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RECONNAISSANCE GEOLOGY OF THE SNAKE RIVER CANYON  
BETWEEN GRANITE CREEK AND PITTSBURG LANDING,  
OREGON AND IDAHO

By Tracy L. Vallier  
Indiana State University

Introduction

This report describes some of the major geologic and topographic features in the Snake River Canyon between Granite Creek and Pittsburg Landing (figure 1), and is part of a continuing project of mapping the canyon from Farewell Bend near Huntington, Oregon to the mouth of the Grande Ronde River, a distance of more than 150 miles. The information presented here synthesizes the results of geologic mapping during the summer of 1968 and adds to investigations previously reported by Brooks and Vallier (1967).

Geologic mapping was of reconnaissance nature only, and was principally confined to the lower elevations of the canyon (see accompanying geologic map and cross sections, pages 243 to 246). Therefore, geologic age assignments and contacts between rock units are subject to revision as detailed work is completed. Stratigraphy, structure, and intrusive sequences are so complex that many relationships will require additional study.

In the 1967 report by Brooks and Vallier (The ORE BIN, December 1967, now out of print), the major stratigraphic units between Farewell Bend and Granite Creek were described. In this report the geology north along the canyon from Granite Creek to Pittsburg Landing is discussed. As work progresses in the canyon, future articles will cover the results.

Previous Geologic Mapping

Very little geologic mapping has been completed in the part of the canyon described in this report. Wagner (1945) compiled a reconnaissance geologic map which included part of the area; however, he made no attempt to separate the pre-Tertiary rocks except at Pittsburg Landing. Hamilton (1963) included a small part of the canyon on the geologic map in his report. A 20-mile section of the canyon, downstream from Pittsburg Landing near the mouths of the Imnaha and Salmon Rivers, was mapped by Morrison (1963). White (1968) mapped a Mesozoic pluton sequence in the adjacent

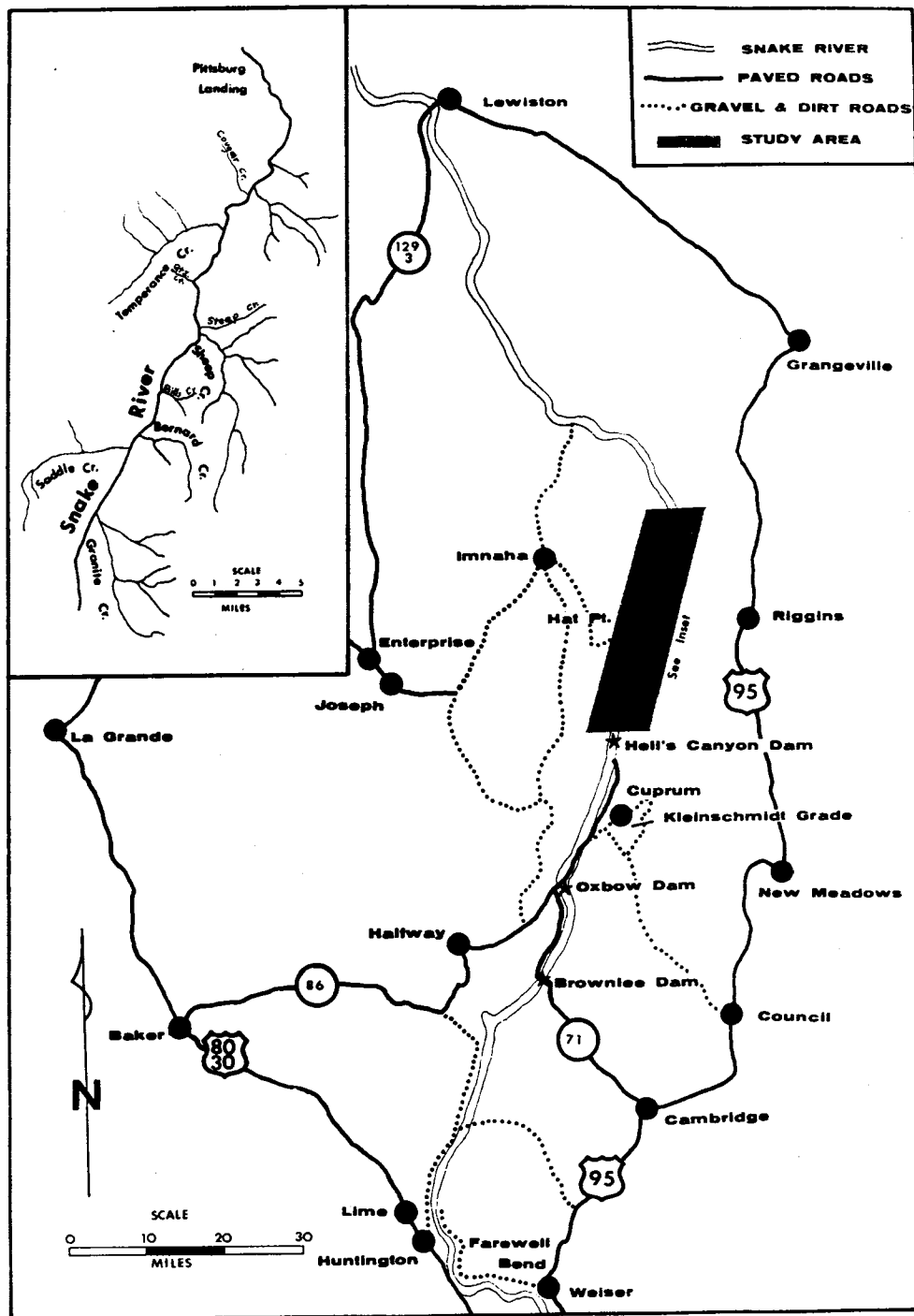


Figure 1. Index map of the Snake River Canyon region, Oregon-Idaho, showing the area described in this report.

Seven Devils Mountains. His interpretations of age relationships should be of valuable assistance to later workers in northeastern Oregon and western Idaho.

## Geography

### General setting

The Snake River plunges into a relatively narrow, steep-walled canyon a few miles north of Oxbow, Oregon. This part of the canyon, known as Hells Canyon of the Snake River, is the deepest gorge in North America (figure 2). At Hat Point, on the west rim of Hells Canyon, rocks tower more than 5500 feet above the river, and on the east the Seven Devils Mountains loom 8000 feet above the canyon floor (figure 3). Cliffs, benches, irregular steps, and sharp ridges characterize the terrain, and narrow V-shaped tributary canyons incise the main canyon walls. In some places the river channel is walled by steep cliffs; in others it winds sinuously between terraces (figure 4). Skilled boatmen in high-powered jet boats navigate the white waters of the many rapids with safety, but small craft are easily upset.

Summer temperatures commonly exceed 110° F. near the canyon floor and winter temperatures are mild. At higher elevations, winters are severe. Cactus, shrubs, small trees, and hardy grasses are the major types of vegetation in the lower parts of the canyon where summers are characteristically dry. Patches of conifer timber, mostly Douglas fir and ponderosa pine, grow above 4000 feet.

### Access

Geologic mapping in this part of the Snake River Canyon has been hindered by the very poor accessibility. One road from U.S. Highway 95 near Whitebird, Idaho leads into the canyon at Pittsburg Landing, but use of it is limited to trucks and 4-wheel drive vehicles. River boats provide the most convenient transportation. The jet boats can reach Granite Creek from Lewiston, Idaho, a distance of more than 100 miles, in less than six hours and can return in about three hours. The only other means of transportation are helicopters, horses, or private airplanes whose skilled pilots land on river terraces.

## Mineral Deposits

Very little mining has been done in this part of the Snake River Canyon. Prospect pits and a few tunnels mark the endeavors of optimistic men. Orange-stained strata near Sluice, Willow, and Quartz Creeks plus scattered, narrow veins of copper sulfides and copper carbonates suggest that a



Figure 2. Hells Canyon of the Snake River near Granite Creek.  
Rugged, somber brown walls rise more than 1 mile above  
the canyon floor.

closer look might be worthwhile. Known areas of mineralization in the adjacent Seven Devils Mountains are described by Livingston and Laney (1920) and Cook (1954). Reports that describe mineral deposits in other parts of the Snake River Canyon are by Swartley (1914), Moore (1937), Libbey (1943), and Brooks and Ramp (1968).

### Geology

The deep gorge of the Snake River exposes rocks of pre-Tertiary and Tertiary ages which are separated by an angular unconformity. Deformed and metamorphosed pre-Tertiary rocks were eroded in late Mesozoic and early Tertiary times. Then, during parts of the Miocene and Pliocene epochs, basalt flows were extruded onto the rugged terrain. The vast lava plateau that subsequently formed was uplifted in the late Pliocene and Pleistocene epochs. The Snake River cut the present canyon in just a few million years. According to Livingston (1928) and Wheeler and Cook (1954), the present course of the Snake River is different from the course it followed in most of late Tertiary time.



Figure 3. The rugged peaks of the Seven Devils Mountains of Idaho rise more than 8000 feet above the Snake River Canyon floor.



Figure 4. The Snake River winds sinuously between river terraces near Temperance Creek.



### Pre-Tertiary rocks

The pre-Tertiary rocks in the Snake River Canyon between Granite Creek and Pittsburg Landing are similar to pre-Tertiary rocks in parts of the eastern Blue Mountains of northeastern Oregon and in parts of the Seven Devils Mountains of western Idaho. A wide variety of eugeosynclinal stratified rocks and several plutons are represented.

Metamorphosed eugeosynclinal strata include volcanic flow rocks, volcanoclastic rocks, limestone, conglomerate, graywacke, and shale. Total thickness of the strata is estimated to be from 20,000 to 30,000 feet, and ages are Permian, Middle and Late Triassic, and Middle Jurassic. Major rock types in the Permian system are volcanoclastic rocks, volcanic flow rocks, conglomerate, and graywacke. Middle and Upper Triassic rocks are volcanoclastic rocks, volcanic flow rocks, graywacke, conglomerate, limestone, and shale. Black shale and dark brown graywacke comprise most of the Middle Jurassic strata.

Plutonic rocks cut the eugeosynclinal strata and occupy a significant part of the total area in this particular section of the Snake River Canyon. All gradations occur between intensely sheared and metamorphosed gabbro, diorite, and quartz diorite to unsheared and essentially unmetamorphosed diorite, quartz diorite, and granodiorite. Thayer and Brown (1964) recognized two major and distinct plutonic events, of Early Permian-Late Triassic and Early Cretaceous ages, in northeastern Oregon. However, work by White (1968) indicates that plutonism in the southern Seven Devils Mountains occurred from Late Triassic to Early Cretaceous times. The 11 plutons mapped by White represent three episodes of plutonism that in part straddle the time interval between the Permian-Triassic plutonism and the middle Cretaceous-early Tertiary Idaho batholith. Most of the plutons in the Snake River Canyon between Granite Creek and Pittsburg Landing apparently are related to the older two intrusive episodes described by White and therefore are of probable Triassic and Jurassic ages.

Regional metamorphism probably occurred during parts of the Middle and Late Jurassic Period. Minerals of the greenschist facies are characteristic in most pre-Tertiary rocks. Major changes that occurred in the rocks were albitization of feldspars, silicification, and chloritization of mafic minerals.

The pre-Tertiary rocks trend northeast throughout most of the area. Prevailing northeast strikes are characteristic of bedding, schistosity, fluxion structure, flow banding, major fold axes, and faults. Even the plutons are crudely aligned in northeast directions, particularly those associated with a wide shear zone that occurs south of Pittsburg Landing. Bedding dips to the northwest in most outcrops.





Figure 5. Middle and Upper (?) Triassic stratified rocks along the north side of Saddle Creek Canyon.

#### Tertiary rocks

Tertiary rocks are mostly basalt flows of the Miocene-Pliocene Columbia River Group. These flows are nearly horizontal and overlie the truncated pre-Tertiary rocks. Maximum thicknesses range between 2000 and 3000 feet. High-angle faults and broad folds are the result of Pliocene-Pleistocene deformation in adjacent areas. Basalt flows at an elevation of 3000 feet along the west side of the canyon probably are the same ones that occur at elevations greater than 7000 feet in the Seven Devils Mountains.

#### Geologic Traverse along the Snake River Canyon from Granite Creek to Pittsburg Landing

The geology of the Snake River Canyon between Granite Creek and Pittsburg Landing is described in four parts from south to north. The total

river distance is about 30 miles.

#### Sec. 1. Granite Creek to Bernard Creek

Several thousand feet of Middle and Upper (?) Triassic rocks are exposed along the Snake River Canyon between Granite Creek and Bernard Creek, both in Idaho (figure 5). Dr. N. J. Silberling (written communication, September 26, 1968) reported that flat clams collected near Saddle Creek are Daonella degeeri Boehm and Daonella frami Kittl of Middle Triassic (early Ladinian) age. These fossils were collected in folded, argillaceous limestone near the floor of the canyon (figure 6). Overlying rocks several thousand feet thick may be partly of Late Triassic age (figure 5). In the lower elevations of the canyon, green flows of spilite are separated by beds of conglomerate, limestone, and volcanoclastic rocks. Monolithic spilite conglomerate and pillow lavas are common. At higher elevations, younger rocks are predominantly volcanoclastic; flow rocks are less abundant.

The structure between Granite and Bernard Creeks is uncomplicated. Most deformation is portrayed by broad folds and high-angle faults. Rocks mostly dip to the northwest.

#### Sec. 2. Bernard Creek to Temperance Creek

Most of the stratified rocks between Bernard Creek, Idaho, and Temperance Creek, Oregon, are Permian in age. An area north of Bernard Creek on the Idaho side contains rocks of uncertain age that show some similarities to known Permian strata.

One major intrusive, of probable Late Triassic or Early Jurassic age, cuts the older rocks. The body, informally named the Bills Creek intrusive, crops out along both sides of the Snake River Canyon for nearly two miles. The northern contact trends northeast and apparently joins the west contact of the deeply incised intrusive that is exposed in Sheep Creek. Rock types are metadiorite, metagabbro, and metamorphosed quartz diorite. Structures within the intrusive include platy flow structures such as aligned hornblendes, aligned xenoliths, and parallel schlieren. Secondary foliation, also called fluxion structure, is mostly absent. Contacts are sharp and, along the northern contact, older country rocks display a zone of fluxion structure more than 200 feet wide. The Bills Creek intrusive is a composite pluton; several plutons could be distinguished by careful mapping. From compositional, structural, and metamorphism studies, the writer believes that this intrusive complex might be correlated with the mafic suite described by White (1968, p. 19-54) in the nearby Seven Devils Mountains. Of particular interest are the similar northeast trends.

Except for a small intrusive in the Willow Creek drainage area about two miles to the north, most of the rocks between the Bills Creek intrusive and Temperance Creek are of Permian age. Productid brachiopods, similar

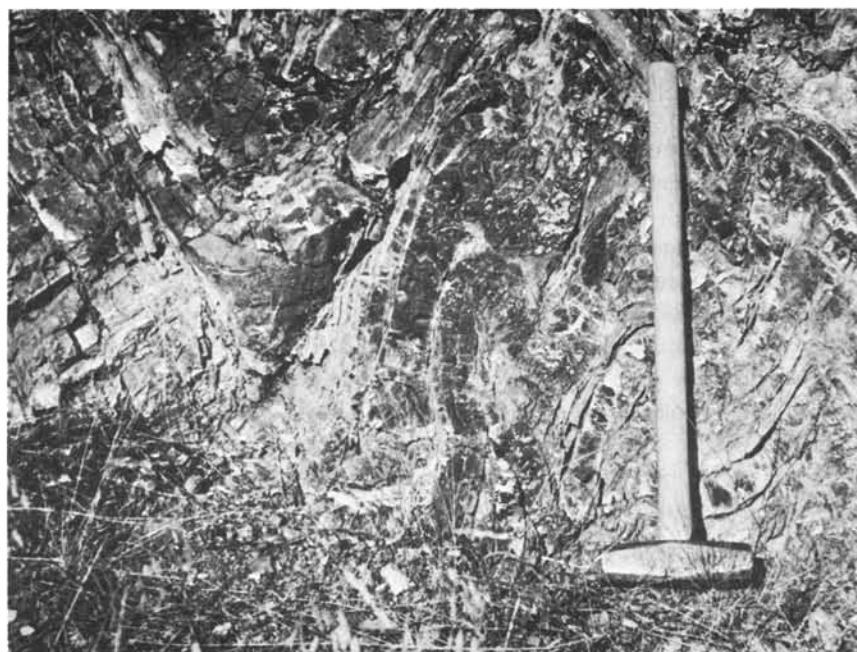


Figure 6. Contorted, thin-bedded argillaceous limestone south of Saddle Creek along the Snake River Canyon. Flat clams (Daonella degeeri Boehm and Daonella frami Kittl) collected here are of Middle Triassic (early Ladinian) age.



Figure 7. Permian rocks near Quartz Creek. Orange-stained strata (in dashed lines) may indicate mineralization at depth.

to the genus *Megousia*, were observed near the mouth of Sheep Creek. Excellent exposures of Permian rocks occur along the north sides of the canyons of Sheep and Steep Creeks where more than 2000 feet of strata could be measured and described. Good exposures also occur near Quartz Creek (figure 7).

Structure is complex in this section of the Snake River Canyon. A fractured and schistose zone in Permian rocks occurs between the west contact of the Bills Creek intrusive and the Snake River south of Sheep Creek. Here the valley is much wider, because the Snake River was able to cut away the more easily eroded rocks. Effects of deformation also are greater north of Quartz Creek where crushing and recrystallization increase to the southern boundary of a wide shear zone near Temperance Creek. Many faults cut the rocks throughout this section of the canyon between Bernard and Temperance Creeks; careful work is necessary for accurate mapping.

### Sec. 3. Temperance Creek to Pittsburg Landing

The area between Temperance Creek, Oregon and Pittsburg Landing, Idaho displays a rugged topography, a complex structure, and numerous rock types. A northeast-trending shear zone, named the Cougar Creek shear zone for the exposures in Cougar Creek, is the dominant geologic feature (figures 8 and 9). Although the Cougar Creek shear zone is only 3 to 4 miles wide, the Snake River follows a tortuous route through it for nearly 7 miles, in some places paralleling the northeast-striking structures and in other places cutting perpendicularly across the structures.

The Cougar Creek shear zone is composed of sheared and mylonitized intrusives and older country rocks. Intrusives were emplaced at least four different times into volcanic flow rocks and volcanoclastic rocks of probable Permian age. Rock types are sheared and metamorphosed gabbro, diorite, quartz diorite, diabase, volcanoclastic rocks, and volcanic flow rocks with amphibolite, mylonite, gneiss, albite granite, schist, and phyllite (figures 10 and 11). Exposures of undeformed and essentially unmetamorphosed diorite are rare. Foliations are caused by fluxion structure, schistosity, and some platy flow structure. Strikes are N. 50° to 70° E. and dips range from 60° to vertical. Lineations created by quartz alignments in mylonite, by prismatic hornblendes, and by slickensides on chlorite-plastered foliation planes approach the horizontal in three widely separated locations, plunging northeast between 10° and 16°.

Similarities between the Cougar Creek shear zone and the Oxbow-Cuprum shear zone (Taubeneck, 1966; Vallier, 1967, 1968; White, 1968) are remarkable. Structural styles and trends, rock types, and probable ages are about the same. Most deformation and intrusive activity in both shear zones occurred before regional metamorphism, although later intrusives were localized along the shear zones. Foliated plutonic clasts in Upper Triassic (Karnian) conglomerates at nearby Pittsburg Landing indicate that plutonism

Reconnaissance Geologic Map: Granite Creek to Pittsburg Landing,  
Oregon and Idaho -- Explanation.



Quaternary deposits; alluvium, terrace deposits, and landslide debris.



Tertiary basalt; correlates with Columbia River Group.



Upper Jurassic black shale and graywacke; minor limestone. Tightly folded.



Jurassic (?) intrusive; weakly metamorphosed diorite, gabbro, and quartz diorite.



Upper Triassic Pittsburg Formation; marine conglomerate, shale, sandstone, and volcanoclastic rocks. Minor andesite flows.



Middle (?) and Upper Triassic undifferentiated; marine volcanoclastic rocks, spilite flows, and minor limestone.



Triassic (?) intrusives; diorite, quartz diorite, albite granite, and gabbro of the Cougar Creek Complex. Strongly foliated. Contains younger undeformed intrusives.



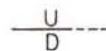
Permian or Triassic volcanoclastic rocks and flow rocks. Most are hornfelsed.



Permian undifferentiated; marine volcanoclastic rocks, spilite and keratophyre flow rocks and small spilite intrusives. Minor amounts of limestone and argillite.

~?~ Unconformity; questioned where uncertain.

Shear zone; strongly foliated, schistose and mylonitic.



Fault; U, upthrown side; D, downthrown side; dashed where approximately located.



Axes of folding; anticline, syncline.



Strike and dip of bedding.



Strike and dip of vertical bedding.



Strike and dip of igneous foliation.



Strike and dip of vertical igneous foliation.



Strike and dip of metamorphic foliation.



Strike and dip of vertical metamorphic foliation.



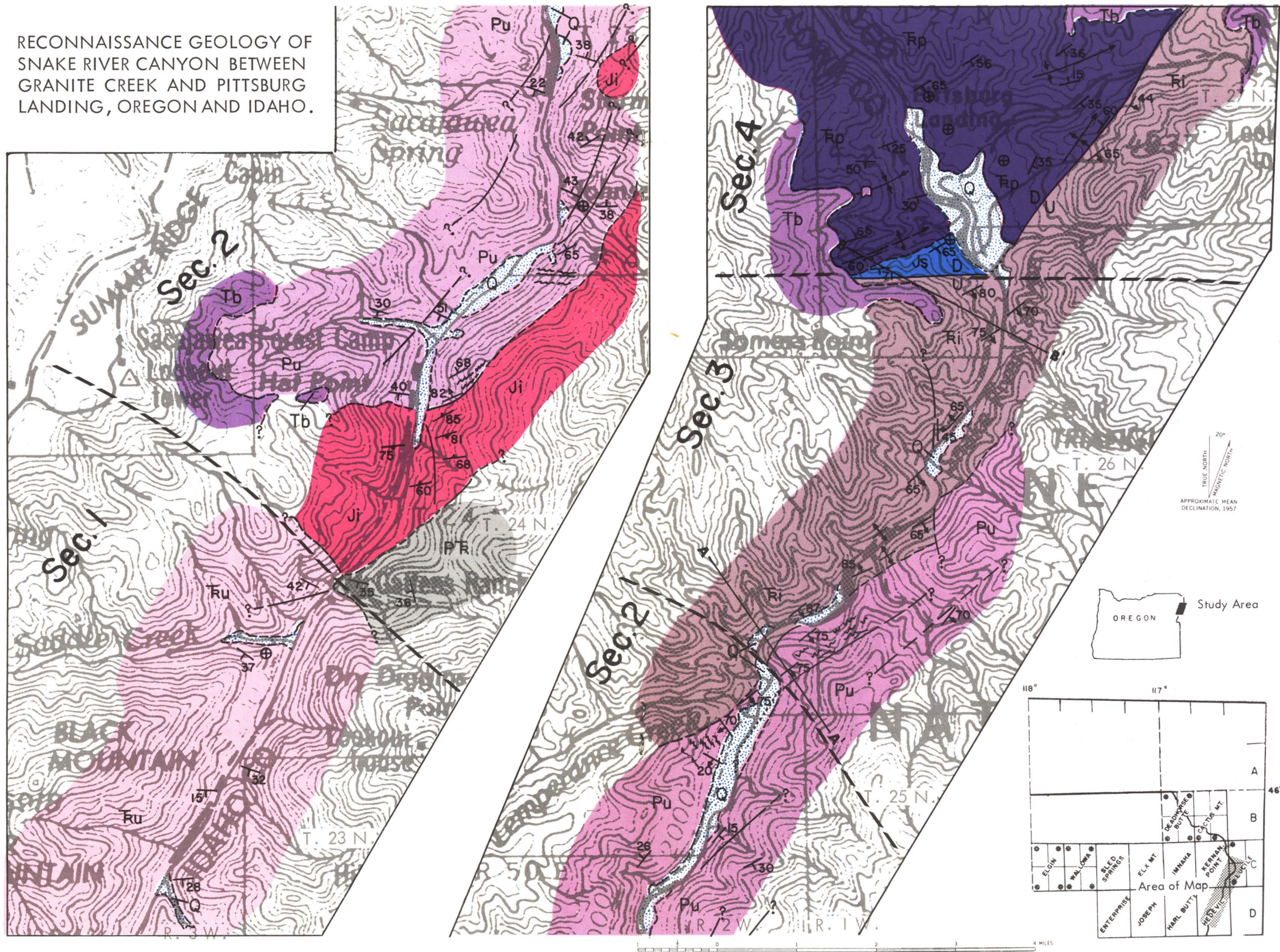
Significant fossils.

—?— Contact; dashed where approximately located; questioned where uncertain.

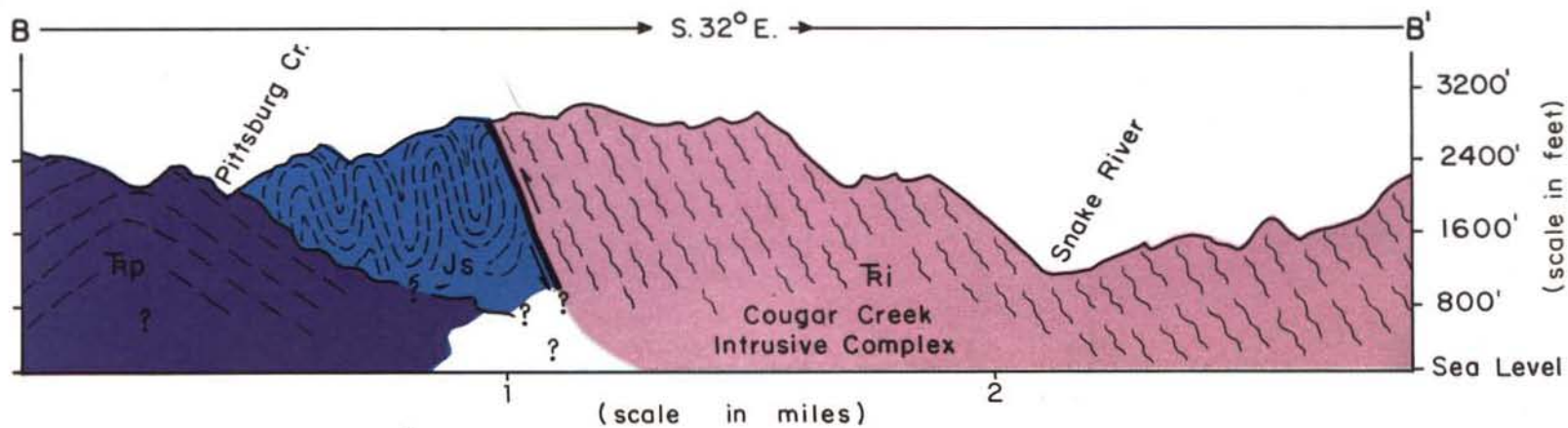
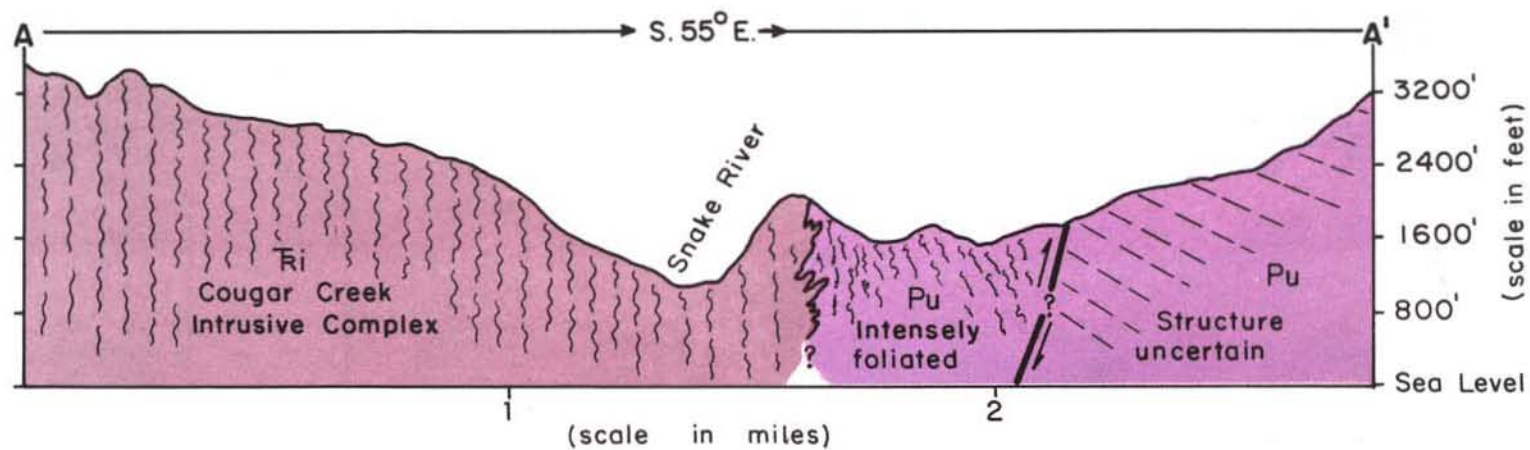
Topographic base from U.S.G.S. 30-minute Grangeville quadrangle map.  
Contour interval 200 feet.



RECONNAISSANCE GEOLOGY OF  
SNAKE RIVER CANYON BETWEEN  
GRANITE CREEK AND PITTSBURG  
LANDING, OREGON AND IDAHO.









had occurred and that foliated plutons, perhaps in the Cougar Creek shear zone, had been eroded. If so, plutonism and deformation had begun at least by Late Triassic time and probably continued through the Jurassic; some intrusives were emplaced after regional metamorphism (Late Jurassic [? ] ).

The width of the shear zone, intense deformation, localization of intrusives, and horizontal slickensides make this area of great value to anyone interested in the tectonic events of northeastern Oregon and western Idaho. The writer suggests that this shear zone may have been another zone of lateral movement during the Mesozoic Era.

#### Sec. 4. Pittsburg Landing area

A great diversity of rock types is exposed in the vicinity of Pittsburg Landing. Stratified rocks of Late Triassic and Middle Jurassic ages (written communications from Drs. N. J. Silberling and Ralph Imlay provided age data) are separated from the Cougar Creek shear zone by a high-angle thrust fault (figure 12).

The stratified rocks are separable into two major mappable units. The older unit, the Pittsburg Formation described by Wagner (1945), is at least 2000 feet thick and consists of conglomerate, shale, sandstone, and volcanic flows. Wagner believed that the formation was of Carboniferous age, but flat clams (*Halobia*) and ammonites indicate a Late Triassic age. A 900-foot stratigraphic section was measured. The lower boundary was tentatively placed at the base of the first thick shale unit, but later revision will certainly be necessary as more studies are completed on the rocks downstream. Rocks of the Pittsburg Formation are only slightly deformed; large open folds are the rule (figure 13).

The younger unit, still unnamed, consists of black shale and dark brown sandstone. These relatively incompetent beds are isoclinally folded; the greater deformation is due to the proximity of the fault that separates the black shales from the Cougar Creek shear zone. Although the shale displays pencil cleavage, ammonites are surprisingly abundant. According to Dr. Ralph Imlay, ammonites collected near the base of the unit are of latest Middle Jurassic age and ammonites of Late Jurassic age may be present in the younger strata. This unit probably is equivalent in part to the Upper Jurassic Idorwa Formation (Morrison, 1963) that was mapped about 30 miles north of Pittsburg Landing.

#### Future Work

The writer and assistants will continue mapping northward along the Snake River Canyon. It is planned that the pre-Tertiary rocks at the more accessible lower elevations of the canyon, from Pittsburg Landing to the mouth of the Grande Ronde River, will be mapped by the fall of 1969. Mapping of the upper levels of the canyon will follow. The results of these



Figure 8. Rugged topography of the Cougar Creek shear zone, looking south from Pittsburg Landing.



Figure 9. Cougar Creek shear zone looking southwest near Cougar Creek. Notice the steep dips of the northeast-striking foliations in the upper right corner of the photograph.

geologic studies along the Snake River Canyon should help solve some of the riddles in the complex geology of northeastern Oregon and western Idaho.

#### Acknowledgments

The writer is particularly grateful to David White for assistance and companionship in the field. Howard Brooks of the State of Oregon Department of Geology and Mineral Industries assisted the writer in the field and also provided a knowledge of regional relationships that was invaluable for some interpretations. However, the conclusions presented here are solely the responsibility of the writer. Thanks are extended to Dr. Rolland Reid and the Idaho Bureau of Mines and Geology for monetary assistance and encouragement. Special acknowledgment is given to Hollis M. Dole and the State of Oregon Department of Geology and Mineral Industries for monetary assistance and continued enthusiasm for the project. The Sigma Xi-RESA research fund also provided a grant that helped defray expenses. Fossil identifications were made by Dr. Ralph Imlay of the U.S. Geological Survey and Dr. N. J. Silberling of Stanford University. Floyd Harvey of Hells Canyon Excursions Inc. provided campground facilities and boat transportation which greatly expedited the field work.

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Figure 10. Vertical, fluxion-structured intrusives ( mylonites ) along the Snake River in the Cougar Creek shear zone. This exposure is about half a mile south of Kirkwood Creek.



Figure 11. Mylonitized diorite and sheared diabase dikes in the Cougar Creek shear zone.



Figure 12. Rocks exposed on the Oregon side of Pittsburg Landing. A solid line separates rocks of the Cougar Creek shear from Middle Jurassic black shale along a fault. Dashed lines separate Middle Jurassic black shale from Upper Triassic clastic rocks along an unconformity.



Figure 13. Synclinal structure in the Pittsburg Formation at Pittsburg Landing. Overlying horizontal basalt flows are the Columbia River Group. The unconformity is marked by a dashed line.

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#### OCHOCO REGION GEOLOGICALLY MAPPED

Two maps recently issued by the U.S. Geological Survey complete a block of geologic mapping in the Ochoco Mountains east of Prineville. They are: Map I-541 - "Reconnaissance geologic map of the Ochoco Reservoir quadrangle, Crook County, Oregon," by A. C. Waters and R. H. Vaughan; and Map I-543 - "Reconnaissance geologic map of the Lookout Mountain quadrangle, Crook and Wheeler Counties, Oregon," by C. M. Swinney, A. C. Waters, and C. P. Miller.

The two adjacent quadrangles are underlain principally by andesitic and basaltic rock of the Clarno Formation of Eocene age, consisting of lava flows, mudflows, tuffs, vent breccias, plugs, and dikes. Overlying the Clarno rocks are patches of rhyolitic rocks of the John Day Formation comprising tuffs, welded tuffs, lava flows, domes, and intrusive bodies of upper Oligocene to lower Miocene age. Basalt flows of the Columbia River Group of middle Miocene to lower Pliocene age occupy fairly large areas in the eastern part of the mapped region. Pleistocene basalt and andesite flows occur south of Ochoco Reservoir on the west. Holocene (Recent) deposits include alluvium and landslide materials.

The multicolored 1:62,500-scale maps are obtainable at 75 cents each from U.S. Geological Survey, Denver Center, Denver, Colo. 80225.

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## LAVA BUTTE ATTRACTS THOUSANDS OF VISITORS

By Phil F. Brogan, Bend, Oregon



A 500-foot-high volcanic cone 10 miles south of Bend on U.S. Highway 97 was visited in the 1968 tourist season by more than 40,000 persons. It was the duty of this writer, serving as director of the U.S. Forest Service information center atop the old volcano, to greet the visitors and to tell them the ancient story of a tiny volcano that challenged the Deschutes River in its northward race. The aerial photograph shows Lava Butte from the south.

Visitors to the center were not only told the story of the butte, its 1678-acre lava flow and the vent from which this lava spilled to dam the Deschutes, but were given information about the rugged lavalands visible from the butte. Not overlooked was the great, white, southward stretch of Cascade volcanoes from Mount Adams, visible to the north in Washington, to Mount Scott in Crater Lake National Park.

Also related for visitors was the history of the Lava Butte country from the first recorded penetration, just to the south, by Peter Skene Ogden in 1826 to the coming of Nathaniel Wyeth and his fur-seekers in 1834 and the exploration by John C. Fremont and his men in 1843.

The 500-foot summit of Lava Butte is reached over a spiral road. On the high northeast lip of the deep crater is a glass-enclosed visitors' center,



surmounted by a lookout house. Parking space on the summit was at a premium at times in the 1968 summer as the thousands of visitors made their way to the top. Many hiked around the crater trail to look over the south rim, where a great flood of molten rock long ago broke through cinders to send waves of lava west to the Deschutes and northward a distance of 6 miles.

Visitors were greatly impressed. They asked why the spectacular viewpoint was not included in western America tourist literature. The view of the Cascades was described by some as the most impressive seen on their western tours.

The U.S. Forest Service has recognized the importance of the viewpoint, and is making plans for enlargement of the center, development of trails over the jagged lava, marking of points of volcanic interest, and improvement of a limited network of roads that will make easily accessible such cinder and lava cones as Mokst Butte, high in the north Paulinas.

About a third of high Mokst Butte was torn away some 6000 years ago when lava breached the southwest wall. On his visit to this region in 1925, Geologist H.T. Stearns said that visible from high cones of the area is more "spectacular volcanism than can be seen from any other point in America."

The visitors' center planned by the Forest Service at the south base of Lava Butte will be developed as a base for the interpretation of the volcanic story of the region, noted for its lava caves, buttes, great fissures, spatter cones, and flows of basalt.

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#### MERCURY TRENDS FORECAST

From January through July the price of mercury per 76-pound flask ranged from \$600 to \$500; it is currently \$524. In 1968, GSA entered the market with 25,357 flasks available for disposal at monthly auctions and through the first 9 months of 1968 marketed 15,125 flasks to local commercial and industrial bidders. In addition, it presented, through AID, 2400 flasks to India and about 1800 flasks to other government agencies, leaving 6032 flasks in the GSA stockpile. If monthly offerings by GSA are at 1500 flasks per month, sales will extend into 1969; but if monthly offerings are at 2500 flasks, the supply could be exhausted by the end of 1968. However, new sources of supply are expanding, the most important of which is Cominco Ltd's Pinchi Lake mine in Canada, which recently began production a few months ahead of schedule. Capacity estimated at around 20,000 flasks a year will probably be reached during 1969. Another important gain in production is projected in Turkey, whose 1967 output amounted to about 4000 flasks, but according to U.S. Bureau of Mines reports is slated to jump to 25,000 flasks by 1970. In 1969, expanded Turkish and Pinchi Lake output may compensate for the loss hereafter of the 20,000-25,000 flasks which GSA is supplying this year. (Nevada Mining Assn. News Letter No. 188, Nov. 15, 1968.)

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