UNIVERSITY OF NEVADA CURTISS-WRIGHT PROJECT NO. 1

GEOLOGY AND MINERAL RESOURCES OF THE CURTISS-WRIGHT PROPERTY IN THE VIRGINIA RANGE, NEVADA

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UNIVERSITY OF NEVADA
RENO, NEVADA

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Roy T. Hurley, President
Curtiss-Wright Corporation
Wood-Ridge, New Jersey

Sir:

Herewith is the report on University of Nevada Curtiss-Wright Project No. 1, entitled "Geology and Mineral Resources of the Curtiss-Wright Property in the Virginia Range, Nevada". Physically, the report consists of two portions: (1) the written report, and (2) a series of maps portraying the geology, mineral resources, and topography of the area studied.

This report is a reconnaissance geological survey of the land owned by the Curtiss-Wright Corporation in Storey and Lyon Counties, Nevada. The purpose of the study was to determine the geologic conditions existing in the area and to evaluate and make recommendations on the mineral deposits.

Robert L. Rose, Economic Geologist, conducted the study and prepared the report. Other members of our staff; namely: George J. Stathis, Geologic Field Assistant; Larry H. Godwin, Geologic Field Assistant; Robert C. Horton, Mining Engineer; Louise C. Winslow, Scientific Illustrator; Aleksis v. Volborth, Mineralogist; and Harold A. Vincent, Chemist; made important contributions to the study, by contributing to the field work, making laboratory determinations and analyses, and assisting in the preparation of the report.

Very truly yours,

Vernon E. Scheid

Vernon E. Scheid, Project Director
Dean, Mackay School of Mines

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GEOLOGY AND MINERAL RESOURCES OF THE CURTISS-WRIGHT PROPERTY IN THE VIRGINIA RANGE, NEVADA

PART I: GEOLOGY OF A PORTION OF THE VIRGINIA RANGE, NEVADA

INTRODUCTION

The area covered by this report is the southern quarter of the Virginia Range in west central Nevada, and is centered about 20 miles east of Reno, Nevada. The area includes all of the Curtiss-Wright property in Lyon and Storey counties; except that located in the Virginia City quadrangle. Plate I, parts A and B, illustrate the geology of this area, and Plate I, part C, shows the geology of the Virginia City quadrangle. Except for a narrow strip of land north of the Truckee River near Vista and Mustang, the area under consideration is situated between the Truckee and Carson rivers. Most of the area lies in the southern half of the Wadsworth quadrangle and the northern half of the Churchill-Butte quadrangle. An east-west strip, just north of the Virginia City quadrangle, is in the southern part of the Spanish Springs Valley quadrangle. Approximately 250 square miles were mapped and studied.

The northern part of the area is readily accessible from U. S. Highway 40, and the southern from U. S. Highway 50. The eastern boundary of the area is just west of alternate U. S. Highway 95, and is reached by dirt roads that extend westward from that highway. The interior of the region is relatively inaccessible but can be reached by an ungraded road that extends from Clark Station through the Ramsey district to U. S. Highway 50, west of Silver Springs. Dirt roads and jeep trails from the Virginia City area provide access to the Cinder Mountain area. Most of the roads and

trails in the interior are in deplorable condition and hinder field work. If the interior of the Curtiss-Wright property is to be exploited, considerable road building and repair work should be anticipated.

Most of the area is mountainous and topographically rugged with a maximum relief of about 3,000 feet. The climate of the area is arid to semi-arid with an average precipitation of less than 10 inches. The lower regions are barren except for scattered brush and little grass. Pinon pines and juniper trees occur in the higher regions, but none of the area is heavily timbered.

There has been very little geological work done in this area up to the date of this investigation. During the latter part of the last century, the northern part of the region was studied by Clarence King and his assistants in the Geological Exploration of the Fortieth Parallel. About 1920 Ramsey Mining District was visited by J. M. Hill of the U. S. Geological Survey; his notes were published in U. S. Geological Survey Bulletin 470. The U. S. Geological Survey, in cooperation with the Nevada Bureau of Mines, investigated the Dayton Iron deposits in 1953. Their results were published in the Nevada Bureau of Mines Bulletin 53-B.

Field mapping for this investigation was started in March 1958 and was completed in November of that year. The work in the Spanish Springs Valley quadrangle was done by George Stathis under the supervision of R. L. Rose. The work in the Churchill Butte and Wadsworth quadrangle was done by R. L. Rose with the assistance of L. H. Godwin. Most of the mapping was done on aerial photographs and transferred to a topographic base map with a scale of 1:24,000 and then reduced to 1:48,000. Some of the mapping was done directly on a topographic map with a scale of 1:48,000.

ROCK UNITS

The rocks of this area are pre-Cenozoic metamorphic and granitic rocks, and Cenozoic volcanic rocks and associated sediments. The older rocks are exposed only in topographically low areas; whereas the Cenozoic rocks are exposed in the mountainous areas and cover more than 85 percent of the region.

Stratigraphic Table

	Formation	Lithology	Max. approx. Thickness in feet
	ALLUVIUM	Unconsolidated gravels & sands.	25+
	OLDER ALLUVIUM	Unconsolidated gravels & sands.	75(?)
Pleistocene	LAHONTAN	Lacustrine sands & silts, with some gravel.	75
	MUSTANG	Hornblende andesite lava flows.	350±
		UNCONFORMITY	
	LOUSETOWN	Basalt & pyroxene andesite lavas.	350
		UNCONFORMITY	
Pliocene	COAL VALLEY	Volcanic & diatomaceous sediments.	500
	KATE PEAK	Dacitic and rhyodacitic lava flows and flow breccias, with interbedded tuffs & diatomaceous sediments.	1500
		UNCONFORMITY	
Mio-Pliocene	THISBE	Upper part: volcanic & diatomaceous sediments. Lower part: dacitic & rhyodacitic lavas & breccias.	1200
		UNCONFORMITY	
	CHLOROPAGUS	Basalt & andesite lavas, with interbedded rhyolitic tuffs & diatomaceous sediments.	2500
		UNCONFORMITY	
Oligocene	ALTA	Hornblende & pyroxene andesite flows & breccias. Upper part (Sutro member), composed of tuffaceous sediments, is about 600 feet near Painted Rock.	1600

	Formation	Lithology	Max. approx. Thickness in feet
Eocene	HARTFORD HILL	Welded & semi-welded rhyolitic tuffs.	2500
		UNCONFORMITY	
Paleocene(?)	RAMSEY	Dark olive green claystone	300
		UNCONFORMITY	
Mesozoic	UNNAMED	Metamorphosed sediments & volcanic rocks; composed of slate, marble, hornfels, meta-andesite, amphibolite, etc. Intruded by granitic rocks.	(?)

Pre-Cenozoic Rocks

The pre-Cenozoic rocks have been separated into two cartographic groups: (1) metamorphic rocks, which include a variety of metamorphosed sedimentary and volcanic rocks, and (2) granitic rocks which include granites, quartz monzonites, granodiorites, etc.

METAMORPHIC ROCKS:--

The oldest rocks of the area are Mesozoic metasediments and metavolcanics; which are probably upper Triassic and lower Jurassic in age. They are exposed in three areas: (1) in the Truckee Canyon just east of Vista, (2) south of Ramsey, between Ramsey and U. S. Highway 50, and (3) in the western part of the area just north of U. S. Highway 50.

In the Truckee Canyon these rocks are for the most part dark greenish gray metavolcanics; mainly andesite breccia, with lesser amounts of reddish brown slates, gray and brown meta-sandstones, and meta-conglomerates. The bedded rocks dip steeply and strike obliquely across the canyon.

In the area south of Ramsey the Mesozoic rocks are predominantly black slates, with thin interbeds of meta-sandstone and limestone. Metavolcanic rocks are present in the northwestern part of this

pre-Cenozoic complex; where they appear to overlie the metasediments. Adjacent to granitic rocks they have been thermally metamorphosed and converted to various types of hornfelses.

The largest occurrence of Mesozoic rocks is in the southwestern part of the area in the vicinity of Dayton iron prospect. Here they consist mainly of metasediments with minor amounts of metavolcanics. Meta-sandstones, crystalline limestones, quartzites, and argillites are the most conspicuous rock types. Adjacent to the granitic rocks they have been converted to hornfelses.

The age of the metamorphic rocks is uncertain as no diagnostic fossils have been found in this area. Lithologic correlations with similar rocks near Carson City and Churchill Butte indicate that they are upper Triassic and lower Jurassic in age.

GRANITIC ROCKS:--

Granitic rocks, ranging from granite to quartz diorite, are exposed in the southern part of the Ramsay district, the southwestern part of the map area, and in the vicinity of the Dayton iron prospect. They intrude Mesozoic metamorphic rocks, and are locally unconformably overlain by the Cenozoic rocks. The regional geologic relationships suggest they are late Mesozoic; probably Cretaceous in age. Exposures of the granitic rocks are poor and only locally conspicuous; as these rocks are deeply weathered and usually covered by arkosic, sandy soil. Although they show a considerable variation in mineral composition, hornblende-biotite granodiorite appears to be the most common granitic rock type.

Typically the granodiorites are light to greenish grey, medium grained with a granular texture. Biotite is megascopically conspicuous as euhedral to subhedral platy crystals; while hornblende is generally subordinate and

only microscopically obvious. Potash feldspar is commonly present as interstitial grains, but in the granodiorite near Ramsey it occurs as large mottled crystals. Thin tabular pegamtite and aplite dikes are locally present in the granitic rocks. They are mineralogically simple and are composed mainly of quartz and feldspar, with minor amounts of biotite, tourmaline, etc. No rare earth minerals, such as allanite or monazite, were observed in any of the pegmatites; however, they may be present in trace amounts.

Cenozoic Rocks

RAMSEY FORMATION:--

In the unnamed canyon in the NW 1/4, sec. 23, T. 18 N., R. 23 E. is a dark greenish claystone, that apparently rests unconformably on the Mesozoic metamorphic rocks and is unconformably overlain by the rhyolites of the Hartford Hill formation. Although this stratigraphic unit has limited areal extent and has not been recognized elsewhere; it is herein named the Ramsey formation.

The Ramsey formation has a maximum thickness of about 200 feet, but it is exposed along its strike only for 2,000 feet. Geologically it is important as it is the oldest fossiliferous Cenozoic unit of this area. Exposures of this formation are poor and much of it is obscurred by rhyolite talus from the overlying Hartford Hill formation. The claystone is hard, compact, and well-indurated. It contains fossil leaves at numerous horizons. Thin interbeds of gray arkosic sandstone are present throughout the formation, but they constitute only a small fraction of the sequence. The Ramsey formation is unconformably overlain by the Eocene Hartford Hill formation, with an angular discordance of at least 20 degrees; hence it is at least as old as Eocene. Its regional setting suggests it is not older

than Tertiary. It is provisionally considered to be Paleocene (?) in age.

HARTFORD HILL FORMATION:--

In the Truckee Canyon, near Painted Rock, and in the Ramsey district is a series of siliceous pyroclastic rocks composed of welded tuff and semi-welded tuff. This series, like the Hartford Hill formation of the Virginia City quadrangle, underlie the older Cenozoic "andesites". Where the base of this formation is exposed, it is unconformable on the Mesozoic rocks. The rocks of this unit are mainly rhyolitic in composition, and generally porphyritic with prominent phenocrysts of quartz, feldspar, and biotite, enclosed in an aphanitic groundmass. In general these rocks are light to medium colored, but are locally stained brownish by iron oxides. They are resistent ridge-forming rocks and yield an abundance of angular talus.

On the north side of the Truckee River, near Painted Rock, the Hartford Hill formation has a stratigraphic thickness of approximately 2,500 feet. South of the River it is apparently thinner, but here the thickness is uncertain owing to structural complications. The thickness in the Ramsey district ranges from 0 to 1,200 feet. In most of the area the Hartford Hill formation is overlain by the Alta formation, but on the south side of the Ramsey district it is overlain by the Kate Peak formation, and in the north eastern part of the area the Chloropagus formation locally rests directly on the Hartford Hill.

Paleontological data and the regional setting suggests that the Hartford Hill formation is probably Eocene age.

ALTA FORMATION:--

Conformably overlying the Hartford Hill formation, in the eastern part of the area, is a sequence of altered lavas, pyroclastic rocks, and tuffaceous sediments having an aggregate thickness of about 1,600 feet. On the basis of stratigraphic relationships and general lithology, this unit is referred to the Alta formation. The lower half of the formation consists mainly of pyroxene andesite and hornblende dacite flows and breccias, with occasional thin interbeds of rhyolitic tuff. The andesites and dacites are dark grey to greenish grey in color, and commonly contain veinlets of quartz or quartz and calcite. Zeolites (laumontite and chabazite) are locally present, as vesicle fillings and veinlets, in the andesitic rocks near Painted Rock.

In the Truckee Canyon, near Painted Rock, the upper part of the Alta formation consists mainly of grey rhyolite tuff, green siltstone and sandstone, and brown cherty shales. This sequence is referred to as the Sutro member of the Alta formation. As it is lithologically correlative and stratigraphically equivalent to the Sutro member in the Virginia City quadrangle.

In the western part of the Spanish Springs Valley quadrangle is a thick sequence of hornblende and pyroxene andesites, that are shown on the map as the Alta formation. These rocks rest directly on the Mesozoic metamorphic rocks, without any intervening Hartford Hill formation, and extend southward into the northern part of the Virginia City quadrangle; where they have been mapped by Thompson as the Kate Peak formation. However, the rocks of this sequence are lithologically dissimilar to the Kate Peak formation but resemble the rocks of the Alta formation; except that they are much fresher than the type Alta formation near Virginia City.

On this basis these rocks are referred to the Alta formation. The writer believes that these rocks are separated from the Kate Peak to the south by a major fault; which possibly passes through the bleached zone in the northwestern part of the Virginia City quadrangle.

CHLOROPAGUS FORMATION:--

The Chloropagus formation consists mainly of dark grey to black basalt and basaltic andesite, with interbeds of rhyolite tuff and diatomaceous sediments. Rhyodacite tuff and tuff breccia occur locally in the eastern part of the area near Horse Spring. Reddish flow breccias and lavas are locally present in this section, but they are less abundant then the grey and black lavas. The formation is well-exposed in the Truckee Canyon east of Clark Station and along the east front of the Virginia Range south of U. S. Highway 40. In the Truckee Canyon it has a stratigraphic thickness of at least 2,500 feet. It is unconformably overlain by the Thisbe formation and unconformably overlies the Alta formation. In the northeastern part of the map area, it locally overlaps the Alta and rests on the Hartford Hill formation.

Individual lava flows are relatively thin, with vesicular tops and brecciated bases. Many of the lavas are amygdaloidal with chalcedony and quartz amygdules, up to an inch or more in diameter. Celadonite is locally abundant as a vesicle filling and as veinlets in the basalts. The rocks of this formation are commonly closely jointed, and yield relatively fine talus and rubble. In general, the Chloropagus rocks are less resistant than the other basaltic rocks in this area, and yield a smoother topography than the younger rocks. They are more or less altered with veinlets of quartz or carbonates. Zeolite minerals are rare, but locally occur as vesicle fillings and veinlets.

Fossil evidence indicates that these rocks are of Mio-pliocene age; hence the unconformity at the base of this formation is a significant time break.

Diatomaceous shales and silts occur at several horizons in the Chloropagus formation, but most of them are too thin to put on the geologic map. Typically they are light grey, well-bedded, soft, and non-resistant rocks.

Pumiceous rhyolite tuffs and tuff breccias occur at several horizons within the Chloropagus, but only the thickest one has been mapped as a separate cartographic unit. The best exposures of this tuff are on the south side of the Truckee River, east of Derby Dam, where it is apparently 200 feet thick.

This tuff apparently extends westward along the north side of the Truckee Canyon from the vicinity of Derby Dam to Tuffstone Quarry, at the mouth of Lagomarsino Canyon. It is white to light grey and well-bedded, but locally it is cross-bedded to massive. The fresh rock is soft and friable, but on exposure to the weather it apparently becomes more coherent and resistant. Thin interbeds of brownish sandstone and diatomaceous shale are present at most places.

Typically the tuff is composed of fragments of white pumice, grey lithic rhyolite, pale colored perlitic glass, and small fragments of quartz and feldspar. East of Derby Dam the grain size varies from layer to layer, with layers of tuff alternating with layers of tuff breccia. To the west much of the tuff is coarser and locally consists largely of coarse tuff breccia, but at Tuffstone Quarry the rock is rather even-grained and massive; however, it grades upward to tuffaceous sandstones.

THISBE FORMATION:--

Unconformably overlying the Chloropagus formation, with a slight angular discordance, is a series of volcanic rocks and lacustrine sediments

herein designated the Thisbe formation. The lower part of the formation consists mainly of porphyritic dacite and rhyodacite lava flows and flow breccias; while the upper part is composed mainly of diatomaceous and volcanic sediments. The maximum total thickness of the formation is approximately 1,600 feet. The lower part of the formation varies from about 600 feet to over 1,000 feet; while the upper part ranges from 0 to about 1,000 feet. Approximately 300 feet of diatomite beds are present at the Celatom mine east of Clark Station. Plant fossils and vertebrate bones have been found in the formation.

The volcanic rocks that make up the lower part of the formation are resistant ridge and cliff-forming rocks, with coarse blocky to platy jointing. Typically these rocks are porphyritic, with conspicuous phenocrysts of plagioclase and biotite; although not all of the flows contain biotite. Some of the rocks have phenocrysts of hornblende or pyroxene. The more basic members of the flows are pyroxene andesites and dacites, with inconspicuous phenocrysts of dark colored pyroxenes. The upper portion of the volcanic sequence interfingers with the overlying sedimentary part of the formation.

The lower portion of the sedimentary or upper part of the formation is composed mostly of diatomites and diatomaceous shales, with minor interbedded sandstone and tuff; while the upper portion consists mainly of tuffaceous sandstones, with minor interbeds of andesite tuff and breccia. Near the Celatom mine, a thin flow of dark grey hypersthene andesite occurs in the middle of the sedimentary or upper part of the formation. The sedimentary part of the Thisbe formation is not resistant; hence it is commonly present in valleys and canyons where it is covered largely by alluvium.

KATE PEAK FORMATION:--

The Kate Peak formation is widely exposed in the western part of the Churchill Butte quadrangle and adjacent portions of the other quadrangles. It consists mainly of resistant, grey to brown, fine-grained and glassy, porphyritic lavas and flow breccias. Dark grey to black pyroxene dacite flows are locally present at several horizons; especially in the southeastern part of the area. Rhyolitic tuffs, tuffaceous sediments, and diatomites occur at several horizons in the section, in the west-central part of the Churchill Butte quadrangle. The tuffs are white to light grey pumiceous crystal-lithic rhyolite tuffs; similar to the tuff in the Chloropagus formation. Tuffaceous and diatomaceous sediments commonly occur with the tuffs. The diatomite is light grey, well-bedded, and non-resistant. The fine-grained and glassy porphyritic lavas in the upper part of the section are hard resistant rocks that form bold cliffs and ridges. In the Ramsey district this upper part is underlain by altered dacitic and rhyodacitic lavas, that are more or less mineralized. These are tentatively referred to the lower Kate Peak formation, but possibly they may be correlative with the Thisbe formation.

Fossil evidence from the Kate Peak formation elsewhere indicates it is of Mio-pliocene age.

COAL VALLEY FORMATION:--

Conformably overlying the Kate Peak formation, in the southeastern part of the area, is a sedimentary unit composed dominantly of diatomaceous siltstones, tuffaceous sandstones, and related rocks. These are lithologically correlative with the Coal Valley formation as defined by Axelrod, and are probably equivalent to the diatomaceous sediments at Chalk Hills in the Virginia City quadrangle, that Thompson refers to as the Truckee

formation. These sediments have been gently folded and faulted. They are in fault contact with the Kate Peak formation. Evidently they are lacustrine sediments of Pliocene age; however, no diagnostic fossils have been found in them in this area. The total exposed thickness of the formation is probably less than 500 feet.

SMALL INSTRUSIVE BODIES OF VOLCANIC HABIT:--

Dikes and plugs of rhyolite, dacite, and andesite, lithologically unlike the other volcanic rocks, are present at various places throughout the area. Most of these intrusives probably are younger than the Coal Valley formation, but older than the Lousetown formation. Some of these rhyolitic intrusives in the Ramsey district are probably much older. The dacite and andesite intrusives are resistant, platy, porphyritic rocks, with phenocrysts of feldspars and mafic minerals enclosed in an aphanitic groundmass. The rhyolites contain feldspar and quartz phenocrysts in an aphanitic or glassy groundmass.

WASHINGTON HILL RHYOLITE:--

The Washington Hill Rhyolite forms a large steep-sided hill northeast of Mustang station in sec. 8 & 9, T. 19 N., R. 21 E. in the southwestern part of the Spanish Springs Valley quadrangle. This rhyolite is a light grey, well-banded felsophyre, with rare phenocrysts of feldspar, quartz, and biotite. Near contacts it is vesicular with broad flathead vesicles. Locally the marginal portions are glassy, and perlitic flow banding is conspicuous and dips steeply: suggesting that the rock was erupted in place as a steep-sided volcanic dome.

The relative age of this unit is somewhat uncertain. Most evidence, however, indicates that it is younger than the Coal Valley formation and

probably older than the Lousetown formation.

LOUSETOWN FORMATION:--

Unconformably overlying the folded earlier Cenozoic volcanic rocks is a series of medium to dark grey lavas, ranging in composition from olivine basalt to pyroxene andesite. These lavas were named the Lousetown formation by Thayer; for the occurrence east of Lousetown Creek, in the Virginia City quadrangle. The Lousetown formation occurs in three areas; (1) along the higher ridges southeast of Clark Station, (2) in the vicinity of Timber Mountain, south of Clark Station, and (3) north of Truckee Canyon in the Spanish Springs Valley quadrangle. Typically, the lavas of this formation are micro-porphyritic, with numerous small lath-shaped plagioclase crystals and small olivine phenocrysts enclosed in an aphanitic groundmass. Tops of individual flows are strongly vesicular, but are free of secondary minerals except for small amounts of opal; which occurs as thin veinlets in joints. The lavas are coarsely jointed and yield coarse angular talus.

Small intrusive bodies of basalt and andesite, that are locally similar to the flows, occur at numerous places in the area. These have been designated as Lousetown intrusives; mainly on lithologic basis.

The age of the Lousetown formation is thought to be late Pliocene or early Pleistocene.

MUSTANG ANDESITE:--

The Mustang Andesite occurs south of the Truckee River, on the slopes of Clark Mountain in the southern part of the Spanish Springs Valley quadrangle, and adjacent parts of the Wadsworth quadrangle south and southwest of Clark Station.

It is a medium to dark grey hornblende andesite, with medium to large hornblende crystals embedded in an aphanitic groundmass. The rock is coarsely jointed

with a tendency for platy structure, and yields abundant angular talus. The formation is apparently made up of a number of relatively thick flows of small areal extent.

The Mustang Andesite overlies the Kate Peak, Thisbe, and Lousetown formations. Boulders of Mustang Andesite are present in the gravels beneath the McClellan Peak Basalt, west of Mustang station; hence, the Mustang Andesite is older than the McClellan Peak Basalt but younger than the Lousetown formation. It is probably early Pleistocene in age.

McCLELLAN PEAK BASALT:--

The youngest volcanic unit recognized in this area is the McClellan Peak Basalt; which occurs as lava flows, two cinder cones, and small dikes.

The two cinder cones are located on the western margin of the Churchill Butte quadrangle, about 10 miles southwest of Clark Station. They are about 2,000 feet in diameter and about 300 feet high. They are composed of reddish-brown and black cinders and bombs of olivine basalt. The surfaces of the cones are loose and unconsolidated, and are apparently permeable to water.

The largest lava flow of this area apparently extends from the base of the southern cinder cone down Long Valley, across the northeastern corner of the Virginia City quadrangle. A similar flow is present on the north side of the Truckee River, opposite Lagomarsino Canyon. This flow apparently came from a dike north of the river and flowed eastward down the Truckee Canyon. The flows are somewhat variable in thickness, but are apparently less than 50 feet thick; except in a local area west of the cinder cone, where the lava appears to have been ponded in a topographic basin. The basalt is dark grey with numerous large yellow olivine crystals, scattered black augite phenocrysts and rare plagioclase crystals embedded in a dense microcrystalline groundmass. The tops of the flows are vesicular, but the interiors are dense and relatively free of vesicles. The basalt is coarsely jointed

and forms coarse talus, composed of large angular blocks. The interior portions of the flows are relatively free of vesicles, and have a specific gravity of 2.7 - 2.9. The rock is resistant to weathering; consequently it is suitable for construction stone and should be good for "riprap".

There is no evidence that these lava flows have been folded or tilted; although they have been off-set by small faults near Mustang station. Gravels beneath these flows, near Mustang station, contain fragments of the Mustang Andesite; therefore, the McClellan Peak Basalt is younger than the Mustang Andesite and is probably of Pleistocene age.

LAHONTAN FORMATION:--

The Lahontan formation is present in the Truckee Canyon in the northeastern part of the map area, and in the southern part of the map area adjacent to U. S. Highway 50. The formation consists mainly of fine-grained sand and silt, and local lenses of gravel. An algal limestone is present on the south side of the hill at the Dayton iron prospect. The sands and silts are unconsolidated, well-bedded, and light grey to buff in color. Most of the sands are somewhat silty, and the silts appear to contain variable amounts of clay; hence, the permeability of these sediments is probably quite variable. The sands and silts contain considerable volcanic detritus and feldspar; consequently, they are unsuitable for glass sand.

OLDER ALLUVIUM:--

Gravels and sands occur as fanglomerates and late (?) deposits, and as old stream terraces throughout the area. They are partly older than the Lahontan formation and in part contemporaneous, but the bulk of the fanglomerates may be younger than the Lahontan sediments.

They are unsorted and unconsolidated, and consist mainly of volcanic detritus. The large rocks are mainly subangular to subrounded fragments

of Lousetown basalt, Kate Peak dacite and rhyodacite, and Thisbe formation. Locally fragments of the Hartford Hill formation and the pre-Cenozoic rocks are abundant.

ALLUVIUM:--

Recent alluvium fills many of the present stream channels and covers much of the low lying area just north of U. S. Highway 50. It consists mainly of unsorted and unconsolidated gravels and sands; largely composed of volcanic detritus. Individual deposits are thin, seldom exceeding 10 or 15 feet in thickness.

STRUCTURAL GEOLOGY

The structural geology of this area is complex and difficult to unravel. During the present investigation there was insufficient time to justify a detailed structural study of the pre-Cenozoic rocks, consequently their structure remains practically unknown. Most of the field work was devoted to the Cenozoic rocks hence the following notes on structure pertain almost exclusively to the Cenozoic structures.

The older Cenozoic rocks have been folded and faulted. The pre-Kate Peak rocks are folded about east-west to east-northeast fold axes that generally plunge westward. The main structural element in the Truckee Canyon east of Clark Station appears to be a compound faulted anticline, with several minor synclinal flexures. South of this, the older rocks appear to form a series of gentle open folds broken by a series of faults.

The structure in the Kate Peak formation is difficult to evaluate because of the massive nature of the rocks and erratic initial dips of the lava flows. However, the Kate Peak formation appears to have been folded gently along structural trends parallel to those in the older Cenozoic

rocks. Only the Lousetown formation and younger rocks seem to be relatively undeformed; however, even these rocks have been dislocated by a number of minor faults.

Many of the metalliferous deposits appear to have been localized by faults. This is demonstrated at the Gooseberry mine where the important ore mineralization is restricted to the main fault zone of this area. Likewise, the gold mineralization in the Ramsey district is concentrated in or adjacent to fault zones.

All of the major faults are shown on the geologic maps, but the numerous minor faults, with displacements of a few feet, are not indicated. The faults are all steep-dipping, with planes generally within 20° of the vertical. Most of them appear to be reverse faults. One north-south fault, in the northeastern part of the area, offsets several structural axes and appears to have a right lateral component of several hundred feet. The major faults have east-west to east-northeast trends in contrast to the north-south trend of the Comstock fault, in the Virginia City area.

PART II: ECONOMIC GEOLOGY

INTRODUCTION

The Curtiss-Wright area is adjacent to the Comstock Mining district, and is one of the most thoroughly prospected areas of Nevada. During the active period of the Comstock district, the adjacent country was thoroughly prospected for gold and silver. This resulted in the discovery of the Gooseberry deposit, 6 miles south of Clark Station, and the Ramsey district about 9 miles southeast of Clark Station. Later the area was prospected for other metals and minerals. Tungsten, iron, and mercury were searched for during the early part of the present century, and several significant discoveries were made. Recently the area has been prospected for deposits of uranium and other radioactive metals, but no deposits of any significance have been found. Besides the prospecting for metallic mineral deposits, the area has been searched for deposits of non-metallics; such as clay, diatomite, and gypsum.

The current mineral production of the area is limited to clay and diatomite. The only metal mine that is currently active in this area is the Gooseberry mine. However, the activity at this mine is apparently limited to exploration and development.

A brief account of the mineral resources of the area studied is given below.

Gold and Silver Deposits

Numerous thin quartz veins are present in the older volcanic rocks of this area, and most of these contain small amounts of gold and silver; but the concentration of metal in these is too low for commercial mining at this time. Commercial deposits of gold and silver have been found in three places in the map area: (1) the Ramsey mining district, (2) the

Gooseberry mine, and (3) near Virginia City.

The deposits at Ramsey carried mainly gold, with very minor amounts of silver. The deposits have apparently been worked out. They were quartz vein deposits along faults and minor fractures in altered volcanic rocks, and carried free gold associated with pyrite and traces of silver. The deposits were shallow and spotty with occasional rich pockets, that are reported to assay up to $150,000.00 per ton. There are numerous prospect pits and abandoned mines in this area, but the only mine that appears to have amounted to much is the Ramsey-Comstock mine in sec. 34, R. 23 E., T. 18 N. The Ramsey-Comstock mine is said to have produced over $80,000 in gold prior to 1910, and about $36,000 between 1910 and 1936. It was shut down about 1936 and apparently has not been operated since that time. An ore sample from this mine collected about 1910 was assayed in our laboratory and found to contain 6.64 ounces of gold per ton. During the present investigation a number of quartz veins in the Ramsey area were sampled and analyzed but none contain appreciable amounts of gold or silver.

The deposit at the Gooseberry mine consists of a quartz-dolomite vein in an east-west zone. The vein is nearly vertical and can be traced for several hundred feet at the surface. Underground workings consist of a vertical shaft 900 feet deep and several hundred feet of drifts at various levels. According to Mr. C. D. Martin, owner of the mine, the vein is better developed at the 900-foot level than at the surface. The country rock enclosing the deposit is altered porphyritic dacite, which is locally strongly argillized. Numerous thin quartz veins are present in the vicinity of the mine, and in some places there is considerable jarosite, gypsum, and disseminated pyrite. Grab samples taken from the dump at the mine were found to contain gold values ranging from 0.83 to 1.14 ounces per ton and

silver values of 13.02 ounces to 69.00 ounces per ton. Presumably these samples came from the underground workings, but it is not known how representative these samples are of the deposit.

Several mines are present on the Curtiss-Wright property near Virginia City. Presumably these were gold-silver mines or prospects, but nothing is known about them. They are on the fringe of the Comstock mineralized area, and probably are commercially insignificant.

Copper Mineral Occurrences

Small quantities of copper minerals are present in the metamorphic and granitic rocks in the southwestern part of the area; particularly in the SW 1/4 sec. 12, T. 18 N., R. 23 E., in the Ramsey district, and SW 1/4 sec. 36, R. 22 E., T. 18 N. about a mile north of the Dayton iron prospect. The copper minerals, mainly bornite and chalcopyrite, are present in small grains disseminated throughout the rocks. Malachite occurs as stains on joint surfaces as an alteration product of the sulfides. In addition, small amounts of malachite and chrysocolla occur in the Alta formation in sec. 15, T. 18 N., R. 23 E.

All of these occurrences are spotty and low-grade, and there is no evidence to indicate the presence of a deposit of commercial grade. The deposits could be studied further but they appear to be too small and too low-grade to have any economic possibilities.

Tungsten

Tungsten minerals are apparently present only in the contact zones between granodiorite and marble, near the Dayton Iron mine. Two shafts are present in sec. 6, T. 17 N., R. 23 E. near the granodiorite, and evidently considerable exploration has been done at these prospects but there is no recorded production.

The skarns between the granodiorite and marble are composed mainly of garnet and epidote, with small amounts of scheelite. The concentration of tungsten in these prospects is unknown; however, the current price of tungsten is too low to justify an evaluation program at this time. Should the price of tungsten return to a more favorable figure, these deposits should be explored and evaluated.

Mercury Deposits

Four mercury deposits are present in the Curtiss-Wright property: (1) Castle Peak mine sec. 20, T. 18 N., R. 21 E., southwest of Mustang and about 8 miles north of Virginia City, (2) Washington Hill prospect in sec. 5, T. 18 N., R. 21 E., about 3 miles north of the Castle Peak Quicksilver mine, (3) Taylor-Branch prospect, sec. 35, T. 20 N., R. 22 E., located one mile south of Clark Station, and (4) an unnamed prospect in sec. 27, R. 23 E., T. 20 N., about 4.5 miles east of Clark Station. The first three of these are described by Bailey and Phoenix in "Quicksilver Deposits in Nevada", Nevada Bureau of Mines Bulletin 41, 1944.

Of these four, only the Castle Peak mine has produced a quantity of mercury. Total production of this mine is 2,576 flasks. 1929-1936 production was valued at $229,180. The other mercury deposits are mere prospects, where some mercury mineralization is present.

Evidently the Castle Peak ore body was exhausted by 1943, and no sizeable mineralized deposits have been found at other prospects. The area near Castle Peak and Washington Hill has probably been thoroughly prospected and there is little hope of finding another sizeable mercury ore body; although this is perhaps the most favorable area to look for mercury.

Iron

Iron ore deposits are present in the metamorphic rocks in the southern part of the area, about 1.5 miles north of U. S. Highway 50, and approximately 18 miles west of Silver Springs. These deposits are collectively known as the Dayton Iron prospects and are presently under lease to the Utah Construction Company. The ore is a mixture of hematite and magnetite and occurs as irregular masses.

The deposits have been studied by various governmental agencies, and are rather thoroughly described by Reeves, Shaw, and Kral in "Iron Ore Deposits of West-Central Nevada", Nevada Bureau of Mines Bulletin 53-B, 1958. According to the authors of the bulletin a composite analysis of several drill cores, which penetrated the ore bodies, assayed 51.6 per cent iron, 7.0 per cent silica, and 4.1 per cent sulfur. The maximum allowable limit of sulfur in iron ore shipped to Japan in 1954 was 0.3 per cent. Since then new metallurgical processes have been developed, which reportedly can treat high sulfur ore; hence these deposits have commercial possibilities.

Uranium

During recent years the Virginia Range and adjacent area have been examined for uranium deposits, and; although several uranium prospects were located in the rhyolitic rocks in the Ramsey district; no deposits of any significance have been found on the Curtiss-Wright property. A few stains of a yellowish uranium mineral (uranophane?) were noted at the prospect in the Ramsey district, but these are commercially insignificant.

Volcanic Cinders

Good quality volcanic cinders comprise the bulk of the two Cinder Cones near the boundary between the Churchill Butte and Virginia City quadrangles, about 9 miles south of Clark Station. These Cinder Cones are

conical in shape with basal diameters of about 2,000 feet. They are both about 200 feet high--hence a considerable tonnage of cinders is present in this area. These Cinder Cones are about 25 miles by road from Reno and about 10 miles from the nearest railroad and paved highway.

In 1956 volcanic cinders used as railroad ballast and highway construction were valued from $0.18 to $1.71 per ton at the mine. Cinders suitable for concrete aggregate were valued at $0.50 to $2.10 per short ton, and cinders used as roofing granules brought $3.00 to $5.00 per short ton, f.o.b. the plant. At these prices it is hardly economical to attempt to work these cinder deposits; as it would probably cost at least $2.00 per ton to transport the cinders to Reno--the nearest market.

Riprap

Riprap is broken stone or boulders used as a protective layer on the face of an earth embankment to protect it from wave action and general erosion by water. Rock to be used for riprap should be resistant, heavy, and available in large fragments. A suitable source for riprap should be close to a market. The most suitable rock in this area is the McClellan Peak basalt; which occurs in the northeastern part of the Virginia City quadrangle. If a reservoir is to be established in the Long Valley-Lagomarsino Canyon area, then the McClellan Peak basalt would be the most suitable rock riprap for such a project.

Gravel

The recent alluvium and older alluvium as shown on the geological maps consist mainly of gravel, with minor amounts of sand. Both the sand and gravel are composed mainly of volcanic detritus; consequently they might not be desirable as aggregate for structural cement. The materials are suitable for ordinary road construction. A number of gravel pits near U. S. Highway 50 have supplied material for road construction.

Decorative Stone

Many of the volcanic rocks of this area are hard and resistant. Some could be used probably as decorative stone; as facings for buildings, fireplace stone, patio stones, etc. Some of the rhyolite of the Hartford Hill formation in sec. 12, T. 18 N., R. 23 E., in the southeastern part of the Ramsey district and adjacent areas, possibly could be used; but much of it is probably too closely jointed for good decorative stone. Better material, that is closer to market, is the Washington Hill rhyolite at Washington Hill, about 10 miles north of Virginia City and 4 miles south of U. S. Highway 40. The rock at Washington Hill is hard and coarsely jointed. It tends to split easily in one direction and yields broad flat pieces of stone.

The local market for such material is probably quite limited. There is little reason to believe that these rock products could be profitably marketed at such distant places as Sacramento, California.

Perlite

Small amounts of perlite are present, in the Virginia City quadrangle, in the Washington Hill rhyolite at Washington Hill and in the vitrophyre member of the Kate Peak formation north of Chalk Hills.

The perlite at Washington Hill occurs mainly as chilled border zones of the Washington Hill volcanic dome. There is little evidence that an appreciable quantity of commercial grade perlite is present at this deposit.

The perlite present in the vitrophyre member of the Kate Peak formation is relatively inaccessible, and according to Mr. R. C. Horton of the Nevada Bureau of Mines it is probably of subcommercial grade. However, the outcrops in this area are rather poor, and it is possible that

significant deposits of perlite are present but are obscured under talus.

The current market for perlite is unsatisfactory; however, if the demand for perlite in western Nevada should improve, the area north of Chalk Hills should be prospected.

Tuff

Tuff, or volcanic ash, occurs at a number of horizons in the Cenozoic volcanic sequence, but the only thick persistant tuff is the tuff in the Chloropagus formation. This tuff is well-exposed; on the south side of the Truckee Canyon east of Derby Dam, on the south side of the Truckee River about 4 miles east of Mustang Station, and near the mouth of Lagomarsino Canyon where the Tuffstone quarry is located.

The tuff is white to pale straw yellow, and when fresh it is soft and somewhat friable. On exposure to the weather it hardens and becomes more coherent; hence its desirability for building stone.

At Tuffstone Quarry, tuff was quarried for building blocks which were used in the construction of a number of houses and buildings in Reno and Sparks. The quarry has been inactive for a number of years. Apparently the tuff cannot compete with brick and other construction materials.

In addition to its possible use as a building stone, tuff could be used as cement aggregate and the pumice rich varieties (pumicite) could be used as insecticide and pesticide carriers. Material suitable for concrete aggregate is worth about $2.00 to $6.00 per ton; and pumicite suitable for use as an insecticide carrier is probably worth about $15.00 per ton.

Limestone and Marble

Limestone or marble is the most important raw material used in the manufacture of portland cement. In this area these rocks have a very limited

distribution and occur mainly as thin interbeds in the pre-Cenozoic rock sequence. Two sizeable bodies of such rocks were discovered during the present investigation. Both of these occur in the vicinity of the Dayton iron prospect, just north of U. S. Highway 50. The largest body is a mass of crystalline limestone, or marble, that is enclosed in granodiorite in sec. 6, T. 17 N., R. 23 E. This is poorly exposed; but appears to be about 1,500 feet in length with an exposed surface area of about 100,000 square feet. It has nearly vertical bedding, and consists dominantly of crystalline calcite with nodules and streaks of calcium bearing silicates (diopside, garnet, epidote, etc.). Contacts with the granodiorite are nearly vertical and are marked by thin reaction skarns, composed dominantly of garnet and epidote. If the contacts with the granodiorite are essentially vertical to a depth of 100 feet, then over a million tons of this marble are available within a hundred feet of the surface.

Table 1. Analyses of Limestone and Marble

Analysis	A	B
	Per Cent	Per Cent
R_2O_3	11.24	5.68
Fe	0.71	---
CaO	48.84	51.89
MgO	0.26	0.44
K_2O	0.024	0.028
Na_2O	<0.05	<0.05
Insoluble (mainly SiO_2)	10.06	8.22

A composite chemical analysis (See Table 1, Analysis A) of several grab samples of this marble was made by Mr. H. A. Vincent of the Nevada Mining Analytical Laboratory. This analysis indicates that the marble has a suitable composition for the manufacture of portland cement.

A limestone deposit occurs on the south side of the hill at the Dayton iron prospect. This deposit, which is the limestone member of the Lahontan formation, is nearly flat-lying with a probable average thickness of 15 feet. It is exposed over an area of about one-fourth of a square mile; hence, a considerable tonnage of the limestone is available, possibly more than 400,000 tons.

A composite analysis (See Table 1, Analysis B) of several grab samples of this limestone was made by Mr. H. A. Vincent, chemist of the Nevada Mining Analytical Laboratory. This analysis indicates the sampled portion of this limestone has a composition favorable for the manufacture of portland cement.

These chemical analyses are inadequate to judge the quality of the entire available carbonate rocks; as they are only representative of a small portion of these deposits. A careful sampling program and analyses of selected samples would be necessary to evaluate all of the limestone and marble. The quality and quantity of carbonate rocks that is indicated by the chemical analyses and field data justifies a thorough geologic study of these deposits and an economic study of the possibility of establishing a cement plant to utilize them.

Diatomite

Diatomite and diatomaceous sediments occur at many places in the Curtiss-Wright property and at many different horizons in the Cenozoic stratigraphic succession. Diatomites in the lower part of the Cenozoic section (e.g., below the Thisbe formation) are of inferior quality and are subcommercial.

The best diatomites occur in the Thisbe, Kate Peak, and Coal Valley formations. The areas that contain diatomite of potential commercial grade are shown on the Economic Geology Map as green areas. (See pl. II, part A

and B.) All of these areas were prospected before the present study. Prospecting has been particularly thorough in the area near Clark Station, adjacent to the Eagle-Picher Company's diatomite processing plant.

The main diatomite area is east and southeast of Clark Station and includes Eagle-Picher's Celatom mine. This area is about 2 square miles in extent and contains considerable diatomite and diatomaceous shale with interbedded sandstone and tuff. The best diatomite is on the Eagle-Picher property, where it is currently being mined at the rate of more than 100 tons per day. In the region adjacent to the Eagle-Picher property, the diatomaceous section contains more interbedded sandstone, shale, and tuff than at the Celatom mine, and good diatomite is evidently restricted to thin layers. There is little hope for finding enough good grade diatomite in this area for a commercial diatomite operation; however, the diatomaceous shales have commercial possibilities as high-silica ceramic clays. This will be discussed under the heading of clays.

The second significant diatomite area is the Chalk Hills region in the east central part of the Virginia City quadrangle, about 6 miles northeast of Virginia City. Diatomite was mined in this area as late as 1930, by the Electro-Silicon Company of New York City, and was used as a silver polish. Diatomite and diatomaceous shales are present in this area as interbeds in a sequence of diatomaceous and tuffaceous sediments; referred to the Truckee formation by Thompson. Most of the diatomites apparently contain variable amounts of clay and silt, and are probably of subcommercial grade. High-grade diatomite is apparently restricted to relatively thin layers, and it is difficult to make any estimate of commercial possibilities. Complete evaluation of this area would require a detailed field and pilot plant study; however, it is doubtful whether this is justified as the area has probably been examined by the Eagle-Picher Company.

In the south central part of the Curtiss-Wright property, about 6 miles north of U. S. Highway 50 and about 3 miles north of the Dayton iron prospect, is a third area in which good grade diatomite is present. The diatomaceous sediments in this area are poorly exposed but seem to consist mainly of an interbedded sequence of diatomite, diatomaceous shales, rhyolite tuff, and tuffaceous sandstone. The amount of commercial grade diatomite that is available is questionable. A number of prospect pits are present in this area, but this area appears to have been less thoroughly examined than the other deposits of this region.

Clay Deposits

Clay deposits occur at many places in this area, but most of these are of inferior grade and consequently are subcommercial. However, the market for clay suitable for ceramic products; such as, brick, tile, etc. should increase in the near future, and the subcommercial deposits of today may be valuable in 10 or 15 years.

Most of the clay deposits occur in the bleached volcanic rocks of the Alta and Kate Peak formations, and are present in four principle areas: (1) in the Geiger Grade region near Virginia City, (2) in the northern part of the Virginia City quadrangle, (3) near the Gooseberry mine, and (4) in the Ramsey district. All of these deposits are erratic in distribution and contain many impurities. The clays are mixtures of kaolinite and montmorillonite, with variable amounts of silica and iron oxides; hence, they are suitable only for dark ceramic products.

The Reno Brick Company is currently mining clay for bricks and colored tiles in the Geiger Grade area, and apparently has sufficient reserves for a number of years. The material they are mining is similar to the clays near the Gooseberry mine and in the Ramsey area.

A different type of clay is present in sec. 23, T. 18 N., R. 23 E., south of the Ramsey district and about 4 miles north of U. S. Highway 50. Dark greenish claystone, which makes up the bulk of this Ramsey formation, occurs on the west side of a gulley, as an elongated mass about 2,000 feet long and up to 300 feet wide. The claystone contains leaf fragments and similar carbonaceous material. It has a relatively high concentration of iron; which was determined as 7.68 per cent; consequently it is not suitable for light colored ceramic products. A 50-pound sample of this material was sent to the Pittsburgh Testing Laboratories in San Francisco, California for detailed testing to see if it is suitable for ceramic products. Their report has not been received, so it is impossible at this time to indicate whether this material has any commercial possibilities.

A third type of clay deposit occurs in the diatomite-bearing area near the Celatom mine, east and southeast of Clark Station. In this area the sedimentary rocks are mainly diatomaceous shales and claystones, with lesser amounts of interbedded diatomite. Most of the clay-rich diatomaceous sediments in this area are light colored and apparently low in iron; consequently, they might be suitable for high silica ceramic products. A chemical analysis of two samples of diatomaceous rock, collected by Curtiss-Wright Company and analyzed by Mr. Hugh H. Miller of Curtiss-Wright, indicates these are diatomaceous clays or shales with a high content of clay. Such material may have commercial possibilities as clay rather than diatomite, and should be investigated.

Miscellaneous Mineral and Rock Occurrences

Minor occurrences of a number of other commercially important minerals and rocks have been observed on the Curtiss-Wright property. Although, these are geologically significant they have little commercial importance; however, it is thought that they should be recorded.

Gypsum occurs in small amounts as thin veinlets in the altered lavas in the vicinity of the Gooseberry mine, and as scattered crystals and veinlets in the vicinity of the Ramsey-Comstock mine in the northern part of the Ramsey district.

Zeolite minerals (chabazite, laumontite, heulandite, and possibly natrolite) occur in minor amounts in some of the older volcanic rocks; particularly the lavas of the Chloropagus and Alta formations. These minerals occur as vesicle fillings and veinlets but are present only in subcommercial quantities.

Wollastonite, a mineral that has recently become important in the ceramic industries, occurs in small amounts in some of the calcareous hornfelses near the Dayton iron prospect. The mineral occurs only in the inner portions of the contact aureoles immediately adjacent to the granodiorite. It is only present in small quantities; too small for any commercial possibilities.

Barite has been reported in small amounts in the Castle Peak quicksilver mine, and is possibly present in some of the other mines. However, there is not much possibility of finding a commercial deposit in this area.

Alunite is present in small amounts in some of the altered lavas in many of the mining areas; such as, Ramsey, Gooseberry mine, Castle Peak, etc. No appreciable quantities of it are available.

SPRINGS AND WATER

A number of springs are present in the Virginia City quadrangle, and the southern part of the Curtiss-Wright property in the Churchill Butte quadrangle. The important springs are marked on the economic geology maps (See pl. II, parts A and B). All of these springs are cold-water springs and all yield palatable water suitable for human consumption. The rate of

flow of the springs varies from a few gallons per day to several gallons per minute. The most prolific springs in the entire area probably are the Sutro Springs in the southeast part of the Virginia City quadrangle, on the Curtiss-Wright property line. These springs probably have a total yield of 50 to 100 gallons per minute, but this possibly could be increased by constructing a series of horizontal water shafts into the hillside yielding the water.

The only spring with a significant flow of water in the interior of the area, east of the Virginia City quadrangle, is Biddlemen Spring in sec. 29, T. 19 N., R. 23 E., about 7 miles south of Clark Station. This spring yields a good flow of cold palatable water and is currently used by sheepmen.

No large supply of water is apparently available in the interior of this area. Wells could be drilled at a number of places, but is questionable whether any wells in the interior region would supply a great volume of water. Initial yield may be good but recharge would likely be slow and the wells probably would be inferior in a few years.

SUMMARY AND RECOMMENDATIONS

A variety of minerals and mineral deposits are present in the Curtiss-Wright area; however, the only mineral commodities that appear to have commercial possibilities are: (1) gold and silver at the Gooseberry mine, (2) diatomite, (3) clay, and (4) limestone and marble.

It is recommended that the following economic evaluation program be initiated:

1. A detailed geological field and laboratory examination of the diatomite deposits. If the geological study should indicate that there is a substantial quantity of high-grade diatomite available, then the

diatomites should be carefully sampled and large samples should be put through a pilot plant for evaluation.

2. A geological and mineralogical field and laboratory study of the clay deposits should be conducted. This should be largely, but not entirely, restricted to the clays associated with the diatomaceous sediments.

3. The limestone and marble deposits near the Dayton iron prospect should be carefully and thoroughly studied in the field and laboratory. The deposits should be systematically sampled and the samples chemically analyzed. A series of core holes should be drilled to obtain samples for chemical analysis and to deliniate the subsurface boundaries of the deposits. This should be accompanied by a thorough economic study of the feasibility of establishing a cement plant in this area to utilize these deposits.

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APPENDIX A: CHEMICAL ANALYSES OF SOME VOLCANIC ROCKS OF THE VIRGINIA RANGE, NEVADA

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SiO_2	47.91	54.77	52.6	63.18	53.24	75.66	59.05	56.45	76.77
TiO_2	2.70	1.08	0.82	---	0.86	0.24	0.75	---	0.19
Al_2O_3	14.26	17.53	18.4	16.00	18.17	12.67	17.05	19.85	12.29
Fe_2O_3	1.65	*8.94	4.2	4.34	2.64	0.23	0.66	4.95	0.07
FeO	7.80	---	4.0	1.52	5.13	1.38	4.63	0.97	0.90
MnO	tr.	0.10	0.14	---	0.00	0.00	0.02	0.11	tr.
MgO	10.83	2.66	5.4	2.07	4.08	0.22	3.01	2.66	0.42
CaO	9.60	7.65	10.2	4.45	6.82	0.64	5.76	7.70	0.27
Na_2O	3.01	3.98	3.1	3.87	4.67	4.89	4.49	3.15	3.03
K_2O	1.89	2.65	1.0	2.65	1.50	3.64	1.67	3.84	4.57
H_2O+	0.37	0.24	(0.26	2.00)	1.29	0.58	2.16	0.38	1.30
H_2O-	---	0.20	(	)	0.75	0.23	0.51	---	0.21

* Total Fe determined as Fe_2O_3

LOCATION OF ANALYZED ROCKS

(1) McClellan Peak Basalt: American Flat Creek, Virginia City quadrangle.

Analyst: S. L. Penfield; U. S. Geol. Surv. Bull. 17, p. 33, 1885.

(2) Mustang Andesite: 1 mile south of Clark Station.

Analyst: A. v. Volborth.

(3) Lousetown Basalt: Knob south of vent at Lousetown.

Analyst: U. S. Geol. Surv. Rapid Analysis Branch (Unpublished).

(4) Kate Peak Rhyodacite: Cross Spur Quarry, Virginia City quadrangle.

Analyst: R. W. Woodward; U. S. Geol. Surv. Exploration of the 40th. Parallel, vol. 1, Table X-B, 1870.

(5) Chloropagus Basalt: Road cut on U. S. Highway 40, about 3 miles northeast of Clark Station. Analyst: A. v. Volborth.

(6) Rhyolite: Fragment from rhyolite tuff in Chloropagus formation.

North side of Beacon Hill, north of Clark Station.

Analyst: A. v. Volborth.

(7) Alta Andesite: From Ramsey mining district.

Analyst: A. v. Volborth.

(8) Porphyritic Pyroxene Andesite: From Painted Rock area, east of Clark Station. Analyst: R. W. Woodward: U. S. Geol. Exploration of the 40th. Parallel, vol. 2, pp. 833-834, 1877.

(9) Hartford Hill Rhyolite: From Ramsey mining district.

Analyst: A. v. Volborth.

APPENDIX B: LOCATIONS OF PLACES NOT SHOWN ON GEOLOGIC MAP

Vista: A small community about 6 miles east of Reno, at the entrance to the Truckee Canyon.

Mustang: A small community in the Truckee Canyon, about 10 miles east of Reno.

Clark Station: A station on the Southern Pacific railroad, in the Truckee Canyon about 20 miles east of Reno.

Lagomarsino Canyon: A north-south canyon on the south side of the Truckee River, about 9 miles east of Reno.

Ramsey Mining district: An area of several square miles, about 13 miles south-southeast of Clark Station. Formerly an active mining district.

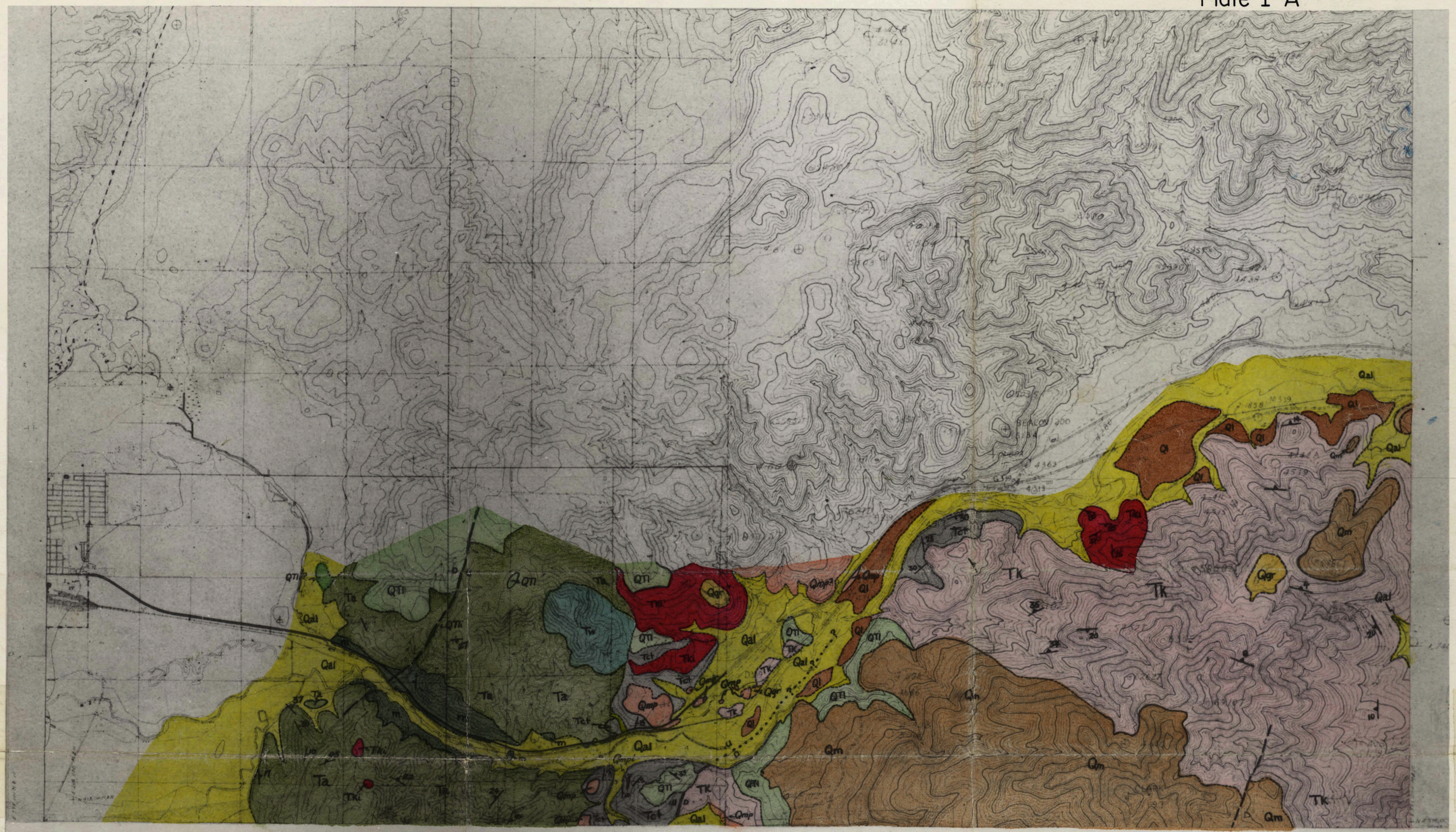
Dayton iron prospect: A group of iron ore prospects, mainly in sec. 6, T. 17 N., R. 23 E., about 23 miles northeast of Carson City and about 10 miles east of Virginia City.

Celatom mine: Eagle-Picher Company's diatomite mine in sec. 34, T. 20 N., R. 23 E., about 7 miles east of Clark Station.

Gooseberry mine: A gold-silver mine in sec. 25, T. 19 N., R. 22 E., about 6 miles south of Clark Station.

Painted Rock: An area in the Truckee Canyon, about 4 miles southwest of Wadsworth and about 26 miles east of Reno.

Plate I-A



N

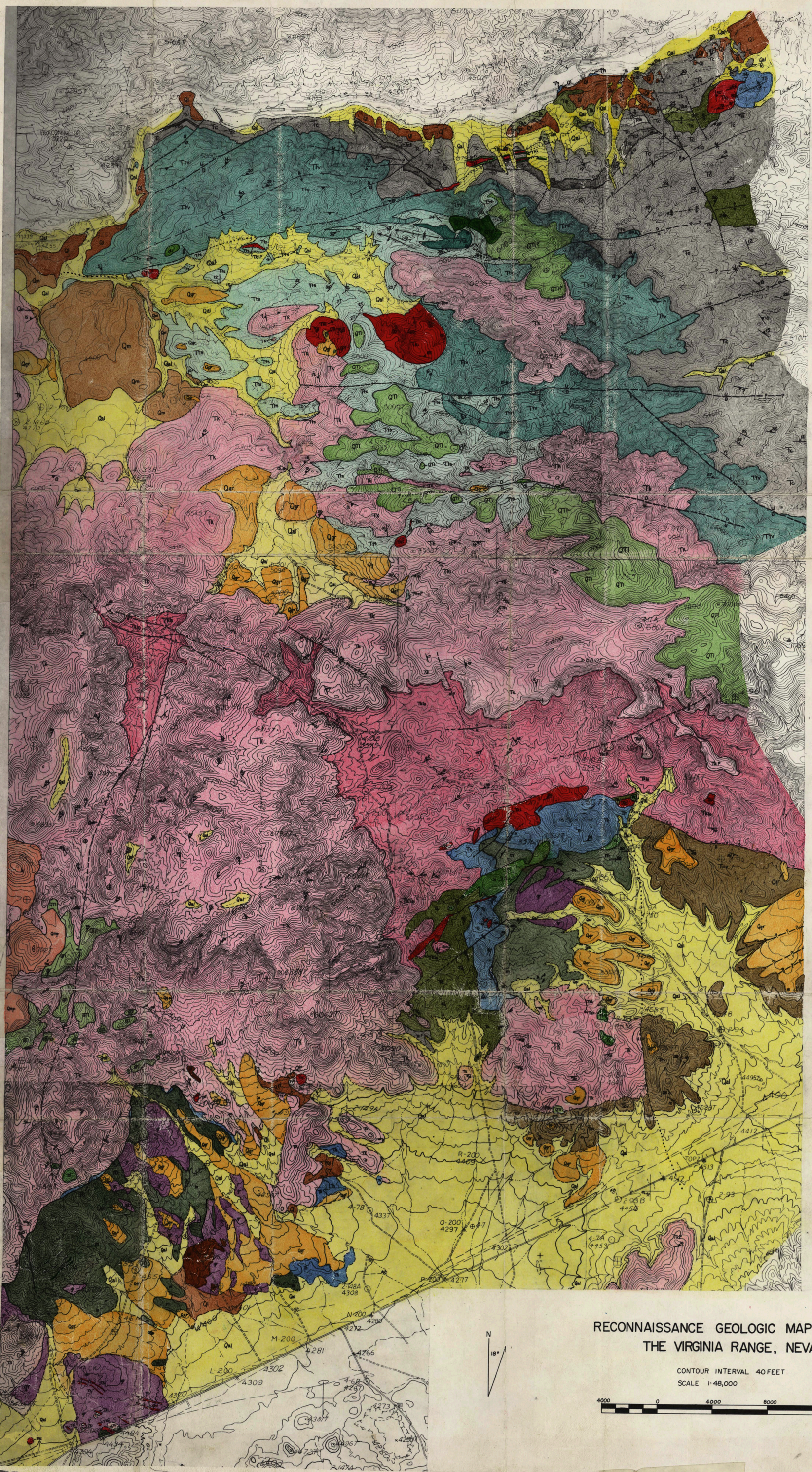
18°

RECONNAISSANCE GEOLOGIC MAP
SOUTHERN PART - SPANISH SPRINGS VALLEY QUADRANGLE

CONTOUR INTERVAL 40 FEET
SCALE 1:48,000

4000 0 4000 8000 12000 16000 20000 FEET

Plate I-B



EXPLANATION

Quaternary

Qal — Alluvium
Stream gravels and sand

Qgr — Older alluvium
Fanglomerates, stream sediments and terrace deposits

Ql — Lahonton formation
Lake Lahonton sediments, mainly fine sand and silt with some gravel. Algal limestone (Qll) at Dayton iron prospect.

Qmp / Qmpl — McClellan Peak formation
Dark gray olivine basalt. Flows, cinder cones and intrusives.(Qmpl)

Qm — Mustang andesite
Thick flows of gray hornblende andesite

QTl / QTli — Lousetown formation
Medium to dark gray basaltic and andesitic lavas(QTl) and intrusives (QTli)

Tertiary

Tw — Washington Hill formation
Domes and small intrusives of felsitic rhyolite

Pliocene

rl, da, al — Small intrusive bodies of volcanic habit
Rhyolite (rl), dacite(da), and andesite(al)

Tcv — Coal Valley formation
Lacustrine and fluviatile sediments. Andesitic sandstones, shales, and diatomites.

Tk / Tklo / Tki — Kate Peak formation
Dacitic and rhyodacitic felsophyric and vitrophyric lavas and flow breccias with interbeds of pumiceous rhyolite tuff and diatomites. Lower portion (Tklo) similar in composition but less resistant and more or less altered (argillized and locally mineralized) but without interbedded tuffs and diatomites. Kate Peak intrusives (Tki) resistant felsophyres and vitrophyres.

Mio-Pliocene

Tta / Tts / Ttv — Thisbe formation
Upper part (Tts) mainly andesitic sandstones and diatomaceous sediments with a pyroxene andesite flow (Tta). Lower part (Ttv) mainly rhyodacite and dacite felsophyres and vitrophyres lithologically like the Kate Peak formation.

Tc / Tcs / Tcl — Chloropagus formation
Thin lava flows of basalt and basaltic andesite (commonly amygdaloidal) with interbeds of pumiceous tuff (Tcl) and diatomaceous sediments (Tcs).

Oligocene

Ta / Tas / Tal — Alta formation
Hornblende and pyroxene andesite flows and flow breccias with some interbedded rhyolite tuff. Small andesitic intrusives locally present (Tai). Near Painted Rock the upper portion of the formation consists of siltstones, shales and tuffs, the Sutro member (Tas).

?Eocene

Th — Hartford Hill formation
Welded and semi-welded biotite rhyolite tuffs with minor rhyodacite tuffs and one thin rhyodacite flow.

?Paleocene

Tr — Ramsay formation
Well-indurated olive green claystone with abundant leaf fossils.

?Cretaceous

gr — Granodiorite
Hornblende biotite and biotite granodiorite intrusive into Mesozoic rocks.

Triassic-Jurassic

m — Metamorphic rocks
Metamorphosed sedimentary and volcanic rocks: slates, marbles, metandesites, etc.

Depositional and intrusive contacts
Solid where well located, dashed where approximate, dashed and questioned where conjectural.

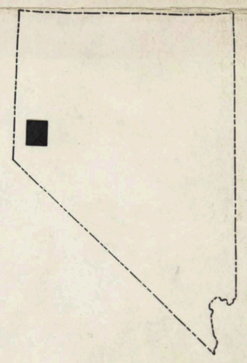
Faults and fault contacts
Dashed where approximately located, questioned where conjectural or doubtful, dotted where concealed.

Anticline, showing trace of axial plane
Dashed where approximate.

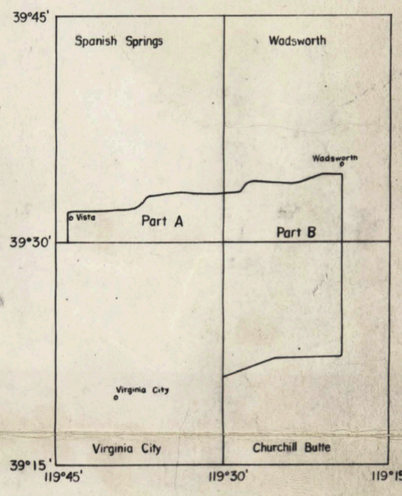
Syncline, showing trace of axial plane
Dashed where approximate.

Strike and dip symbols of planar elements

	bedding	igneous flow banding	jointing
inclined	50	45	50
vertical			
horizontal			



INDEX MAP
Showing location of area covered in this report.



INDEX MAP
Showing mapped area.
Part A by G.J. Stathis
Part B by R.L. Rose & L.H. Godwin
Virginia City quadrangle covered in U.S.G.S. Bulletin No. 1042-C.

RECONNAISSANCE GEOLOGIC MAP OF A PART OF THE VIRGINIA RANGE, NEVADA

CONTOUR INTERVAL 40 FEET
SCALE 1:48,000

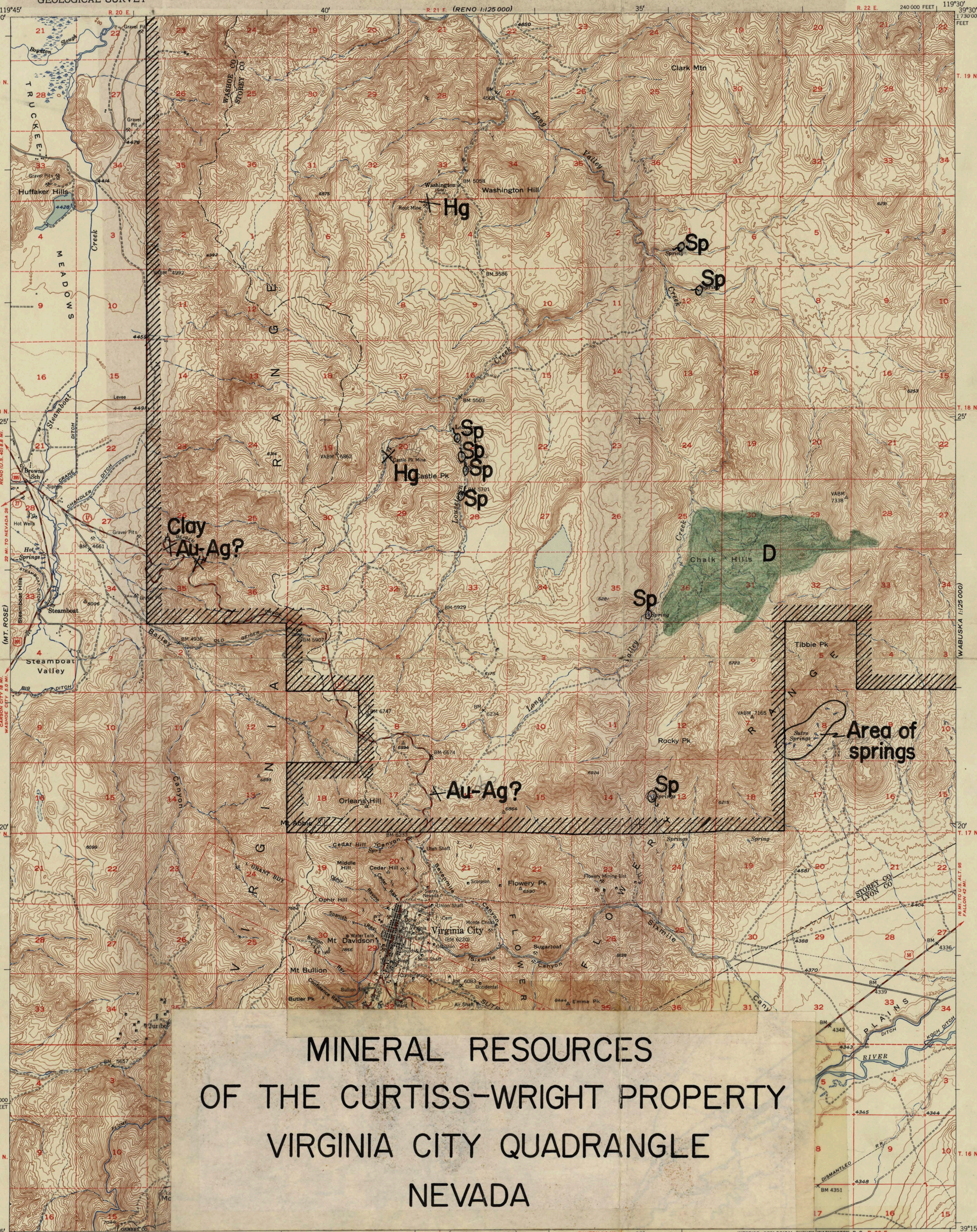
4000 0 4000 8000 12000 16000 FEET

N 18°

Plate II-A

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

VIRGINIA CITY QUADRANGLE
NEVADA
15 MINUTE SERIES (TOPOGRAPHIC)



MINERAL RESOURCES OF THE CURTISS-WRIGHT PROPERTY VIRGINIA CITY QUADRANGLE NEVADA

Mapped, edited, and published by the Geological Survey
Control by USGS and USC&GS

Topography from aerial photographs by multiplex methods
Aerial photographs taken 1948. Field check 1950

Polyconic projection. 1927 North American Datum
10,000-foot grid based on Nevada coordinate system, west zone

Dashed land lines indicate approximate location

Unchecked elevations are shown in brown

(CARSON 1:125 000)
2.2 MI. TO U.S. 50
CARSON CITY 10 MI.
DAYTON 1.0 MI.
CARSON CITY 12 MI.

SCALE 1:62 500

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT HALF-INTERVAL CONTOURS
DATUM IS MEAN SEA LEVEL

TRUE NORTH
MAGNETIC NORTH
18°
APPROXIMATE MEAN DECLINATION, 1950

ROAD CLASSIFICATION
Heavy-duty — 4 LANE | 6 LANE
Medium-duty — 4 LANE | 6 LANE
Light-duty
Unimproved dirt
U. S. Route
State Route

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, FEDERAL CENTER, DENVER, COLORADO OR WASHINGTON 25, D. C.
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

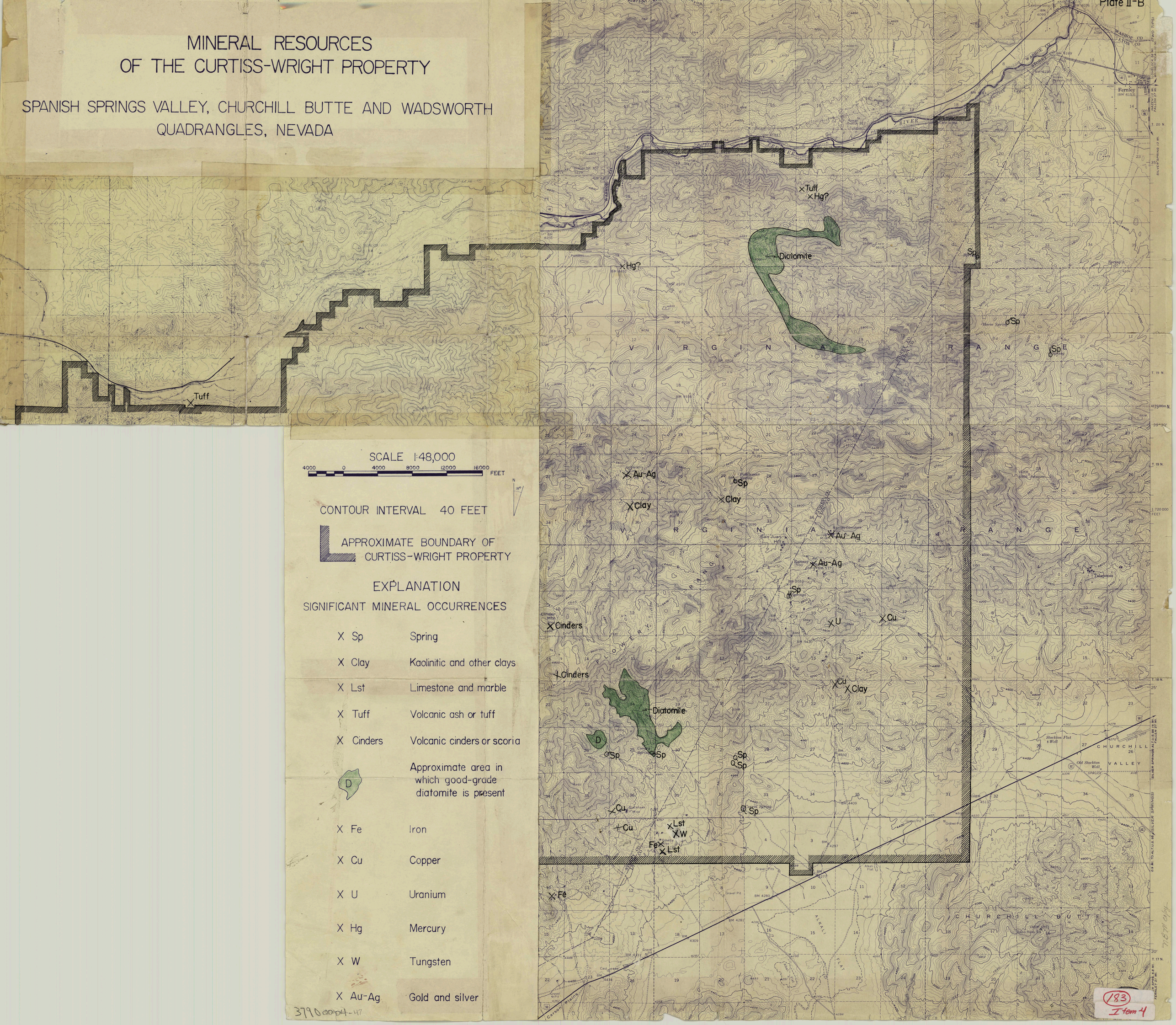
INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.
M R-7706 1955

VIRGINIA CITY, NEV.
N3915—W11930/15
1950

Plate II-B

MINERAL RESOURCES OF THE CURTISS-WRIGHT PROPERTY

SPANISH SPRINGS VALLEY, CHURCHILL BUTTE AND WADSWORTH QUADRANGLES, NEVADA



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Item 4