J.C. Haff
September, 1944

MR44-4

PRELIMINARY REPORT ON THE FLUORITE DEPOSITS NEAR OGDEN CREEK, BEARLODGE MTS., CROOK CO., WYOMING

Location

The area mapped lies chiefly in the SW ¼ of Sec. 27 and SE ¼ of Sec. 28, Twp. T. 52 N., R. 63 W., Crook County, Wyoming. The Fluorite deposits herein described occur on and near the crest of an approximately east-west trending ridge forming the divide between Ogden and Tent Creeks. The claims on this ground are held chiefly by Messrs. W.W. Wright and Ray V. Allen of Newcastle, Wyoming. The area is about 2 miles southeast of the Warrens Peak Lookout Station. It may best be reached by a secondary Black Hills National Forest road from the town of Sundance which is about 7 miles southward.

Purpose of Examination

The purpose of this examination was (1) to map the area in the vicinity of the claims and the surrounding prospected ground, (2) to examine details of mineralization in the small workings available, and (3) to appraise the area in terms of probable fluorite production.

Field Methods

A detailed planetable map of the area was prepared on a scale of 1" = 200'; the entire mapped portion being about three-quarters of a mile long by one-half mile wide. A total of five and one-half days were utilized in mapping the geology and topography and in examination of prospect pits and trenches.

A supplementary traverse requiring an additional day was run from U.S.C. & G.S. triangulation point, El. 6707 feet, situated at the base of the firetower on Warrens Peak. This traverse was required in order to establish vertical control and was tied to planetable station S-1. A correction of 92.7 feet was then subsequently applied in contouring.

Local Topographic Conditions

The Bearlodge Mountains represent the northwesternmost extension of the Black Hills uplift. Structurally the region consists of an eroded mass of up-arched Paleozoic and Mesozoic rocks, with annular outcrop, surrounding a central laccolithic or domelike igneous core exposed by erosion.

The claims investigated lie near the southern part of the Bearlodge Range and wholly within the igneous core, although the Deadwood sandstone scarp is not more than ½ mile eastward of the mapped area. The area examined lies almost wholly along the ridge between Ogden Creek to the north and the headwaters of Tent Creek to the south. Exposures are generally poor because of abundant timber and the presence of dense, burned-over brushy, second-growth tracts. The only reasonably continuous exposures, indeed the only parts in which even occasional outcrops are found, lie on the ridge crest and on the higher and steeper portions of the slopes above Ogden Creek.

General Geology

Four formations, whose relative ages cannot in all cases be determined with certainty, are exposed locally. The oldest rocks are crystalline limestones or marbles. These represent predominantely calcareous originals which have been intruded by, or engulfed in, Tertiary intrusives. The Tertiary intrusive rocks are most widespread in the vicinity and sometimes in contact with igneous breccias. The field relations suggest, but do not definitely establish that the breccias are probably intrusive into the earlier, more abundant porphyritic rock. A series of phonolite dikes, none of which can be traced for any considerable distance, are probably youngest of all. The three dikes encountered seem, as a group, to manifest a noticeable NE-SW trend.

Crystalline Limestone (marble)

The crystalline limestone is a coarse grained, rather uniformly massive rock. No traces of fossils or of original bedding or lamination, by means of which its attitude could be established with certainty, were found. On the fresh fractures it is grey or white, coarse-textured, and appears to be wholly recrystallized. At and near some contacts with the porphyry it contains abundant euhedra of purple fluorite. Grains of the latter mineral are generally from 1/8 to 1/4 in. across but may locally reach 1/2 to 1 in. in size. The fluorite tends to bleach to a greenish-white color on weathered surfaces but is always lavender or deep purple beneath. It is in this crystalline limestone that relatively abundant evidence of mineralization may be found, although the fluorite is by no means confined thereto. Also the marble masses themselves have been most extensively prospected.

The areal distribution of the limestone masses locally is such that serious weight should be given this factor in considering the economic possibilities of the area. As is shown on the map there are two large masses of marble lying on the north side of the ridge. To the eastward of these are three smaller crystalline limestone outcrops. In particular it should be noted that the marble masses are discontinuous, mere patches as it were, and that there is no field evidence necessarily indicative of their continuation at depth. It is possible that these exposures of partially fluoritized marble represent once-continuous parts of either Pre-Cambrian or Paleozoic roof rocks into which the Tertiary rocks were intruded. Their general trend as a group, is, however, at a high angle to the escarpment of Paleozoic rocks which encircles the igneous core of the uplift and which are exposed less than 1/2 mile eastward of the mapped area. It is quite possible that the marble segments are parts of a large xenolith or roof pendant of Pre-Cambrian material stoped off by the transecting intrusives. Whatever the age or mode of emplacement of these isolated blocks no field evidence that they are continuous at depth was obtained. Indeed, if they are actually individual xenoliths, or isolated parts of a single, once more extensive and structurally continuous roof pendant their continuation to any great depths within the body of the enclosing porphyry would be purely fortuitous and could only be established by exploratory work.

Intermediate Porphyry and Related Intrusives

Two conspicuously different textural and structural varieties of intrusive rock of intermediate composition occur in the area. The most widespread and abundant type, and that which extends over practically the entire central part of the region, is a conspicuously porphyritic rock of monzonitic or trachytic composition. This rock weathers to various shades of rusty brown and has such pronounced porphyritic structure that it is readily identifiable in the field. It contains abundant flat, tabular feldspar phenocrysts set in an aphanitic groundmass of pinkish or buff hue when fresh. The tabular phenocrysts are strongly idiomorphic, range from $\frac{1}{2}$ - 1 inch in length, are white or greenish, and nearly everywhere show the conspicuous parallelism characteristic of trachytic structure. It is this rock, hereinafter called trachytic porphyry, which, near the western end of the area contains most of the siliceous fluorite masses.

In both the eastern and western extremities of the area a relatively fine-grained, apparently monzonitic intrusive facies is developed. As regards its texture and structure this rock contrasts strongly with the more widespread trachytic porphyry. It is predominantly massive, fine-textured (0.25-0.50 mm.) and non-porphyritic, at least on a megascopic scale. Weathered surfaces are brownish but on the fresh fracture the rock is predominantly grey or sometimes buff. Hand specimen identification suggests it is probably of the composition of biotite-monzonite or, biotite-syenite.

At no place was the contact between these two rock types observed, so no information as regards their relative age could be secured. Because of their similarity in composition they were mapped as a unit and the fine-grained, massive variety represented as transitional with the trachytic porphyry. These two rocks are probably closely related genetically and are tentatively considered structurally different facies of one magma.

It is the trachytic porphyry which has intruded the crystalline limestone masses lying along the north slope of the ridge. These contacts can be well observed at Stations S-14 and S-15. Exposures at these localities show that the contact is really a mixed zone consisting of interpenetrating portions of marble and trachytic porphyry. Apophyses of finer-textured chill phases of trachytic porphyry extend into the marble for several feet. Likewise, wholly recrystallized marble xenoliths may be found completely surrounded by and suspended in porphyry several feet from the actual chill margins. It may, perhaps, be significant that mere recrystallization of the calcareous original rock seems to be the extent of modification of the marble resulting from intrusion of trachytic porphyry. There is no indication of localized fluoritization of the marble at or near the immediate contacts at Stations S-14 and S-15. These conditions of mutual interpenetration of intrusive and intruded rock (marble) can also be clearly observed 25 feet east of Station S-17 and at or near Stations S-30, S-38, S-42 and S-56.

Igneous Breccia

Igneous breccia occurs at many isolated outcrops north of the ridge crest and also forms a large mass on the ridge near its eastern end. The relative age of the breccias with respect to the trachytic porphyry could not be directly determined. The breccias apparently have an igneous matrix; in most instances highly altered and in some cases slightly porphyritic. The fragments are chiefly of igneous rock. Many of them are of trachytic rock types similar in structure and composition to the surrounding trachytic porphyry. Because of this relationship, namely the presence in the breccia, in abundance, of igneous rock fragments comparable in composition and structure to the trachytic porphyry, the breccia is tentatively considered as younger than the main intrusive mass. Other igneous fragments in the breccia are of fine-textured igneous rocks. Some of these are similar to the fine-textured, massive biotite-monzonite, and others appear to have been originally phonolitic. There are also some fragments of leuocratic, aphanitic, rhyolitic rocks which crop out nowhere in the immediate vicinity. On some exposures fragments of sandstone and a few of fluoritized marble also occur. In the exposures examined the bulk of the fragments are, however, predominantely of igneous derivation.

The fragments in the igneous breccia are rather well rounded and on the average range from ¼ to 3 inches in size. In places both igneous and sedimentary rock fragments as well as portions of the matrix, have been fluoritized. This fact, together with other structural evidence, assuming the conclusion that the breccia is younger than the trachytic porphyry to be correct, indicates that mineralization was relatively late episode in the areal history.

The portions mapped as breccia are not in all instances entirely pure breccia, for at many exposures it is extremely difficult to distinguish true breccia from partially brecciated and highly altered trachytic porphry. In other words those parts mapped as breccia represent areas in which the fragmental rock is predominant or extremely abundant. In many places it is intimately mingled with irregularly ramifying masses of porphyry and the boundaries as shown are merely tentative.

Phonolitic Dikes

Three well-defined dikes cut through the intrusive rocks. Without exception all appear to be definitely of alkaline composition, and in all probability are phonolites. They have in common a dark green or greyish-green color, and are all porphyritic with respect to feldspar. They show conspicuous flow structure, in some cases striking parallelism of euhedral phenocrysts, and have a pronounced tendency toward platy jointing and slabby structure. As a group they range in width from a maximum of 25 ft. in thickness (Station S-8) to 15 ft. in thickness as in the dike at (Station S-40). The dike at (Station S-34) is approximately 10 ft. thick. None of these dikes forms very prominent exposures and thus they can be traced for only short distances near or along the ridge crest. Although an insufficient number of dikes were encountered to justify any generalization as regards their regional distribution, the three dikes mapped, even though traced for only short distances, show a uniform NE-SW trend and general parallelism. None of the dikes exhibit any fluoritization, unlike the trachytic porphyry into which they are intruded. It is therefore likely they are post-mineral, although no conclusive evidences as regarding this was procured.

Fluorite Deposits

Distribution: Detailed mapping, aided by the presence of small, though numerous, prospect pits and trenches shows that the fluorite masses, and also most fluoritized portions of intrusive rock, are not concentrated in any one particular area or restricted to any definite zone or contact environment. It is generally true that the larger crystalline limestone areas consistently show some fluoritization, commonly at or near contacts with the trachytic porphyry. On the other hand there is widespread distribution of siliceous fluorite throughout the trachytic porphyry, especially near the western end of the ridge. Also upon close inspection of both trachytic porphyry and breccia outcrops, veinlets and traces of disseminated fluorspar occur quite generally throughout the area. The largest concentration of fluorite seems to be in the vicinity of the major, westernmost crystalline-limestone mass, although its relative abundance here may be more apparent than real inasmuch as this locality has been most extensively prospected.

By and large two types of occurrence involving noteworthy amounts of fluorite are developed; (1) disseminated deposits at and near the contacts of the marble and trachytic porphyry and (2) more massive, relatively siliceous, deposits of fluorite which occur as isolated bodies within porphyry and relatively remote from contacts.

These concentrations of fluorite are of two conspicuously different structural and mineralogic types. Deposits of the first type are rather coarsely crystalline aggregates and disseminations of fluorite in crystalline limestone. In such deposits fluorite has replaced the limestone, with local development of massive fluorite aggregates of irregular form and distribution. In the marble adjacent to the massive fluorspar are, usually, disseminated fluorite grains scattered throughout the outcrops. In the massive coarsely crystalline aggregates the individual fluorite grains may exceed 1 inch in cross-section and the (111) cleavages are conspicuous. This type of massive fluorite commonly has a pale-green color on the weathered surface but is invariably deep purple on the fresh fracture. The carbonate in the marble containing the disseminated fluorite is coarsely crystalline. It sometimes shows radiating or plumose structure, is often dull grey and may be dolomitic. In the prospect trench at Station S-56 there is much brown carbonate, probably siderite, associated with the fluorite. In general the ore in the marble, or near its contacts with the trachytic porphyry, shows a simple mineralogy involving merely carbonate, fluorite, siderite, ankerite (?), and traces of pyrite.

The second type of fluorite concentration contrasts strongly with the first in texture, structure, mineralogy, and distribution with respect to the surrounding rocks. Type two is typically an exceedingly fine-textured, very dense, hard siliceous type of ore with deep purple or lilac color and conchoidal fracture. The ore is essentially a mixture of microcrystalline fluorite in a siliceous matrix of chalcedonic gangue. Many subhedra of clear quartz may occur in such ore, and in places, massive quartz aggregates as well. Associated with the dense siliceous fluorite there is susually some pyrite and, commonly, much limonite and ferruginous quartz or jasper. Much of the siliceous ore tends to be vuggy, the cavities being partly filled with drusy quartz or grey chalcedony or both. Cellular limonitic matter also occurs in the cavities on weathered surfaces. The siliceous fluorite is more widespread in distribution than the calcareous type of ore. It is found in the trachytic porphyry remote from contacts as well as at or near the contacts of the trachytic porphyry and crystalline limestone.

Structure:

Field evidence suggests that brecciation and shearing may have exercised control in localization of fluorite in this area. The relative ease of replacement of the crystalline limestone may explain fluoritization of the calcareous rocks, but such a control can hardly be assumed to account for the highly irregular distribution of siliceous fluorite masses on the margins of, and also well within, the trachytic porphyry. Portions of the igneous breccia show fragments of igneous and sedimentary lithologies which have been partially or wholly fluoritized. Fluorite also occurs, in small amounts, in and along minor shear and crush zones in all types of intrusive rocks, with the probable exception of the phonolitic dikes. In places the siliceous fluorite has been deposited along the seams and crevices of very minutely fragmented trachytic porphyry with concomitant replacement of the porphyry fragments.

Some specimens of siliceous fluorite ore have been mashed and brecciated and coarsely crystalline fluorite introduced into interstices with partial replacement of fragments. The existence of no well-defined vein or fracture system, or systems, could be established. It seems most probable that the ore-bearing solutions followed available weaknesses (1) within the igneous breccias themselves, (2) along zones of shear and brecciation in the intrusives, (3) along contacts between the trachytic porphyry and crystalline limestone inliers, and (4) in part replaced the marbles themselves at and near contacts. It is fairly certain, as shown by exposures at Station 56, and elsewhere that much, and perhaps all, of the fluorite is younger than the trachytic porphyry intrusive. It follows that, except as intrusive contacts constituted favorable zones of weakness and afforded suitable passageways for ore-bearing solutions, mineralization cannot necessarily be directly correlated in space with the areal distribution of the intrusive rocks.

Respectfully submitted

[signature]

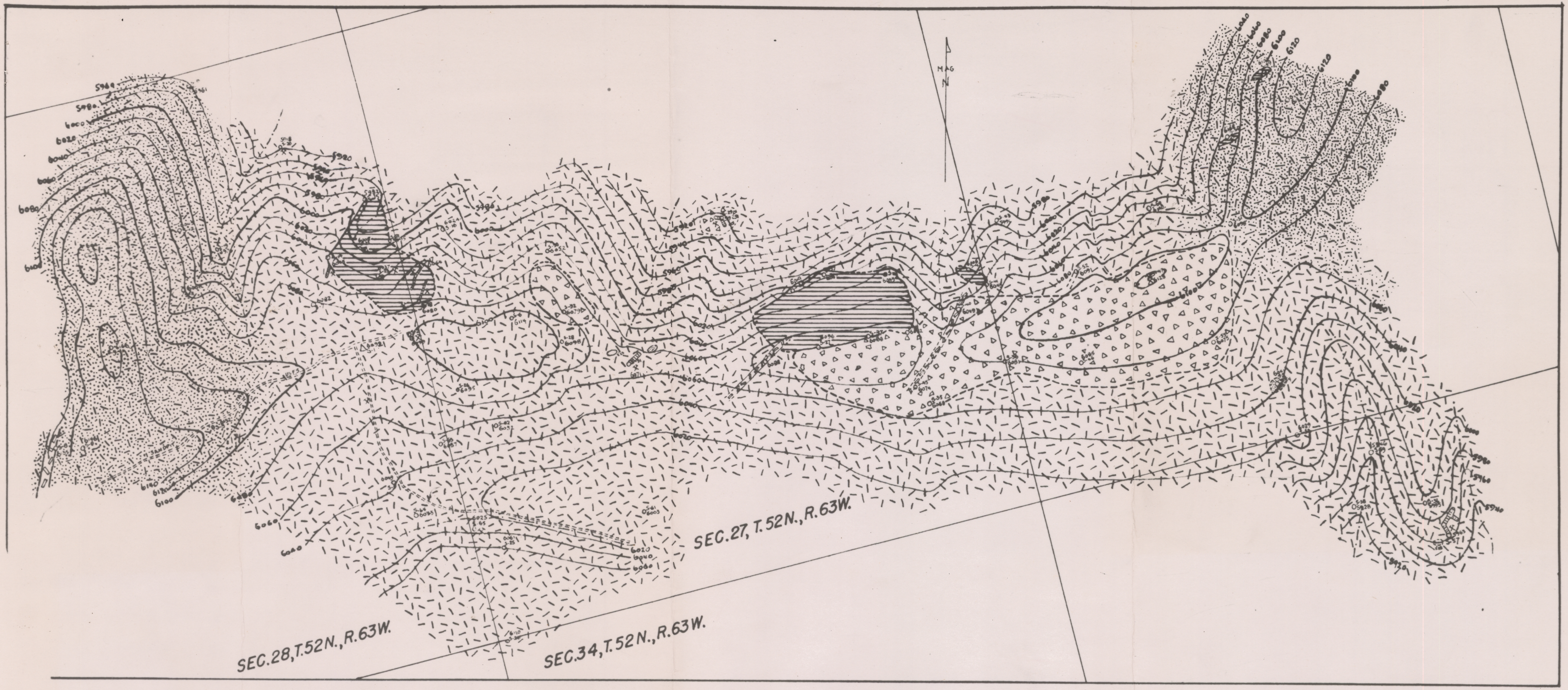
Sept 2, 1944

Conclusions

Judging from surface indications alone the fluorite reserves of this area are relatively low. Such ore as was encountered was, in general, not of conspicuously high grade except for small local concentrations which could not, by themselves, be profitably mined. Much of the fluorite is disseminated and, although it could perhaps be beneficiated, there is considerable doubt as to its extent laterally or in depth. The siliceous fluorite ores, though locally most abundant, are unsuitable for marketing under the existing penalties.

Exposures in the available small workings suggest that many of the fluorite masses are spotty, lense-like and pockety in distribution. This fact alone has considerable bearing on the economic possibilities.

No definite veins, or vein systems, of significant magnitude or extending over appreciable distances were observed. The complicated nature of the geology inherently produces difficulty in precise estabilshment of controls of ore deposition without extensive and deliberate development work.



LEGEND

- Alkaline (phonolitic) dikes
- Igneous breccia
- Trachytic porphyry — syenitic or monzonitic in composition
- Fine-grained biotite-monzonite and syenite
- Crystalline limestone (marble)
- Local siliceous masses as quartzite and pegmatitic quartz

PLANETABLE MAP OF FLUORITE DEPOSITS

T.52N., R.63W.

CROOK CO., WYOMING

GEOLOGY — JOHN C. HAFF, INSTR. — F.J. ADLER

JUNE, 1944

200 100 0 200 400

SCALE IN FEET