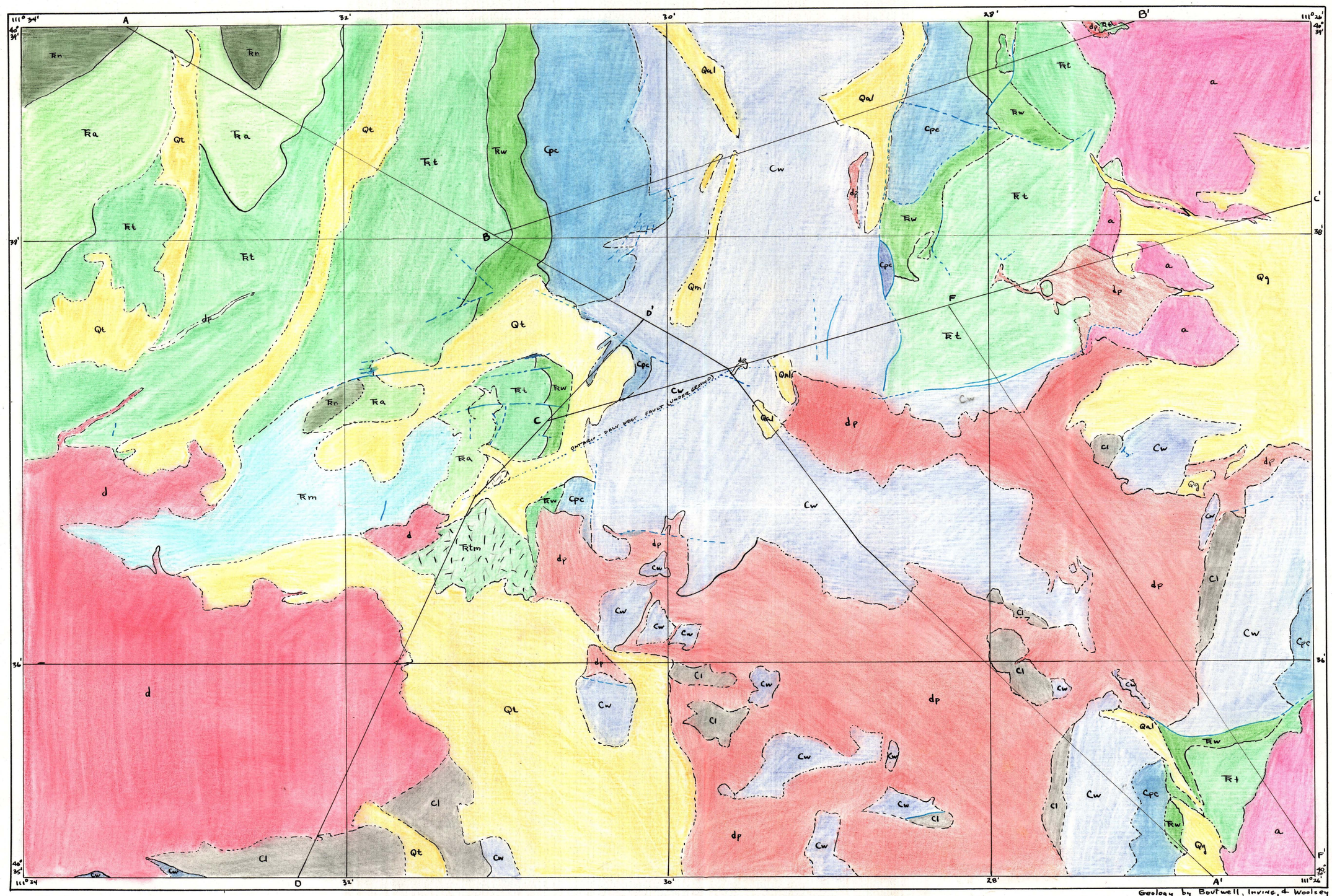
SECTION D-D'



SECTION F-F'

PLATE III

GEOLOGIC STRUCTURE SECTIONS, PARK CITY DISTRICT, UTAH



LEGEND

SEDIMENTARY ROCKS

QUATERNARY

- Qal, Qm, Qg, Qt — Quaternary Deposits

JURASSIC TRIASSIC

- Ŧn — Nugget Sandstone

TRIASSIC

- Ŧa — Ankareh Shale
- Ŧt Ŧtm — Thaynes Formation
- Ŧw Ŧwm — Woodside Shale
- Ŧm — Metamorphic Sediments

CARBONIFEROUS

- Cpc — Park City Formation
- Cw — Weber Quartzite
- Cl — Undifferentiated Limestones in Cw & igh. mks.

IGNEOUS ROCKS

POST-CARBONIFEROUS

- a — Andesite
- dp — Quartz diorite Porphory
- d — Quartz diorite

SYMBOLS

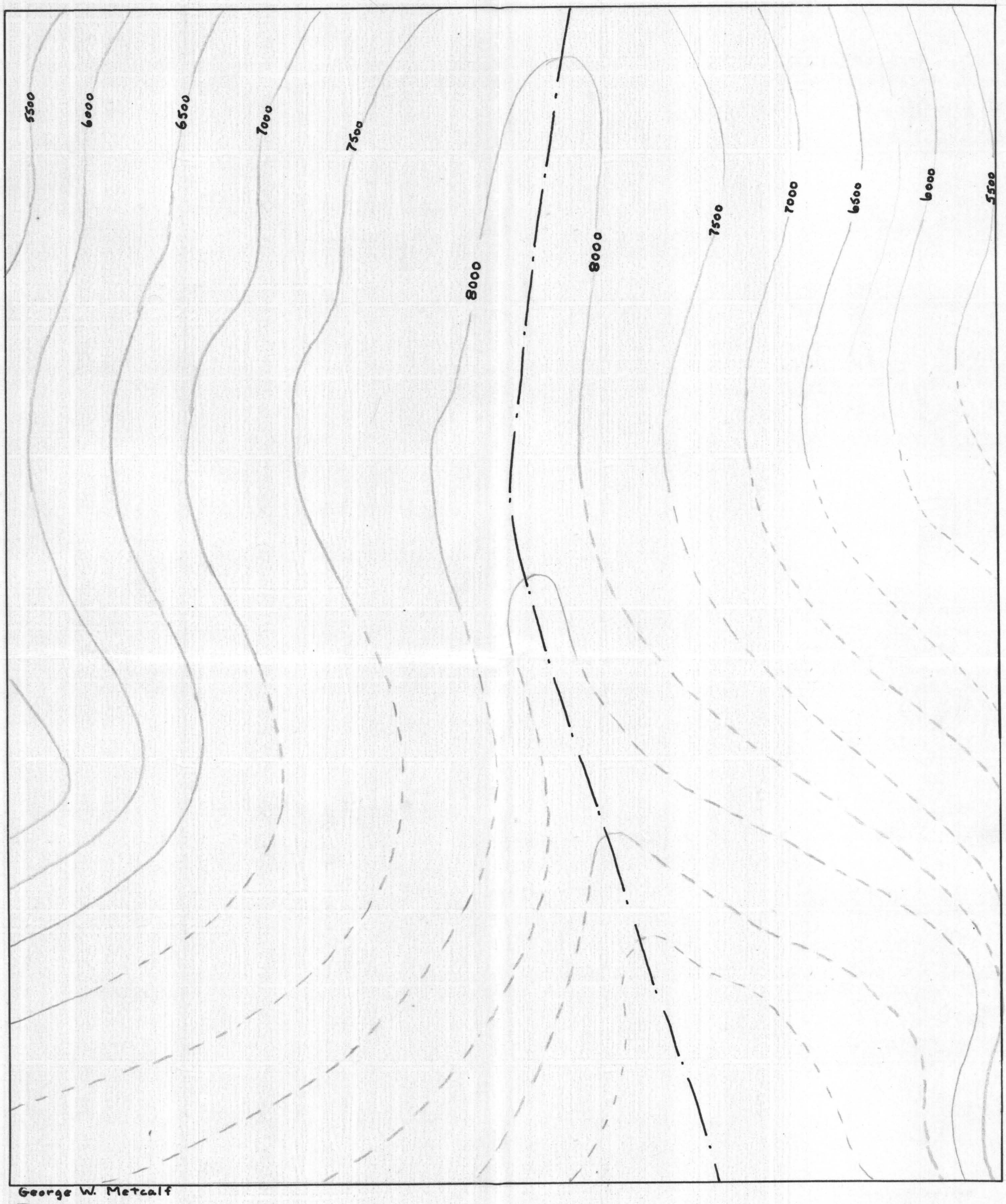
- Known formation contact
- Probable formation contact
- Known fault
- Probable fault

PLATE I

GEOLOGIC MAP OF THE PARK CITY DISTRICT, UTAH

SCALE $\frac{1}{25000}$

Geology by Boutwell, Irving, & Woolsey
U.S.G.S. PROFESSIONAL PAPER 77



George W. Metcalf

PLATE IV

INFERRED STRUCTURE CONTOUR MAP ON THE BASE OF THE PARK CITY FORMATION AFTER UPLIFT

SCALE $\frac{1}{25000}$

——— Definite Contour

– – – – Inferred Contour