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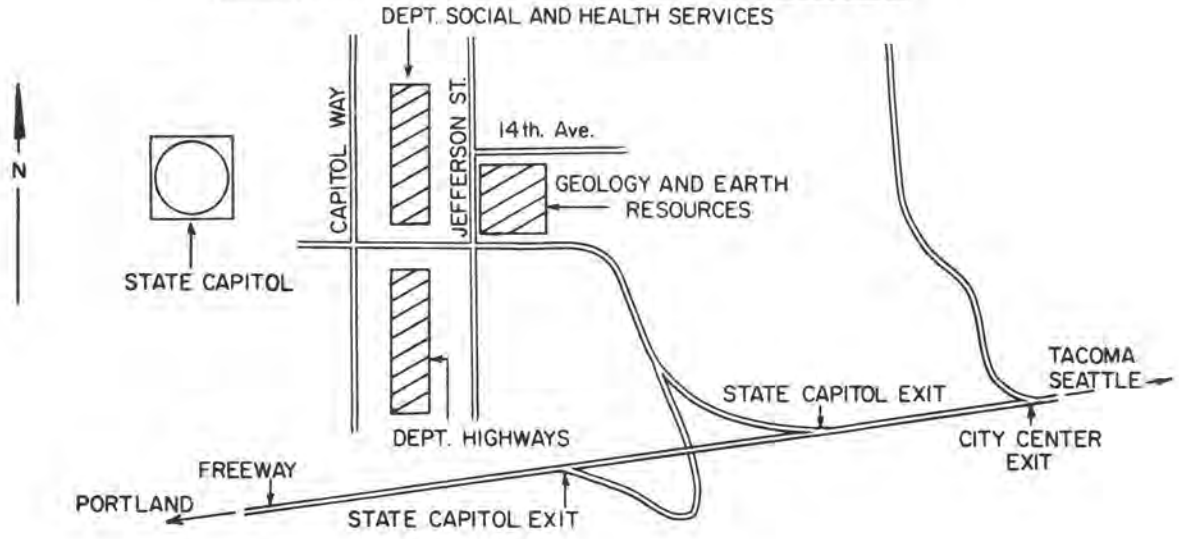

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GOLD IN WASHINGTON *

INTRODUCTION

Gold, throughout the ages, has been synonymous with wealth. For thousands of years, it has been the foremost medium of exchange in most countries. Everyone is familiar with gold and with the romance associated with its recovery from occurrences in nature. In fact, it is probable that gold is the first, and to many the only, metal thought of when mining is mentioned. Certainly, it is the metal first thought of under ordinary conditions when a person decides to become a prospector and seek his fortune on the streams and in the mountains. This is easily understood, for, of all metals, gold is the most simply and easily recovered from its containing formation, whether it occurs as a lode or as a placer deposit. A minimum of experience and equipment is required to pan for gold; and, when won, gold is tangible wealth, requiring little or no treatment to be exchangeable for goods.

HISTORY OF GOLD IN WASHINGTON

The first discovery of gold in Washington was probably that reported by Stevens (1860)[1/], who, in describing explorations made by Captain McClellan and his party in search of a railroad route through the Cascades in 1853, said, "Here the first traces of gold were discovered, and though not sufficiently abundant to pay for working, it caused considerable excitement in the camp." The locality referred to was in the Yakima Valley, though it is not clear whether it was near the mouth of the Naches River or was on the headwaters of the Yakima River. In the same report Stevens wrote, "It is also worthy of observation that gold was found to exist, in the explorations of 1853, throughout the whole region between the Cascades and the main Columbia to north of the boundary, and paying localities have since been found at several points, particularly on the southern tributary [probably Peshastin Creek] of the Wenatshapan [Wenatchee River]. The gold quartz also is found on the Naches River."

In 1855 there was a small gold rush to the Colville region, and on September 14 of that year the Oregonian newspaper reported

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* Extracted from Washington Division of Geology and Earth Resources Information Circular 57, Handbook for gold prospectors in Washington, by Wayne S. Moen and Marshall T. Huntting.

1/ Stevens, I. I., 1860, Reports of explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean, made . . . in 1853-4: U.S. Pacific Railroad Explorations, v. 12, Book 1.

prospectors recovering $5 to $8 per day using rockers along the Pend Oreille River. On September 28 and November 23 the Olympia Pioneer and Democrat newspaper reported placer-gold discoveries along the Columbia River from the mouth of the Spokane River to the mouth of the Pend Oreille River and up that river for at least 40 miles. Prospectors were said to be making fairly good recoveries on Sheep Creek just south of the Canadian boundary. The placers in this region appear to have been too small and too low grade to hold the prospectors' interest for long, and their attention was soon directed to other areas.

From the beginning, gold-mining activities were intermittent rather than constant. Periods of activity were followed by periods of stagnation. These cycles were influenced to some extent by economic conditions. In general, gold mining has fared relatively well and prospecting has flourished during economic recessions, and gold mining has been at a disadvantage and has declined during periods of general prosperity and high prices. Of even more influence locally has been the prospectors' urge to move on to possibly more lucrative fields as news was spread of gold strikes in new areas. Thus, though a party that was surveying the international boundary discovered gold on the Similkameen River in Okanogan County in 1859, the men who rushed to the Similkameen stayed only about three months and then flocked northward to the Frazier River and Cariboo district, leaving the Similkameen placers practically deserted. A few months later the surge was reversed and many of the same men returned to the Similkameen, and others spread out in both eastern and western Washington. Hodges (1897)[2/] reports that these men returning from the north discovered placer gold on Ruby Creek in Whatcom County, on the Sultan River in Snohomish County, and on Peshastin and Swauk Creeks in Chelan and Kittitas Counties in the early 1860's, but Bethune (1891, p. 6-7)[3/] sets the dates for discovery of gold in these districts at later dates, as follows: Swauk Creek in 1874, Peshastin Creek in 1877, Ruby Creek in 1878, and Cle Elum River in 1881. Bethune records placer mining on Cassimer Bar at the mouth of the Okanogan River as early as 1860 and increased placer activities along this river in the middle 1880's.

Bars along the Columbia River adjacent to the Colville Indian Reservation were worked intermittently, mainly by Chinese, from 1870 to 1890, and Columbia River bars above Priest Rapids were reported to have been worked prior to 1860. Other bars of the Columbia, Snake, and most of the other rivers in the state were prospected, and some of these yielded moderate amounts of placer gold. Beach placers were discovered along the Pacific Coast and were worked in a small way for many years. During a brief gold excitement in 1894 the beaches were staked for 60 or 70 miles south of Cape Flattery, but productive localities were found to be limited to 20 miles south of Portage Head. By 1900 most of the state's placers had been found and largely worked out.

Nearly all the lode mining districts in the state have some mines that produced gold,

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2/ Hodges, L. K., Editor, 1897, Mining in the Pacific Northwest: The Post-Intelligencer, Seattle, Washington, 192 p. Facsimile Reproduction SJS-134 by the Shorey Book Store, Seattle, Washington in 1967.

3/ Bethune, G. A., 1891, Mines and minerals of Washington: Washington State Geologist First Annual Report, 122 p.

at least as a byproduct, and most of these districts had been discovered by 1897, when a historically interesting account of the mines of the Pacific Northwest was published (Bethune, 1891)[4/]. One of the first discoveries of lode gold in the state was at the base of Mount Chopaka in 1871. In 1878, C. P. Culver discovered lode gold in the Blewett district, where the first stamp mill was built in the then Territory of Washington. Lode gold was discovered at Monte Cristo in Snohomish County in 1889 and at Republic in Ferry County in 1896. Previous to 1898 gold quartz veins were being mined and the ore milled in arrastres near Liberty in the Swauk district of Kittitas County. A few very early discoveries of lode gold were made within the area of the Colville Indian Reservation, but it was not until the Reservation was opened to mineral entry in 1898 that mining began to expand in this region. The Republic district has been the leading lode gold camp in the state, but other important gold-producing areas have been the Railroad Creek, Blewett, Mount Baker, Monte Cristo, Slate Creek, Oroville-Nighthawk, Orient, and Wenatchee districts. Some of the most famous of the early gold mining camps in Washington are shown in figure 1.

Throughout the years, mining operations at the state's gold mines have almost ceased and currently (1979) the Knob Hill

1. Republic
2. Liberty
3. Blewett
4. Chesaw
5. Barron
6. Monte Cristo
7. Mineral City
8. Orient
9. Gilbert
10. Mazama
11. Gold Hill
12. Oroville
13. Nighthawk
14. Loomis
15. Danville
16. Bodie

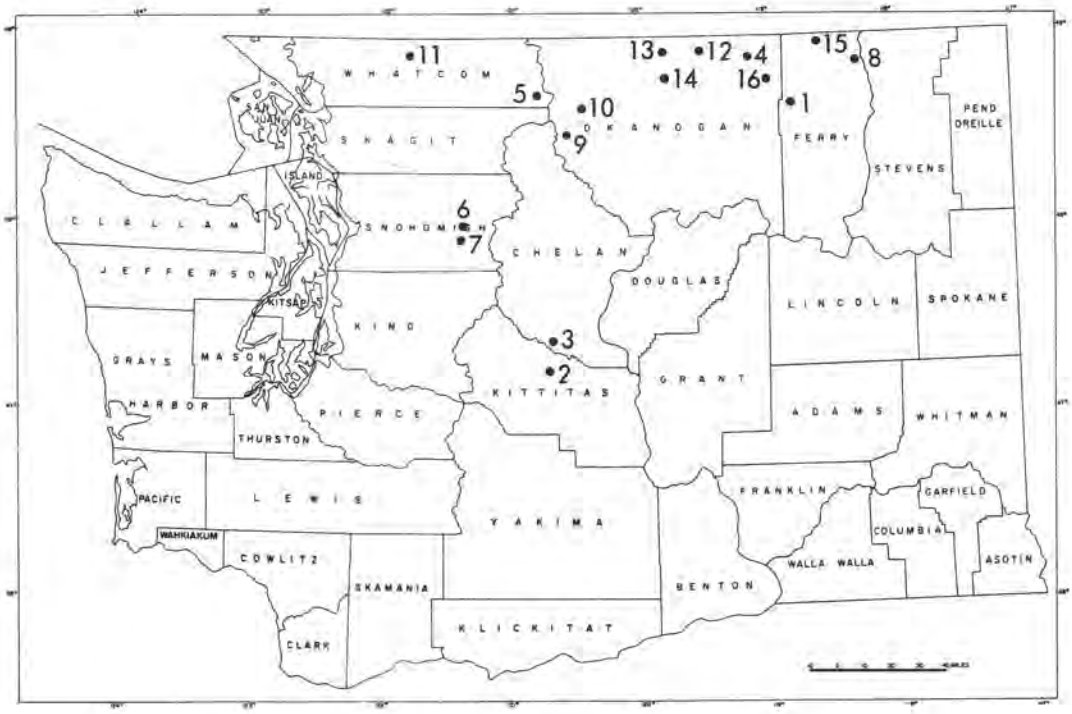

FIGURE 1.—Some gold mining camps of Washington (1885-1910).

4/ Bethune, G. A., 1891, Mines and minerals of Washington: Washington State Geologist First Annual Report, 122 p.

mine at Republic in Ferry County and the New Light mine in eastern Whatcom County are the only operating lode gold mines in Washington. Most mines ceased to operate because it was no longer profitable to mine the gold-bearing veins, the richest parts of which had been mined out. However, the rise in the price of gold over the past several years has resulted in renewed interest in the state's gold deposits. Deposits that were too low in grade to operate in the past are currently undergoing examinations.

Although most of the state's gold placer deposits had been worked out by 1900, almost yearly some streams have been worked on a small scale for placer gold. During the depression years of the 1930's, placer mining increased as many unemployed men attempted to earn a living by working the gold-bearing sands and gravels of many streams throughout the state. However, the average daily income of these depression-days gold miners was less than 50 cents. In recent years gold panning has been nothing more than a weekend hobby for many individuals, but because of the high gold prices that prevail today, several placer gold deposits are being operated on a commercial scale.

Figure 2 shows locations of the state's gold deposits.

PRODUCTION

Gold production forms an important part of the total mineral output of the State of Washington. Every year prior to 1916, gold outranked in value all other metals produced, and it has ranked first in many of the years since that date. However, in 1956 gold accounted for only 15 percent of the value of metallic production in the state. Annual gold production in Washington from 1866 through 1978 is shown in figure 3.

The following data on production, except as otherwise noted, are from the annual volumes of Mineral Resources and its successor, the Minerals Yearbook, published prior to 1924 by the United States Geological Survey and later by the United States Bureau of Mines. Since 1956, gold production figures for individual counties have been withheld to avoid disclosing individual company confidential data. Total Washington State gold production from 1860 through 1956 was 2,844,204 ounces, valued at $78,306,908, which ranks Washington eleventh among the states as a gold producer. Total United States gold output from the beginning of the record through 1972 has been 318 million ounces, and the Washington share of this amount has been slightly less than 1 percent. The greatest production of gold in Washington in any single year since 1900 was 92,117 ounces, valued at $3,224,095 in 1950. In that year, 97 percent of the state's production came from three mines—the Holden, Gold King, and Knob Hill, which ranked in production twelfth, fourteenth, and eighteenth, respectively, among the gold mines of the United States. In the next year, 1951, the Gold King mine was the leading producer in this state, ranking eleventh nationally, followed by the Holden mine (thirteenth) and the Knob Hill mine (sixteenth). Combined production from the Holden and Gold King mines in Chelan County outranked that of all but six other gold districts in the United States in 1951. Prior to 1900 most of the gold produced in the state was from placers, but since that time less than 2 percent of the output has been from placers. Placer production from 1900 through 1956 was $935,042. To illustrate further, placer production for the 10-year

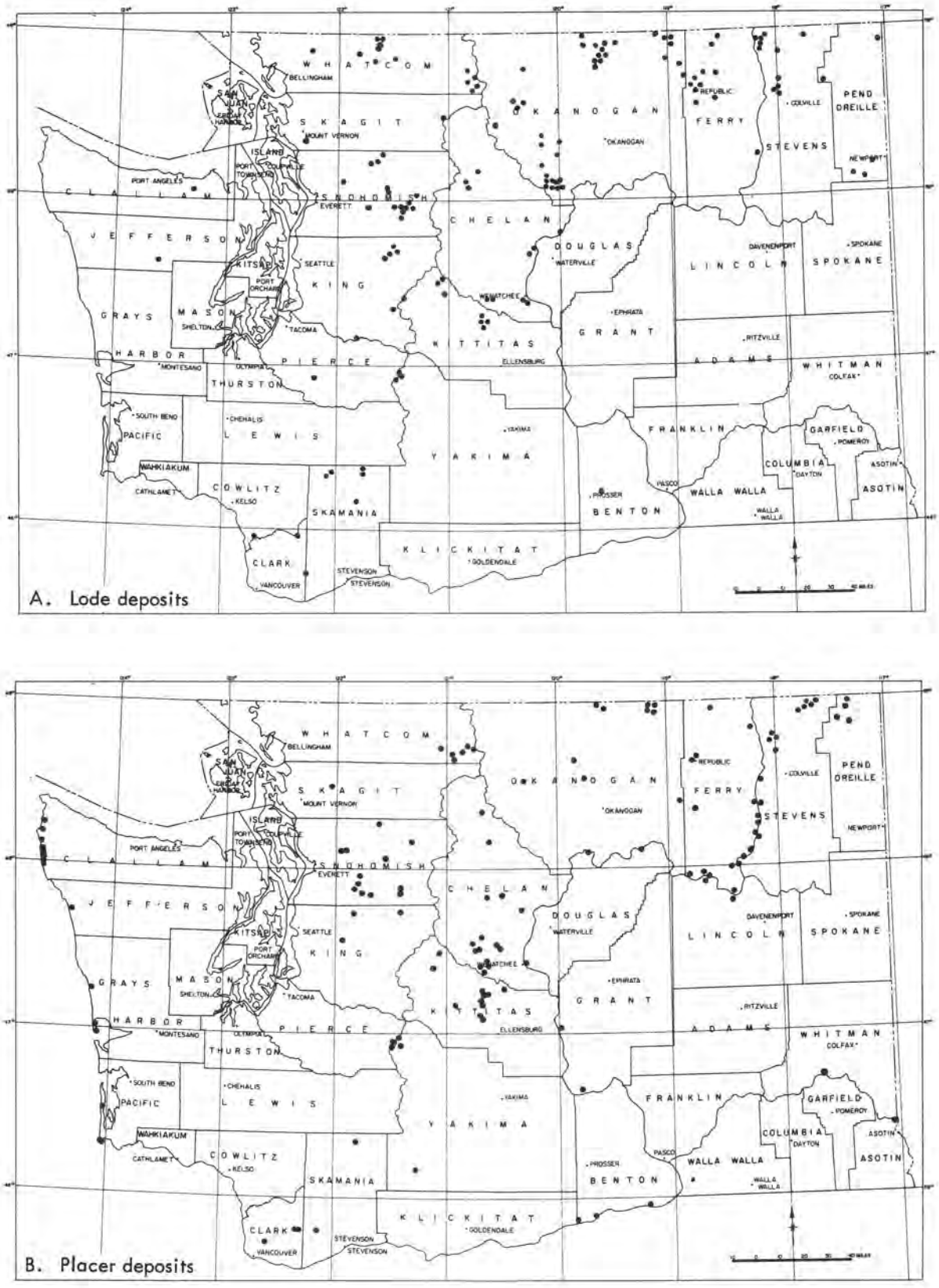

FIGURE 2.—Gold deposits of Washington. A. Lode deposits; B. Placer deposits.

period from 1900 through 1909 was $350,541 but for a similar period from 1944 through 1956 production was only $16,870.

The Republic district of Ferry County has had the longest consistent record of gold production, and Ferry County has led all counties during 28 of the 50 years from 1903 to 1952, inclusive. Chelan County, formerly a small producer, took the lead in 1938 as a result of the output of the Holden mine and continued to hold it (except for 1947) up through 1956. Stevens County produced the greatest amount of gold during 5 years (1905 through 1908, and 1922), and Whatcom County led for 3 years (1904, 1929, and 1930). Okanogan, Snohomish, and Kittitas Counties have nearly always produced some gold, and in some years important amounts. In total gold production for the years 1903 through 1956, Chelan and Ferry Counties are at the top of the list with about $25 million each, followed in order of output by Whatcom, Stevens, Okanogan, Snohomish, and Kittitas Counties. Since 1957, most gold produced in Washington has come from Ferry County where the Knob Hill mine produces over $2 million yearly in gold.

Early statistics are not as complete as might be desired, and some early estimates of production appear to have been too high. Total gold and silver production in Washington through 1866 was estimated by J. Ross Browne (1869)[5/], United States Commissioner of Mining Statistics, to be $10,000,000. Estimates of early gold production from a few districts follow: $1,500,000 (placer and lode) from the Blewett district from 1870 through 1900, and $200,000 from 1901 through 1910; $500,000 from the Similkameen placers up to 1911; $1,800,000 from the Republic district through 1910; and about $7,000,000 from the Monte Cristo district through 1918.

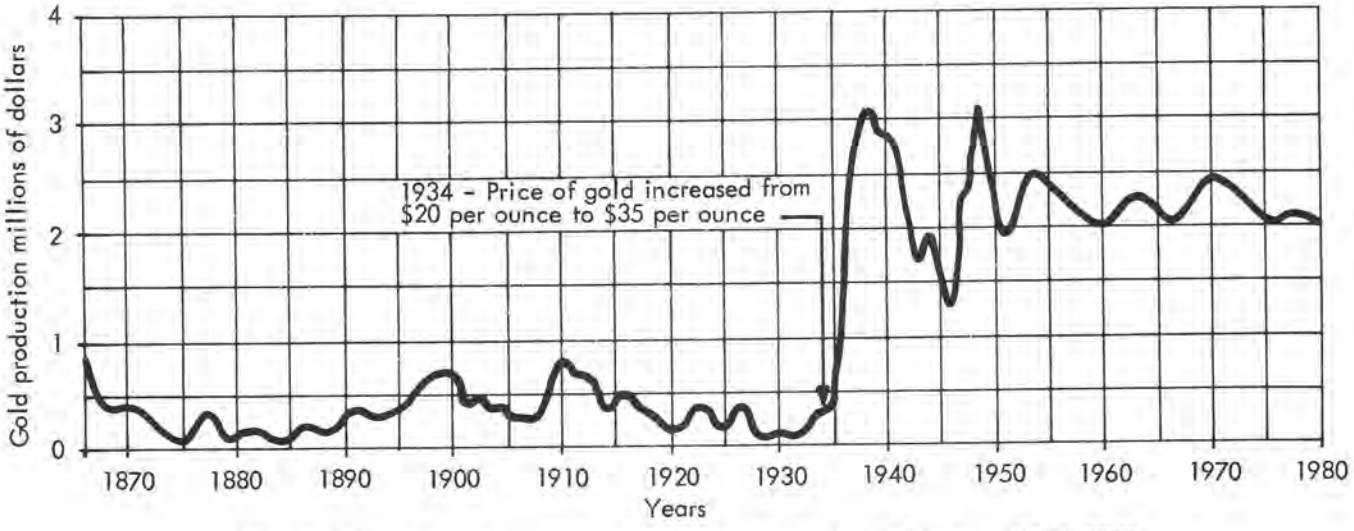

FIGURE 3.—Graph showing total gold production in Washington, 1866-1979.

5/ Browne, J. R., 1869, Resources of the Pacific slope: D. Appleton and Company, New York, 678 p.

U.S. GEOLOGICAL SURVEY
CURRENT ACTIVITIES IN WASHINGTON, 1979

MINERAL RESOURCES ACTIVITIES

Mineral resources of Spirit Lake quadrangle, R. P. Ashley. Plan to continue geologic mapping at 1:62,500 scale and geochemical sampling, and processing of samples and field data collected last year.

Lead and zinc resources of Western U.S., J. A. Briskey and H. T. Morris. Continue to appraise lead and zinc resources of Western U.S. by means of field, laboratory, and library studies, and by direct interaction with government agencies and mining industry; develop an understanding of genesis and occurrence of polymetallic deposits; develop and maintain active commodity files; conduct a detailed geologic study of a new, major lead-zinc deposit in eastern Nevada; and complete preliminary report on lead-zinc deposits of Basin and Range and Pacific States.

Indian lands resource studies, E. B. Eckel. Prepare administrative reports for 18 Indian Reservations in western Washington summarizing unpublished and published mineral resource information and make recommendations on further work to fully evaluate and develop the mineral resources on these lands. Reports will be prepared jointly by USGS and USBM personnel.

Geology of chromium, B. R. Lipin. Main objectives will be to complete evaluation of geology, petrology, exploration prospects, and resources of worldwide podiform chromite deposits; continue to examine small chromite deposits and ultramafic rocks in Precambrian terrane northwest and southeast of Stillwater Complex for disrupted slabs of Stillwater; continue to study large low-grade chromite deposits in four chosen study areas—North Carolina dunites, Pelliken deposit in central California, Twin Sisters dunite in Washington, and Red Mountain in Alaska; and begin study on mineralogical and chemical changes in chromite as function of pressure, temperatures, and bulk composition of host rock.

Glacier Peak Wilderness, J. G. Evans. Geologic mapping at scale 1:62,500 and geochemical sampling are proceeding concurrently. Geochemical studies will emphasize locating areas of anomalous concentrations of metals, chiefly gold and copper.

Salmo-Priest Wilderness, K. F. Miller. Geologic mapping and ground scintillometer surveys are being done, in addition to interpretation of geochemical and geophysical data, to evaluate the mineral resource potential of Salmo-Priest Wilderness area.

Wenaha Tucannon Wilderness area, D. A. Swanson, and Monte Cristo, Baring and Glacier Peak (L6-031 and 6-054), RARE II, R. W. Tabor. Work is just underway in these projects to determine the mineral resource potential of areas in Washington by geologic mapping, geochemical and geophysical surveys, and by compilation and interpretation of these data.

ENERGY RESOURCES ACTIVITIES

Geologic characteristics of deep-water reservoir rocks, Hugh McLean. Initial work of this new project will be literature review, synthesis, and preliminary interpretation of data; development of sampling program and data recording format; fieldwork on submarine fan sequences in northern California Late Cretaceous rocks; and reconnaissance field work and sampling several Tertiary deep-water sequences in California, Oregon and Washington.

Chemical analysis and geologic evaluation of coal in the Western United States, J. R. Hatch. Work will continue toward making complete chemical analyses on approximately 3,700 coal and coal-associated rock samples, from states west of the Mississippi River, readily available to the public, mainly through publications by state surveys and USGS reports. Plan to improve data base by collecting 200 to 300 coal samples from fields lacking modern, complete analyses and to continue research on changes in coal chemical composition with increasing rank and on distribution in coal of Zn, Cd, Pb, Ni, Co, and Mo.

Geochronology of uranium ores and their host rocks, K. R. Ludwig. Geochronology of uranium-rich opals from Thomas Range, Utah, and geochronology of uranium ores from Marysvale, Utah, southern Powder River Basin, Wyoming, and Midnite mine, Washington, will be determined. Also, plan to complete development and refinement of minicomputer-based statistical analysis of U-Pb isotope systematics.

Resource assessment, Oregon-Washington continental margin, P. D. Snavely, Jr. Landsea geologic transect under preparation of central Oregon (near latitude 44°44') will be revised as soon as 24-fold seismic records collected in 1977 are processed and interpreted, and subsequently added to profiles collected in 1976. Also, additional cross sections and isopach maps will be prepared to show tectonic and stratigraphic framework of central Oregon continental margin. Geology of four 15-minute quadrangles that comprise Cape Flattery area, northwesternmost Olympic Peninsula, Washington, will be extended onto Pacific shelf and into Strait of Juan de Fuca within quadrangle boundaries.

San Francisco Bay, F. H. Nichols. Mapping will begin on distribution of various organic matter components of surficial sediments in San Francisco Bay; e.g., carbon, nitrogen, ATP, chlorophyll, and perhaps total protein, to estimate quantitatively role of surficial sediments in fluxes of organic matter through estuary. Also, data from bottom samples collected in Puget Sound between 1963 and 1978 will be summarized in an interpretation of long-term changes in structure of continental-shelf depth benthic community.

Coastal sedimentary processes studies, R. E. Hunter. Included in plans this year are studies of estuaries (Willapa Bay, Washington, and Morro Bay, California), beaches, and inner continental shelves (Monterey Bay, Carmel Bay, and Estero Bay, California, and Bering Sea, Alaska), and coastal dunes (Oregon coast). Plan deployment of recently developed system to measure currents, waves, and profile changes in surf zones during storms and collection of cores 2 m or more in length from various coastal environments.

Marine organic geochemistry, K. A. Kvenvolden. Plan to complete work on correlation and chronology of estuarine deposits at Willapa Bay, by means of amino acid dating technique. Study of amino acids will be extended to other shell deposits, bone, teeth, and bulk marine and lake sediments.

ENVIRONMENTAL GEOLOGY ACTIVITIES

Northwest Olympic peninsula, P. D. Snavely, Jr. Summary report on tectonic framework of land-sea transect between latitudes 44 and 45 degrees north, Oregon continental margin, will be completed, as will a geologic map of Cape Flattery, Clallam Bay, Lake Pleasant, and Ozette Lake 15-minute quadrangles, Washington. Plan to continue interpretation of 24-fold seismic-refraction profiles of Oregon and Washington OCS and Dixon Entrance, U.S.-Canada.

Puget Sound urban studies, B. L. Foxworthy. Basic-data mapping of Port Townsend quadrangle at 1:100,000 will be completed, including bedrock and surficial maps, regional ground-water studies, slope maps, and maps showing depth to bedrock. Similar basic-data compilations will begin in adjacent Seattle 1:100,000-scale quadrangle. Studies such as coastal erosion-sedimentation processes, engineering properties of surficial materials, and landslide susceptibility will begin for Port Townsend quadrangle, including computer-composite mapping of quadrangle. Beginning in 1980 this project will be subdivided into a number of smaller projects to better describe the activities.

Wenatchee 2° quadrangle, R. W. Tabor. Compilation work on Snoqualmie Pass, Skykomish River, and Chelan 1:100,000-scale quadrangles will be completed, but mapping in quadrangles will continue. Other activities will include map and text preparation of Wenatchee quadrangle at 1:100,000 scale; petrographic studies and modal analyses; separation of minerals from bulk samples; dating of rocks by K/Ar and fission track methods; field mapping, stratigraphy, and tephrochronology in High Cascades and western Cascades; and preparation of reports.

Tectonic analysis, K. F. Fox, Jr. Objective for current year is to delineate major petrotectonic assemblages and tectonic features of the State of Washington on maps at appropriate scales.

Physical and geologic characteristics of catastrophic rockfall avalanches, R. D. Brown, Jr. Investigation this year will be of well-documented rock avalanche localities in California, Washington, Wyoming, Montana, Nevada, and Alaska. Includes reconnaissance geologic mapping of deposit and source area, and data collection and analysis. Summary report and demonstration map will illustrate how potentially hazardous areas can be recognized and delineated.

Tephrochronology of the Western Region, A. M. Sarna-Wojcicki. Correlation of late Cenozoic (late Pliocene and Quaternary) ashes and tuffs by neutron activation analyses of separated volcanic glass and petrography are being carried out in California (Huichica and Paso Robles Formations, Livermore Gravels, Nomlaki Tuff, Ventura basin, Lake Tecopa), Washington (Mount St. Helens), and western Nevada.

Sandpoint 2° quadrangle, F. K. Miller. Project will be involved in geologic mapping

and ground scintillometer surveys, and petrographic, modal, K/Ar work, and writing report on rocks in quadrangle.

Soil correlation and dating, Western Region, D. E. Marchand. Study field morphology of soils formed on dated sequences of Quaternary deposits in Merced River and Dry Creek terraces, California, Colorado Front Range, and Cowlitz River terraces, Washington, and obtain and interpret extensive quantitative laboratory data for these soils. Studies will determine how soils properties can be best used for correlation and semiquantitative dating of Quaternary deposits and land surfaces.

Seismo-tectonic analysis of Puget Sound province, H. D. Gower. Work is underway to prepare seismo-tectonic map of 1:100,000-scale Seattle sheet, tectonic map of eastern Strait of Juan de Fuca area, and seismic-response map of Seattle South and part of adjacent Duwamish Head 7½-minute quadrangles, and complete mapping bedrock geology of 1:100,000-scale Port Townsend sheet.

Okanogan 2° quadrangle, K. F. Fox, Jr. Through continued mapping of northeastern corner of quadrangle, project seeks to establish structural and stratigraphic relations between miogeosynclinal and eugeosynclinal provinces, in particular to develop evidence as to whether or not contact between them represents a suture zone between a miniplate (west) and craton (east). Fieldwork will also seek to establish the structural relations of possibly tectonically displaced rocks containing an early Triassic fauna.

Volcanic hazards, D. R. Crandell. Studies will continue on age, stratigraphy, mineralogy, origin and distribution of late Quaternary volcanic rocks and unconsolidated volcanic deposits at Mount St. Helens and Glacier Peak in Washington, Mount Hood, and Crater Lake in Oregon, Mount Shasta, Lassen Volcanic National Park, and other areas of recent volcanism in California and in Maui, Hawaii.

Tephra hazards from Cascade Range volcanoes, D. R. Mullineaux. Plans include study of stratigraphy and age of tephras from Mount Mazama, Oregon, and preparation of draft report on stratigraphy and age of tephras from Mount St. Helens, Washington. Preparation and revision of overview maps of volcanic hazards in Hawaii will be continued.

Re-examination of White River valley train, Mount Rainier, R. K. Fahnestock. A valley train developing on the surface of a 1964 debris avalanche in White River valley will be investigated to determine what changes have occurred during the past 15 years in this active, well-documented geologic environment.

Mesozoic and Cenozoic Pacific onshore biostratigraphy related to environmental geology, W. O. Addicott. Current investigations include biostratigraphic study of upper Miocene of western Washington; microfossil and megafossil biostratigraphy of Type Luisian Stage, California; and correlation of Pacific Coast Paleogene benthic foraminiferal stages with standard calcareous planktonic microfaunal zonations. In 1980, project will be broken into a number of individual projects to better describe activities.

GEOCHEMISTRY AND GEOPHYSICS ACTIVITIES

Genesis of basalt, T. L. Wright. Continue to formulate and quantify petrogenetic

models for ocean floor tholeiites, Kilauea volcano in Island of Hawaii, and Columbia River basalts in southeastern Washington and northeastern Oregon. Companion studies will emphasize similarities and differences in source material, depth of melting and differentiation, eruption rates and volumes, and inferred magma storage and conduit complexes.

Regional volcanology, R. L. Smith. Late Cenozoic volcano maps at scale of 1:1,000,000 for California-Nevada are in final compilation stage. Compilation of raw data and final maps of Oregon-Washington and Idaho-Montana will follow.

Columbia River basalt, D. A. Swanson. Geologic map of Columbia River basalt in Washington will be completed and open filed. Mapping of large area in northern Oregon and in Lewiston embayment, Idaho, will be continued.

Geoelectric sounding studies, W. D. Stanley. Activities will continue in order to estimate geothermal potential of Snake River Plain-Yellowstone region and Cascades region to determine nature of crustal structures. Plan to contract magnetotelluric study of 60 cites and conduct detailed work using USGA MT system in the Cascades.

Geophysics of young volcanic systems, D. L. Williams. Plan to complete reduction and interpretation of gravity and magnetics data from Coso Hot Springs, California; interpretation of magnetic data from Mount Hood, Oregon, geothermal project; and reports on results of geothermal surveys on Galapagos Spreading Center and Gulf of California. Large-scale research effort, including an extensive regional geophysical study, will begin in Cascade Mountains.

Geothermal regional studies, R. W. Simpson. Follow up recent paleomagnetic work which suggests that older Cascade volcanics are rotated approximately 30 degrees from their original orientation. Paleomagnetic samples collected from Oligocene and Eocene Cascade volcanics will be measured and demagnetized and tectonic interpretation of data performed.

Geochemical survey of coal-bearing rocks of the western coal regions, T. K. Hinkley. Plan to publish results of geochemical survey of Cretaceous rocks that are overburden to minable coal in Northern Great Plains coal regions, and also to study the connection between geochemistry and sedimentary depositional environments of the rocks. Chemical analysis of surficial material and plants from near Ford, Washington, and near Grants, New Mexico, will be completed and then followed by analysis of data.

Repeat magnetic surveys, J. D. Wood. Measurements will be made at approximately 40 stations in the following states: Alabama, Arizona, Arkansas, California, Colorado, Florida, Georgia, Idaho, Kansas, Mississippi, Montana, Nebraska, Nevada, New Mexico, North Carolina, North Dakota, Oklahoma, Oregon, South Carolina, South Dakota, Tennessee, Texas, Utah, and Washington. At each station, variations in components of Earth's magnetic field will be recorded and absolute measurements of component values will be made for determination of secular magnetic field changes.

Magnetic observatory and field data processing and analysis, R. G. Green. Magnetic observatory and field results will continue to be processed and made available

through World Data Center A (NOAA) for use in land surveying, space and upper atmosphere research, R&D testing laboratories, national defense, chart compilation, international exchanges, etc. Permanent observatories are located at Fredericksburg, Virginia; Boulder, Colorado; Newport, Washington; Honolulu, Hawaii; San Juan, Puerto Rico; Guam, Mariana Islands; Tucson, Arizona; Barrow, College, and Sitka, Alaska.

Geomagnetic systems and development, F. C. Frischknecht. Current year goals are to re-establish two geomagnetic observatories and to upgrade instrumentation at existing observatories to improve reliability of digital data acquisition. Site near Fresno, California, has been officially selected and a site selected in south Texas is pending approval.

Airborne operations, R. A. Mills. Major emphasis will be placed on airborne geophysical investigations consisting of spectral reflectance, thermal infrared, and radiation and magnetics in Washington; Powder River, Wyoming; Papago, Arizona; Nevada Test Site; and Southwestern states.

Remote sensing—geothermal, Kenneth Watson. Complete preparation of master image sets of all aircraft data for Mount Hood and Newberry Caldera, extend use of theoretical thermal model to more complex geological situations, develop computer methodology for registration of aircraft images acquired at different times in the diurnal cycle, and apply these techniques to the analysis of multispectral data acquired for the island of Hawaii. Techniques will be applied to digitally enhance Landsat images of part of Cascade Range, interpreting images for geologic linear features and statistically analyzing significant trend directions and spatial distribution patterns.

Gamma-ray spectrometry in uranium exploration, J. S. Duval. A significant part of the year will be spent on reduction and interpretation of aerial gamma-ray data obtained over seven small areas in Washington, Wyoming, California, Arizona, and Colorado. In a continuing effort to improve the use of color images of radiometric data, plan to produce new images of radiometric data in Texas and Wyoming. Some color manipulation techniques will be applied in attempt to remove some subjective aspects of interpretation of the color images.

Mineral exploration by gamma-ray spectrometry in crystalline rocks, J. A. Pitkin. Field data from areas in Washington, Idaho, Wyoming, and Montana are being computer-reduced to apparent concentrations, of K, U, and Th, and to ratios of these concentrations. These data will be examined to determine their value in detailing the surface expression of any uranium mineralization.

Uranium geophysics in frontier areas, J. W. Cady. Plan geophysical interpretation of gneiss terranes of northern Washington and British Columbia, with emphasis on uranium exploration; geophysical investigations of crustal structure of Sweetwater Uplift, Wyoming, with emphasis on origin of uranium deposits; and geophysical investigation and possible uranium potential of Ekiek Creek nepheline syenite pluton, western Alaska.

EARTHQUAKE STUDIES ACTIVITIES

Coastal tectonics of the Western United States, K. R. Lajoie. Reports on dating and maps showing marine terraces and their defor-

mation along California coast will be completed. Investigations will continue in areas of Santa Barbara-Ventura, Humboldt Bay, Point Conception, and San Diego County, California, and coastal Oregon and Washington.

NRC site seismicity, S. R. Brockman. Seismological reports of two sites (Skagit, Washington, and Arecibo, Puerto Rico) submitted to NRC by electrical power companies seeking permits to construct nuclear power facilities will be under review during the year. Reviews entail evaluation of quality, completeness, and validity of seismological data in PSAR (Preliminary Safety Analysis Reports). Field examinations and conferences will provide information supplementary to that in PSAR.

Outer Continental Shelf (OCS seismic risk, D. M. Perkins. Plan continued preparation of seismic hazard maps for five OCS regions: Alaska, Pacific Coast south of Cape Mendocino, Pacific Coast north of Cape Mendocino, North Atlantic, and South Atlantic. These maps will display peak acceleration and velocity for three probability levels—90 percent probability of not being exceeded in 10, 50, and 250 years.

Crustal strain, J. C. Savage. Resurvey all major California networks and networks of Washington and Nevada. Conduct analysis of surveys in Anza and Hollister areas, modify aircraft meteorological instruments, and analyze tilt data and San Francisco Bay data.

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The following USGS reports are now available for inspection in our division library:

Foxworthy, B. L., 1979, Summary appraisals for the Nation's ground-water resources—Pacific Northwest region: Professional Paper 813-S, 39 p.

Nelson, L. M., 1979, Sediment transport by the White River into Mud Mountain Reservoir, Washington, June 1974-June 1976: Water Resources Investigations 78-133, 26 p. Prepared in cooperation with the U.S. Army Corps of Engineers.

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Analysis of actual fault zones in bedrock; Proceedings of Conference VIII, National Earthquake Hazards Reduction Program, April 1-5, 1979, 595 p. USGS Open-File Report 79-1239.

Preliminary map of the Wenatchee 1:100,000 quadrangle, compiled and mapped by R. W. Tabor, R. B. Waitt, Jr., V. A. Frizzell, Jr., D. A. Swanson, and G. R. Byerly, map and 40-page text. USGS Open-File Map 77-531.

Preliminary geologic map of the Clear Lake NE. orthophotoquad, Skagit County, Washington, by J. T. Whetten, D. P. Dethier, and P. R. Carroll, 2 maps (scale 1:24,000) and 10-page text. USGS Open-File Report 79-1468.

Bedrock geologic map of the vent system for the Ice Harbor Member of the Saddle Mountains Basalt, Ice Harbor Dam-Basin City area, southeast Washington, by D. A. Swanson and R. T. Helz, 8 sheets, scale 1:24,000. USGS Open-File Report 79-292.

Limitations on genesis of uranium ores, Midnite mine, Washington—Based on lead-uranium ages, by J. T. Nash and K. R. Ludwig, 2 figs., 7 p. USGS Open-File Report 79-1178.

NORTHWEST MINING ASSOCIATION PLANS ANNUAL CONVENTION

John LaGrange, director of lands and government relations for Bear Creek Mining Co., has been appointed chairman of the Northwest Mining Association 85th annual convention to be held December 6-8 at the Davenport Hotel in Spokane.

The convention will focus on the role that minerals play in our economy. The twenty-one sessions scheduled will cover technical, financial, legal, and regulatory aspects of the mining industry. Technical sessions will include recent developments in drilling, geology, metallurgy, health and safety, and geophysics.

U.S. GEOLOGICAL SURVEY 7½-MINUTE TOPOGRAPHIC QUADRANGLES
(Maps received in the division library September 7, 1979)

Name	New edition	Photo revised	Latitude (indicates southeast corner)	Longitude (indicates southeast corner)	County
Eltopia	1979	--	46°22'30"	119°00'00"	Franklin
Joyce	1950	1979	48°07'30"	123°37'30"	Clallam
Mount Constitution	1978	--	48°37'30"	122°45'00"	San Juan
Priest Rapids	1948	1978	46°37'30"	119°52'30"	Grant, Yakima, Kittitas
Soda Lake	1954	1979	46°52'30"	119°07'30"	Grant, Adams
Twin Rivers	1950	1979	48°07'30"	123°52'30"	Clallam

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