DRUM MOUNTAIN PROJECT

FINAL REPORT

for

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FREEPORT EXPLORATION COMPANY

SECTION 1

DRUM MOUNTAINS GOLD PROJECT

A. GENERAL GEOLOGY

The Drum Mountains are located in west central Utah, about 40 miles northwest of Delta, within portions in Juab and Millard counties. The central and southern Drums consist of a thick, conformable sequence (approximately 12,000 feet) of Precambrian-Cambrian quartzites overlain by Cambrian limestones. These sediments form a relatively simple southwestward tilted homoclinal block. East to northeast small scale faulting disrupts the block locally, and provides a plumbing system for hydrothermal solutions.

The Central Drums are bounded to the north by the Joy Fault, a steeply north dipping fault of major displacement. This fault drops Tertiary plugs, tuffs and flows on the north into contact with the Drum Mountain sediments to the south. These igneous rocks are interpreted to be part of a large caldera system located to the north (Newell, R.A., 1971).

The east side of the range resembles an escarpment of a steeply dipping basin and range type fault that strikes nearly north (Crittenden, M.D., et al, 1961). To the south and west, the sedimentary rocks of the Drums dip below recent sediments that largely originate from volcanics common to the Little Drum Mountains.

B. ROCK TYPES

1. Sedimentary Rocks

Approximately 9000 feet of Prospect Mountain quartzite comprises the basal section of the sedimenatry column. The unit consists of buff to red-brown weathering gray, white, or pink, medium to coarse grained, cross-bedded quartzite with some shale interbeds and minor conglomerate.

Thin to medium bedded Cambrian carbonates and shales conformably overly the quartzites. The initial mapping by Crittenden and others used a letter designation for the carbonate stratigraphic units and numbers for the shales. However, tentative correlation to the standard Cambrian section exposed in the House Range to the west is proposed. This convention was continued by Freeport project members.

The following is a brief lithologic description from oldest to youngest of the sedimentary map units based on Crittenden, et al, and our own investigation. All contacts are conformable and thicknesses are map estimates; and, therefore, approximate:

1. Prospect Mtn. Quartzite - 9000 feet; as described above.

2. Cabin Shale - 120 feet; conformably overlies the Prospect Mtn Quartzite; olive-green to gray micaceous shale, sandstone, and quartzite; ripple marks, cross bedding, rain imprints, and worm tracts are common sedimentary structures.

3. Busby Quartzite - 180 feet; white to gray, fine to medium grained quartzite with greenish-gray sandy shales and argillite interbeds.

4. Dolomite A - 20 feet; brown weathering, sandy, shaly dolomite; extensive and rapid lateral variation; in places missing from the section.

5. Shale 1 - 20 feet; grayish weathering shale with some fine grained shaly sandstone; some trilobites; possibly correlated to upper part of the Pioche shale.

6. Limestone B - 90 feet; massive thick bedded limestone; abundant pisolites near the base of the unit; 10-51 feet of brown dolomite similar to Dolomite A at the base.

7. Shale 2 - 10-15 feet; brown weathering, thin bedded micaeous shales and interbedded calcareous sandstones.

8. Limestone C - 200 feet; thin bedded, bluish gray, fine grained limestone characterized by wavy argillaceous partings that weather to a brown color while preferentially weathering.

9. Shale 3 - 50 feet; greenish gray to brown limey shales and shaly limestones; crossbedding and oolitic horizons common.

10. Limestone D - 120 feet; thick bedded, gray pisolitic and oolitic limestone with minor shaley beds; pisolites sometimes preferentially dolomitized.

11. Shale 4 - 65 feet Cs_4; olive green to brown weathering; thin-bedded, shaly limestones with thick-bedded limestone interbeds; platy angular fracturing fragments.

12. Limestone E - 300 feet; Cle; thick bedded, medium gray, oolitic and pisolitic limestone; irregular white calcite mottlings, minor silty partings, minor flat pebble conglomerate near top (distinctive); present weathering surface rough and pitted; correlates with the Dome limestone of the House Range.

13. Shale 5 - 120 feet Cs_5; greenish-gray to buff weathering shales and shaly limestone; thin-bedded, platy angular fracturing fragments; correlates with the base of the Swasey Formation.

14. Limestone F - 230 feet; Clf; thin bedded to massive beds of drk gray limestone with thin, wavy, siltpartings that weather tan to lavendar; abundant calcite "twiggy structures," oolites, pisolites; weathered surface rough and pitted; a cliff former; correlative with the Swasey formation of the House Range.

15. Limestone G - 390 Feet; Clg; thin bedded, platy pale gray weathering, carbonaceous, fine grained, finely laminated dark gray to black limestone; thin bedded, finely laminated silty interbeds that preferentially part, with a massive fracturing member in the middle of the formation; unit is noted for abundant trilobites, sponge spicules and bedding plane pyrites; correlates with the Wheeler limestone of the House Range.

16. Dolomite H - 375 feet Cdh; massive brown to light medium gray weathering light gray coarse grained dolomite of hydrothermal origin (Lovering, T.S., et al, 1963); lenticular outcrop dimensions cross cuts bedding planes; corelates with the base of the Marjum limestone of the House Range.

17. Limestone I - 1250 feet; Cli; strongly banded, blue gray limestone with 1-3 inch thick beds separated by thin wavy tan weathering silty partings; pisolitic at base, abundant "twiggy structures," thin beds and tan silty interbeds increase upward; gradational contact with the overlying J formation; correlates with the Marjum limestone of the House Range.

18. Limestone J - 125 feet; Clj; thin bedded, tan to gray weathering; medium gray silty limestones; mudcracks and soft sediment deformation abundant (distinctive); correlates with the top of the Marjum formation.

19. Dolomite K - 410 feet; Cdk; masive thick bedded, blue-gray to brown weathering, coarse grained, oolitic, alternating light and dark layered dolomite; abundant pisolites; sharp contact with underlying J formation; correlative with the Weeks Limestone of the House Range.

20. Dolomites L through Q - 1330 feet; brown to gray weathering; thin to massive bedded gray dolomites with some limestone interbeds; correlates with the Weeks Limestone of the House Range

2. Igneous and Related Rocks

The following is a brief preliminary description of the igneous rocks in the Drum Mountains based on macroscopic characteristics:

A. Quartz Diorite. The Copperhead quartz diorite is an equigranular, medium grained, dark colored, dense, hard diorite. Mineral phases include amphibole (hornblende) and euhedral plagioclase laths sometimes as phenocrysts up to 1 cm in length and accessory amounts of biotite, K-spar and magnetite.

The main body of the quartz diorite is fresh looking though there is minor chloritization of the hornblendes. Its eastern margin is completely altered to clay to the point of being saprolitic, and highly veined by goethite and calcite. The bulk of the stock lies to the west of the Copperhead road forming a basin. A dark soil color anomaly is associated with the stock.

B. Quartz Monzonite Porphyry. Plugs and dikes of porphyritic intrusives outcrop throughout the map area. Crittenden, et al (1961), mapped these as quartz monzonite porphyry; however, we prefer quartz latite or dacite. The rock is a feldspar-biotite-amphibole porphyry with a dark green ground mass and minor clear phenocrysts, which are sometimes partially resorbed. Plagioclase usually occurs as euhedral laths. Occasionally the dikes carry coarse lithic fragments of unaltered limestone.

Circular plug-like bodies of this rock adjoin the Coppperhead stock on its northeast and southwest margins. Interestingly the alignment of these plugs with the main stock is concordant with the general orientation of the dike emplacement (i.e. N70E). The dikes, while not thick (5-25 feet wide) extend along strike on the order of hundreds to thousands of feet. More extensive occurrances may exist along the western flank of the range where they have been easily confused with the volcanics of the Little Drum Mountains. Drill logs furnished by Crittenden (1961) for the Staats-Pratt manganese mine also imply an extensive prophyry at depth.

C. Altered intrusives. On the east side of the Copperhead road, essentially in Section 31, T14S, R10W and Section 6, T15S, R10W, is an area of complexly altered (phyllic alteration) and texturally diverse igneous rocks. Map units within this area include (1) an argillized quartz-feldspar porphyry essentially absent of any mafics, (2) a quartz-sericite rock that is heavily limonitically stained (jarosite), and (3) a bleached white limonitic stained quartz porphyry with light gray quartz stockwork throughout.

(1) Argillized porphyry - This rock is an intensely argillized quartz-feldspar porphyry. The quartz pehnocrysts

are light gray and the feldspar phenocrysts are typically 100% argillized. The extent of argillization varies from fissures close to 100% Kaolinite (Dickite? halloysite?) to areas where just the plagioclase sites show the alteration. Minor amounts of jarosite staining and sericite are present throughout. Isolated outcrops show very minor copper staining.

(2) Sericite-Quartz intrusive - Mapped as felsic intrusive, it contains sand size quartz, very abundant sericite, and stockwork jarosite staining with no observed mafics. In some outcrops jarosite is confined to veinlets. Weathered outcrops resemble a badly weathered sandstone. Few samples show euhedral limonite-after-pyrite cubes on the order of 1-2 mm. Additional textures include rounded quartzite clasts (on the order of 2-6 centimeters in diameter) and an occasional prophyry clast suspended in a light gray siliceous, sericitic matrix. This textural variation is often times seen within the same outcrop.

(3) Quartz stockwork - Also mapped as felsic intrusive, it consists of a fine grained quartz-sericite groundmass with rounded light gray to clear quartz phenocrysts and light gray quartz stockwork. Sericite and jarosite staining is abundant in the host rock, yet apparently not associated with the stockwork.

D. Pebble dikes - Rounded pink and gray quartzite clasts in a fine grained quartz, sericite, clay carbonate matrix is associated with some outcrops of the quartz sericite intrusive. Included with the quartzite clasts are angular, bleached limestone fragments and an occasional igneous rock fragment.

In several areas, especially well exposed at the Copperhead Mine, these pebble dikes show an intimate asociation with the underlying quartz monzonite dikes and the overlying jasperoid lenses. Emplacment of these dikes, like the quartz monzonite dikes, appears to be fault controlled.

E. Jasperoids - The Drum Mountains are noted for their excellent exposure and numerous occurrances of jasperoid bodies (Crittenden, et al, 1961, McCarthy, J.H., et al, 1969; O'Neil, J.R., 1979; Lovering, T.G., 1972). These bodies appear to be structurally controlled and commonly outcrop as linear bodies 5-15 feet wide and a few tens to a few hundreds of feet long. Often, several isolated bodies appear over a distance of a few thousand feet along the same structure. In addition to linear outcrops, circular pipe-like bodies also occur. These may extend several tens of feet in diameter and presumably mark the intersections of two or more structures.

Jasperoid bodies form rugged, weather-resistant outcrops of high local relief. Generally, they carry an overall reddish brown color with reds, blacks, and grays in lesser amounts. A high degree of brecciation is common with both matrix and fragments being composed of iron oxide stained microcrystalline silica. Some fragments within the jasperoid resemble quartzite fragments, indicating movement from below.

Drusy quartz lined cavities are common in some brecciated jasperoids. It is not uncommon to find local areas of large fragments with preserved sedimentary structures.

These jasperoid bodies are always rich in associated limonite minerals (i.e. hematite, goethite, jarosite), and sometimes show copper oxides. The most notable characteristic, however, is their anomalous concentrations of gold and other metals. Local gold concentrations of up to .55 oz./metric ton have been reported (McCarthy, J.R., Jr., 1969), with similar results duplicated by Freeport's sampling.

O'Neil and Bailey (1979) reported that gold occurs as finely disseminated grams ranging in size from 5 to 300 microns, averaging about 50 microns in diameter. They found the gold always associated with pyrite or its oxidation products, occurring interstitally or as inclusions near grain boundries in coarse grained jasperoidal quartz.

C. ALTERATIONS

1. Skarn, Marbilization, Bleaching

The intrusion of the quartz diorite stock was accompanied by the development of small contact metamorphic zones in the surrounding carbonate rocks. Typically, calcite-epidote skarns form, but where the stock intrudes lower dolomite A, a coarse grained idocrase-calcite assemblage developed. In most cases, grading outward from the skarn and concentric to the diorite is a marblized zone followed by a bleached zone. The main difference between these two zones is the presence or absence of recrystallization. The bleaching sometimes accompanies recrystallization, but not always. Where shale overlies the diorite, the shale has been altered to argillite with mica flakes aligned on bedding plane. In one instance, the fissle shale has acted as a conduit for hydrothermal solutions which slightly silicified both overlying and underlying limestones for up to 30 feet.

2. Goethite veinlets and diorite alteration

In a few outcrops, the quartz diorite along with the accompanying skarn is: (a) cut by felsic intrusives, (b) intensely altered to the point where it resembles saprolite, (c) is host to a stockwork of limonite (goethite) veinlets, and (d) is locally hornfelsed where it has been intruded by a subsequent felsic plug.

3. Altered intrusives

In addition to the above, other alterations are present as described under "Igneous Rocks: altered intrusives" in the report. The jarosite-rich solutions common to the quartz-sericite alteration were also active in the Cabin shale and Prospect Mountain Quartzite. This is evidenced by local bleaching of the Cabin shale and locally heavy jarosite staining on fracture surfaces.

4. Hydrothermal dolomite

Unit H is given a hydrothermal origin through oxygen and carbon isotope studies (Lovering, et al, 1963). At this point it is not well understood how this event fits into the overall picture temporally. However, the field evidence for the hydrothermal nature includes spotty dolomitization of limestones with preserved original textures, along with a general fading in and out of dolomite/limestone along strike.

D. GEOCHEMISTRY

During the spring of 1979 all major ridges and spurs were soil sampled on 400 foot centers. In addition, all prospect pits, dumps, and jasperoid outcrops were sampled.

Sample locations are shown on maps U3-GC1S and 1N; U3-GC2S and 2N. All sample results are included in the appendix.

Essentially all prospect pits, dumps, and jasperoids produced detectable gold values with some as high as .55 oz/metric ton. Of the trace element geochemistry (Sb, Mo, Hg, As) analyzed in addition to gold, antimony showed local highs coincident with gold values.

Molybdenum values, however, proved most interesting. Highs of several hundred ppm within several jasperoids in the district led us to a detailed investigation of the igneous complex within the Copperhead Basin. Detailed mapping and some 200 chip samples were collected in the fall of 1979. These are discussed in another section.

E. DRILLING

Following geologic mapping and geochemical sampling a 46 hole rotary drilling program was laid out to test our conceptualized targets. As the program developed we elected to delete several holes, but also added an additional hole, FDM-47. A total of 13,280 feet were drilled in 41 holes. Results are tabulated below; logs and assays are included in the appendix.

DRUM MOUNTAIN DRILL HOLES

Hole No.	Depth	Intercepts/Assays	Comments
FDM-1	300'	Nil	
FDM-2	300'	Nil	
FMD-3	300'	Nil	
FDM-4	300'	Nil	
FDM-5	300'	Nil	
FDM-6	-	-	Not Drilled
FDM-7	-	-	Not Drilled
FDM-8	-	-	Not Drilled

FDM-9	165'	Nil	Lost Circulation
FDM-10	500'	95-130 trace Au	
FDM-11	-	-	Not Drilled
FDM-12	300'	Nil	
FDM-13	250'	Nil	
FDM-14	300'	Nil	
FDM-15	-	Nil	
FDM-16	300'	Nil	
FDM-17	300'	Nil	
FDM-18	300'	170-225 trace Au	
FDM-19	300'	5-20 trace Au	
FDM-20			Not Drilled
FDM-21	300'	150-300 @ 4 ppm Mo	
FDM-22	300'	Nil	
FDM-23	300'	Nil	
FDM-24	1000'	0-1000 @ 56 ppm Mo 0-1000 @ 126 ppm Cu 0-1000 @ 1075 ppm F Trace Au throughout (.00x)	
FDM-25	810'	0-810 @ 29 ppm Mo 0-810 @ 125 ppm Cu 0-810 @ 925 ppm F 0-65 trace Au	
FDM-26	300'	Nil	
FDM-27	360'	Nil	
FDM-28	50'	Nil	Lost Circulation
FDM-29	300'	Nil	
FDM-30	153	Nil	Lost Circulation

FDM-31	285'	Nil	
FDM-32	300'	Nil	
FDM-33	300'	Nil	
FDM-34	160'	Nil	Stuck Bit
FDM-35	255'	Nil	Lost Circulation
FDM-36	300'	Nil	
FDM-37	75'	Nil	Lost Circulation
FDM-38	115'	Nil	Lost Circulation
FDM-39	140'	Nil	Lost Circulation
FDM-40	300'	Nil	
FDM-41	300'	Nil	
FDM-42	285'	Nil	
FDM-43	35'	0-10 @ .032 Au 0-35 @ .012 Au	
FDM-44	300'	Nil	
FDM-45	125 (135)	95-115 trace Au	Lost Circulation
FDM-46	300'	10-25 @ .024 Au 100-250 trace Au (.00x)	
FDM-47	1450'	0-1450 @48 ppm Mo 0-1450 @ 130 ppm Cu 0-1450 @ 2900 ppm F No Au sample	

<u>Depth: 11,830 feet</u>

SECTION 2

MOLYBDENUM EVALUATION

INTRODUCTION

During the early stages of acquiring ground and evaluating the Central Drum Mountains for their disseminated gold potential, an altered stock was identified in Copperhead Basin which subsequently was found to be geochemicaly anomalous in Mo and F. Rock chip geochemistry for this area showed anomalous values for molybdenum (up to 165 ppm Mo) and Fluorine (up to 2800 ppm). The center of the system is marked by variably altered rhyolite porphyry, rhyolite intrusive breccias, pebble dikes and quartz stockwork veining.

GEOLOGY

The central and southern Drum Mountains consist of a thick conformable sequence of Precambrian-Cambrian quartzites overlain by Cambrian limestones and dolomites with minor shales and siltstones. Several younger intrusive events are marked by stocks throughout the range and most prominently in Copperhead Basin which is located in the east central portion of the project area.

The overall extent of intrusive activity in Copperhead Basin is difficult to assess due to very limited outcrop. It appears that the intrusive center consists of two stocks. The earliest stock, a fine to medium grained diorite, occupies the western portion of the basin. Associated with this are small zones of calcite-epidote and idocrase-calcite skarns which grade away from the diorite to marbles and then bleached zones. The eastern portion of the basin is marked by a rhyolite porphyry which intruded into and hornfelsed the diorite. Rhyolitic dikes radiating outward from the plug cut all nearby lithologies. Breccias, porphyritic and frothy textures are common in the rhyolite, however, the exact interrelationships are unknown due to the lack of good outcroppings. The best geochemical values are associated with a quartz stockwork veined phyllitically altered rhyolite and a rhyolite breccia. Peripheral to these areas the rhyolite is moderately to intensely argillized. Pebble dikes are common especially in the quartzite to the east of the rhyolite. Clasts consist of both altered rhyolite and spherical to subangular quartzite pebbles.

Rock chip geochemistry outlined two Mo and two F anomalies as outlined on the map. Based on these and an apparent alteration zoning in a favorable rhyolite, rotary holes FDM-24 and 25 were located to test for vertical zoning.

FDM-24 was drilled to 1000 feet. Local jarosite-goethite staining, clay-sericite alteration and quartz stockwork veining occur in the highly oxidized and bleached zone in the top 100 feet of the hole. The lower 900 feet consists of a highly altered clay-sericite quartz stockwork veined porphyritic rhyolite. Prophyritic texture and feldspar ghosts are easily recognizable. Large, primary unaltered euhedral biotites are present along with fine grained secondary biotite on fractures. Pyrite (3-5%) is associated with the quartz veining throughout this lower 900 feet. Molybdenum and chalcopyrite are also visible in quartz veinlets and moly is occassionally present as "paint" coating fractures. Alteration, pyrite content, quartz stockwork intensity, Mo, Cu and F showed no readily apparent gradient in this hole. Mo averaged 56 ppm; Cu averaged 126 ppm; F averaged 1075 ppm. Mo and Cu were sampled at 10 foot intervals; F analyses were run on 50 foot composites.

FDM-25 was located approximately 800 feet northwest of FDM-24 and tested the highest Mo geochemistry. The hole was drilled to 810 feet. The upper 120 feet are identical to FDM-24. The lower 690 feet differ from FDM-24 in that it has zones of silica flooding, more quartz stockwork veining, greater pyrite (5% overall) and magnetite. It appears that magnetite slightly increases down the hole at the expense of a slight decrease in pyrite. Weak calcite veining occurs occassionally. The overall rock and alteration are identical to FDM-24. Again, there were no apparent gradients, except magnetite, in this hole. Mo averaged 29 ppm; Cu averaged 125 ppm; F averaged 925 ppm. Sample intervals were the same as FDM-24.

Though downhole geochemistry and alteration showed no significant variation there is a geochemical difference between FDM-24 and 25. Mo doubles to the east and F increases by 150 ppm. With this geochemical difference in mind the area east and northeast of FDM-24 was examined in detail. Several small, highly fluidized pebble dikes were encountered in the quartzite. These dikes appeared to be radiating from a point north of FDM-24. This became the site for the last hole (FDM-47).

Hole FDM-47 is located approximately 1000' north-northeast of FDM-24 and is 1450 feet deep. Again the top 100 feet consists of oxidized and highly bleached, clay-sericite altered rhyolite with strong quartz and iron oxide veining. Unlike either FDM-24 or 25, however, the unoxidized rock is more intensely altered with original textures completely destroyed. From approximately 100 to 500 feet, the rock is an intensely argillized intrusive which grades to a pronounced clay-quartz-sericite assemblage for the rest of the hole. Both the upper and lower zones are pyrite veined with pryite averaging 3-5% of the rock. Quartz veining may increase slightly with depth. As with FDM-24 and 25, unaltered, euhedral primary biotite is present as is fracture controlled secondary biotite. Trace amounts of anhydrite were recognized in several places below the 1000 foot depth; no magnetite was seen. Mo averaged 48 ppm; Cu averaged 130 ppm; F averaged 2900 ppm. Again, there does not appear to be any gradient in Mo or Cu. However, F does seem to increase in an erratic way downhole from 1600 ppm to 4200 ppm.

17 pgs