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INTRODUCTION

This listing of reports and maps related to the geology, mineral resources, and other aspects of the Glacier Peak Wilderness and vicinity in the northern Cascade Mountains of Washington (fig. 1) was prepared as a background for 1979-82 field studies on the geology (Ford and others, 1983), regional geophysics (Flanigan and Sherrard, 1983), and geochemistry (Church and others, 1983) of the Wilderness by the U.S. Geological Survey. The studies were part of an investigation of the mineral-resource potential of the Wilderness by the Survey and the U.S. Bureau of Mines, results of which are given by Church and others (in press) and summarized by Church and Stotelmeyer (in press). Figure 2 shows areas of previous geologic mapping in and near the Wilderness. U.S. Geological Survey topographic quadrangle maps of the Wilderness are shown in figure 3. Reference citations include many on studies outside the Wilderness but on topics related to it. In general, selection of references for annotation was to provide main highlights of reports, if not given in titles, or to mention how studies of other areas relate to the geology, petrology, structure or other aspects of the Wilderness. Geologic maps of areas shown in figure 2 are generally accompanied by reports that provide many details on the geology of their areas.

ACKNOWLEDGMENTS

Reviews and addition of references by Peter Misch (University of Washington, Seattle, Wash.), Ronald B. Stotelmeyer (U.S. Bureau of Mines, Spokane, Wash.), Alan Robert Grant (Langley, Wash.), and Rowland W. Tabor and Steven M. Hodge (U.S. Geological Survey) significantly improved this bibliography on the geology of the Glacier Peak Wilderness.
Figure 1.--Location of the Glacier Peak Wilderness.
Figure 2.—Index to geologic mapping in and near the Glacier Peak Wilderness. Numbers inside mapped areas (dashed lines) refer to sources listed below. An additional area, the Marblemount quadrangle, mapped by Misch (1979), adjoins the western part of the index-map area on the north.

Figure 3--Index to 1:24,000 and 1:62,500-scale topographic map quadrangles of the Glacier Peak Wilderness and vicinity. Dotted lines show proposed additions to the Wilderness.

1. Illabot Peaks 1966
2. Snowking Mtn 1966
4. Cascade Pass 1963
5. Goode Mtn 1963
6. McGregor Mtn 1963
7. Prairie Mtn 1966
8. Huckleberry Mtn 1982
9. Downey Mtn 1963
10. Dome Peak 1963
11. Agnes Mtn 1963
12. Mt Lyall 1963
13. Stehekin 1969
14. White Chuck Mtn 1966
15. Pugh Mtn 1966
16. Glacier Peak 1950
17. Holden 1944
18. Lucerne 1944
20. Sloan Peak 1966
22. Bench Mark Mtn 1965
23. Poe Mtn 1965
24. Wenatchee Lake 1965
MISCELLANEOUS TOPICS


Notes: Contains maps showing locations of thesis geologic mapping.


Wilson, Marjorie, 1958, Bibliography (Glacier Peak Wilderness): The Mountaineer, v. 51, p. 68-72.

Notes: Contains extensive listings of mostly nontechnical reports, many dealing with early history of establishing the Glacier Peak Wilderness and controversial issues involved.
GLACIER PEAK VOLCANO, VOLCANISM, AND THERMAL SPRINGS

(See listings under "Geochronology and isotope studies" for references to those subjects)


Notes: Discusses compositions and occurrences, including Kennedy Hot Spring, of anomalous spring waters unusually rich in ammonia, boron, carbon dioxide, hydrogen sulfide, and hydrocarbons in more than 100 localities along the Pacific coast. Suggests that waters are products of low-grade metamorphism of marine sediments in many places tectonically emplaced beneath crystalline rocks.


Notes: Detailed study of postglacial volcanic eruptions and debris flows from Glacier Peak. Deposits from pyroclastic flows, debris flows and floods reach tens of kilometers down main valleys adjoining the volcano, including from one outburst flood as recent as 1975. The record shows frequent and varied activity during late-glacial and postglacial time. The two main periods of postglacial activity are dated as (1) 11,700-11,250 yrs ago, with deposits extending to Puget Sound; and (2) 5,500-5,100 yrs ago, with deposits extending far down the Sauk, Suiattle, and Skagit Valleys. Eruptions continued until about 200-300 yrs ago. The report also discusses potential volcanic hazards.


Notes: Brief summary of Glacier Peak volcanic activity during the past 14,000 yrs. During the past several thousand years Glacier Peak has been one of the most active Cascade volcanoes.


Notes: Contains listings with locations and temperatures for Sulphur Creek (99°F, 37°C), Gamma (140°F, 60°C) and Kennedy (100°F, 38°C) hot springs in the vicinity of Glacier Peak volcano. Copies of publication available free of charge from: NOAA/NGSDC Datamapping Group, Code D64, 325 Broadway, Boulder, CO 80303.


Notes: Evaluates use of TiO₂ content to correlate pyroclastic units from Cascade volcanoes, including Glacier Peak. TiO₂ content of volcanic ashes reflects chemical differences in parental magmas. The method might prove useful for distinguishing several major ash layers, but not all, from Mt. St. Helens, Glacier Peak, and Mt. Mazama.


Notes: Contains first description of Glacier Peak volcanic rocks and of pyroclastic deposits of upper Suiattle and White Chuck River valleys, and postglacial cinder cones south of Glacier Peak.


Notes: A radiocarbon age of about 12,000 yrs confirms geologic evidence that ash from a Glacier Peak eruption is substantially older than ash from Mt. Mazama (6,600 yrs).


Notes: Volcano alignments divide the Cascade volcanic chain (northern California to British Columbia) into six segments averaging 175 km long. Glacier Peak, classed as a "divergent volcano", lies on a segment boundary.


Notes: Report by native Indians (to pioneer naturalist, George Cribbs) that they observed Glacier Peak had "smoked" in the recent past.


Notes: Contains data for Gamma, Kennedy, and Sulphur Hot Springs in the vicinity of Glacier Peak. Gamma is the hottest (65°C, 149°F) thermal spring in Washington State, and temperatures for Kennedy are 35°C (95°F) and for Sulphur are 37°C (99°F). Note differences for Gamma and Kennedy given by Berry and others (1980). See listing under heading "Mineral deposits and resource studies" for additional comments.


Notes: Reviews chiefly Quaternary development and trends of magmatic evolution of Cascade volcanoes: a general discussion, with little specific mention of Glacier Peak. Concludes that there is little direct relation, other than a somewhat ambiguous spatial one, between Cascade volcanism and the Pacific margin subduction commonly proposed to be associated with it.


Notes: Account similar to that by McBirney (1978). Authors conclude that the ultimate cause of andesitic volcanism in the Cascade province is still unknown.


Notes: Early traverses across northern Cascades, with first description, as far as known to present author, of the volcano of Glacier Peak.


Notes: Detailed description of Glacier Peak volcano and the petrology and mineralogy of its lavas, most of which are dacitic in composition. Provides numerous chemical analyses of the eruptive rocks. Distinguishes them from older volcanic rocks of possible Miocene or Pliocene age on Gamma Ridge.


Notes: Describes ash-fill terraces of the lower Suiattle, White Chuck, and Sauk Rivers related to a major Recent eruption of Glacier Peak volcano. The terraces unconformably overlie the youngest Pleistocene deposits in the area. Ash carried by the White Chuck and Sauk Rivers was deposited in a large fan near Darrington that extended far westward down the valley of North Fork of the Stillaguamish River. The Sauk was later diverted to flow northward into the Skagit River. The Sauk Prairie surface was built as a smaller similar fan by the Suiattle River.


QUATERNARY GEOLOGY AND GLACIER STUDIES

(See also Glacier Peak volcano listings)


Notes: Bore-hole drilling of South Cascade Glacier for study of long-term trend in bore-hole water levels supports the idea of seasonal storage and release of liquid water.


1971, Gravimetric ice thickness determination, South Cascade Glacier, Washington (abs.): EOS, v. 52, no. 5, p. 434.


Meier, M. F., Tangborn, W. V., Mayo, L. R., and Post, A., 1971, Combined ice
and water balances of Gulkana and Wolverine Glaciers, Alaska, and South

Miller, C. D., 1967, Chronology of neoglacial moraines in the Dome Peak area,
north Cascade Range, Washington: Seattle, Washington University M.S.

_____1969, Chronology of Neoglacial moraines in the Dome Peak area, north
Cascade Range, Washington: Arctic and Alpine Research, v. 1, no. 1,
p. 49-66.

Nimick, D. A., 1977, Glacial geology of Lake Wenatchee and vicinity,

Post, Austin, Richardson, Don, Tangborn, W. V., and Rosselot, F. L., 1971,
Inventory of glaciers in the North Cascades, Washington: U.S. Geological

Notes: Listings include each glacier's location, drainage basin, area,
length, orientation, altitude and classification. The report contains
excellent photographs showing glaciers on the east side of Glacier Peak
(Chocolate and North Guardian Glaciers), on the eastern side of Dome Peak
(Chickamin Glacier), and south side of Glacier Peak (White Chuck
Glacier). The active Chocolate Glacier advanced about 400 m in 1950-1955
and showed little change since then. The North Guardian Glacier advanced
140 m between 1956 and 1968. The White Chuck Glacier retreated 430 m in
1949-67 and is now nearly stagnant.

Tangborn, W. V., 1962, Glaciological investigations on South Cascade
Glacier: The Mountaineer (Seattle), v. 55, no. 4, p. 24-32.

Tangborn, W. V., Krimmel, R. M., and Meier, M. F., 1975, A comparison of
glacier mass balance by glaciologic, hydrologic, and mapping methods,
South Cascade Glacier, Washington: International Association of
Hydrologic Sciences, Moscow General Assembly 1971, IAHS-AISH Pub. 104,
p. 185-196.

Tangborn, W. V., Mayo, L. R., Scully, D. R., and Krimmel, R. M., 1977,
Combined ice and water balances of Maclure Glacier, California, South
Cascade Glacier, Washington, and Wolverine and Gulkana Glaciers, Alaska,
20 p.

Notes: South Cascade Glacier had a 1967 winter balance of 3.28 m,
slightly above average. Above-normal summer ablation resulted in a final
annual balance of -0.58 m, slightly more negative than for the past
decade.

Watts, R. D., England, A. W., Vickers, R. S., and Meier, M. F., 1975, Radio-
echo sounding on South Cascade Glacier, Washington, using a long-
wavelength, mono-pulse source (abs.): Journal of Glaciology, v. 15, no.
73, p. 459-461.

Notes: Contains early (1895-1900) observations and inferences on the physiographic development of the northern Cascades in the vicinity of the Glacier Peak Wilderness. Recognizes five stages of physiographic development and two stages of deformation, associated with uplift, from Pliocene to Recent time.
(See figure 2 for location of geologic mapping near Glacier Peak Wilderness)


1961, Petrology and structure of the Stehekin-Twisp Pass area, northern Cascades, Washington: Seattle, Washington University Ph.D. thesis, 172 p. (Fig. 2)


Notes: Based on thesis studies (Adams, 1958 and 1961, above) of area lying immediately northeast of the Glacier Peak Wilderness, shows continuation of the Skagit Gneiss eastward from the Stehekin River valley and gradational changes into the Black Peak Quartz Diorite having typical igneous-appearing textures.


Notes: An early reconnaissance geological survey, in 1901-06, of 5-10-mile-wide area along the Canadian border, during which some of the major rock units of the northern Cascades were first recognized.


Notes: Contains geologic map of area about 4 mi. west of Glacier Peak Wilderness. (Fig. 2)


Notes: Contains geologic map of area lying about 2 miles west of recommended Wilderness addition. (Fig. 2)


Notes: Discusses two possible origins of the Chiwaukum graben, the northern apex of which lies near the southeast border of Glacier Peak Wilderness: (1) by a combination of strike-slip motion and clockwise
rotation; and (2) a preferred model, by development of a pull-apart basin, or "rhombochasm," related to right-lateral strike-slip movements on the Entiat fault, the east-bounding fault of the graben. Cessation of graben activity about 40 m.y. ago coincides with ending of western North American Laramide deformation and global reorganization of plate motions.

Huntting, M. T., Bennett, W. A. G., Livingston, V. S., and Moen, W. S., 1961, Geologic map of Washington (scale 1:500,000): Washington Department of Natural Resources; Division of Mines and Geology.


Notes: Contains geologic map of area lying about 5 miles west of recommended Wilderness addition. (Fig. 2)


Notes: Discusses origin, by metamorphism of Hozameen Group rocks, of the Custer Gneiss and its correlation with the Skagit Gneiss of Misch (1966), a unit present in the eastern part of Glacier Peak Wilderness. Area contains gneissic tonalite bodies (Spuzzum intrusions) very similar in age and lithology to units (Tenpeak and Sloan Creek plutons) in the Wilderness.


Notes: Contains first reconnaissance geologic sketch map, based on 1949-52 mapping, of the northern Cascades from the Cascade and Stehekin River valleys to the Canadian border; and first usage of names of units (including "Skagit gneisses, Marblemount quartz diorite, and Shuksan greenschist") that extend southward into the vicinity of the Glacier Peak Wilderness.


Notes: Contains updated version of above-mentioned (1952) geologic map (scale, 1 in. = approx. 9 mi.) of the northern Cascades and shows the following major map units named by Misch that project southward or southeastward into the area of the Glacier Peak Wilderness: from west to east, Shuksan Greenschist (west of the Straight Creek fault, others east)
Cascade River Schist, Marblemount Meta-Quartz Diorite, Eldorado Orthogneiss, and Skagit Gneiss. The report also names and discusses structural relations of the Magic Mountain Gneiss—a diaphthoritic gneiss unit thrust eastward from a root zone in the belt of Marblemount Meta-Quartz Diorite in the northern part of the Wilderness area. This is the most complete available report describing the geologic history, including metamorphism, of many of the rock units of the Wilderness. Of particular interest regarding age of faulting on the Straight Creek fault (west edge of the Wilderness), Misch's mapping shows the northward extension of the fault to be truncated by the Chilliwack Composite Batholith of late Eocene to early Oligocene age. (Fig. 2)

1971, Metamorphic facies types in north Cascades (abs.): Geological Society of Canada, Cordilleran Section, Symposium on Metamorphism in Canadian Cordillera, Program, p. 22-23.


Notes: Recognizes very large amount of dextral (right lateral) slip on faults, including the Straight Creek fault.

1979, Geologic map of the Marblemount quadrangle, Washington (1:48,000 scale): Washington Division of Geology and Earth Resources Geologic Map GM-23.

Notes: Area lies immediately north of that shown in Plate 1. The map shows continuation of schist and gneiss units northwestward from the Glacier Peak Wilderness vicinity to the Skagit Valley region, and shows continuation of the Straight Creek fault northward to where it is cut by granitoid rocks of the late Eocene to early Oligocene Chilliwack Composite Batholith.


Notes: Early traverses across northern Cascades, including White and Sauk Rivers between Lake Wenatchee and Darrington. Contains colored geologic sketch map of routes. First description, as far as known to present author, of the volcano and volcanic rocks of Glacier Peak.


Notes: Map area extends southward from Canadian border and includes most of area of Glacier Peak Wilderness.


Notes: The Washington Cascades comprise two overlapping Cenozoic magmatic arcs, one (Challis arc) of Eocene age and the other (Cascade arc) beginning in the early Oligocene. Development of the Chiwaukum graben (Willis, 1953; Gresens, 1982) near the southeast border of the Wilderness marks major Eocene intra-arc extension accompanying shift of activity from the Challis to Cascade arc system.


Notes: Describes major, sedimentary-rock-filled graben extending northwestward from Wenatchee to just southeast of the Glacier Peak Wilderness. Bounding faults appear to extend northwestward into Wilderness area. See also Gresen's (1982) report on graben origin.
BEDROCK GEOLOGY AND PETROLOGY OF THE WILDERNESS AREA
(See figure 2 for location of geologic mapping)


Notes: Provides description, petrology, and geochemistry of a major pre-Tertiary unit (Skagit Gneiss of Misch, 1966) north of the Glacier Peak Wilderness that is directly traceable southeastward into the Wilderness area in the vicinity of Stehekin River and the upper part of Lake Chelan.

Boak, J. L., 1977, Geology and petrology of the Mount Chaval area, north Cascades, Washington: Seattle, Washington University M.S. thesis, 87 p. (Fig. 2)


Notes: North Cascades' blueschists described probably correlate with similar rocks west of the Straight Creek fault in and near westernmost part of Glacier Peak Wilderness.


1955, Petrology and reconnaissance geology of the Snowking area, northern Cascades, Washington: Seattle, Washington University Ph.D. thesis, 321 p. (Fig. 2)


Cater, F. W., and Crowder, D. F., 1967, Geologic map of the Holden quadrangle, Snohomish and Chelan Counties, Washington (scale 1:62,500): U.S. Geological Survey Geologic Quadrangle Map GQ-646. (Fig. 2)
Cater, F. W., and Wright, T. L., 1967, Geologic map of the Lucerne quadrangle, Chelan County, Washington (scale 1:62,500): U.S. Geological Survey Geologic Quadrangle Map GQ-647. (Fig. 2)

Crowder, D. F., 1959, Granitization, migmatization, and fusion in the northern Entiat Mountains, Washington: Geological Society of America Bulletin, v. 70, no. 7, p. 827-877. (Fig. 2)


Dotter, J. A., 1977, Prairie Mountain Lakes area, southeast Skagit County, Washington--structural geology, sedimentary petrography, and magnetics: Corvallis, Oregon State University M.S. thesis, 105 p. (Fig. 2)


_____1959, Geology and petrology of the Glacier Peak quadrangle, northern Cascades, Washington: Seattle, Washington University Ph.D. thesis, 337 p. (Fig. 2)


Notes: Area lies south of area of figure 2. Discusses petrology of a major schist unit that extends northward into Wilderness area.


--- 1966, Bedrock geology of the Dome Peak area, Chelan, Skagit and Snohomish Counties, northern Cascades, Washington: Seattle, Washington University Ph.D. thesis, 270 p. (Fig. 2)

Heath, M. T., 1971, Bedrock geology of the Monte Cristo area, northern Cascades, Washington: Seattle, Washington University Ph.D. thesis, 164 p. (Fig. 2)


Libby, W. G., 1964, Petrography and structure of the crystalline rocks between Agnes Creek and the Methow Valley, Washington: Seattle, Washington University Ph.D. thesis, 133 p. (Fig. 2)

Milnes, P. T., 1976, Structural geology and metamorphic petrology of the Illabot Peaks area, Skagit County, Washington: Corvallis, Oregon State University M.S. thesis, 118 p. (Fig. 2)


Notes: Discusses petrology of blueschists and greenschists of Misch's Shuksan Greenschist, a unit that extends southward to west margin of the Glacier Peak Wilderness, on the west side of the Straight Creek fault.

Notes: Detailed petrologic study of regionally developed migmatitic gneisses of the Skagit Gneiss of Misch (1966) in its type area: a unit that extends southward and makes up the eastern part of the Glacier Peak Wilderness. The unit also contains some orthogneiss members.


Notes: Provides details on amphibole zoning history in the Shuksan Greenschist.


Notes: Geologic guide and road log along State Highway 20 from about 5 miles west of Marblemount to about 4 miles north of Washington Pass. Section along Skagit River gorge shows exposure of units (Darrington Phyllite, Shuksan Greenschist, Marblemount Meta-Quartz Diorite, Cascade River Schist, and Skagit Gneiss, as defined by Misch) correlative with units in and near the Glacier Peak Wilderness. Guide describes rock units and their structural setting and contains a geologic sketch map of the upper Skagit region, including northernmost part of Wilderness area.


Notes: Metaperidotite pods of possibly similar origin are scattered widely in a mainly central belt of the Glacier Peak Wilderness.


Notes: Petrologic and analytical study by electron microprobe of amphiboles from units (Cascade River Schist, Skagit Gneiss) near and north of Cascade River that extend southeastward into the Glacier Peak Wilderness.

Morrison, M. E., 1954, Petrology of the Phelps Ridge-Red Mountain area, Chelan County, Washington: Seattle, Washington University M.S. thesis, 95 p. (Fig. 2)


Rosenberg, E. A., 1961, Geology and petrology of the northern Wenatchee Ridge area, northern Cascades, Washington: Seattle, Washington University M.S. thesis, 109 p. (Fig. 2)


_____1961, The crystalline geology of the area south of Cascade Pass, northern Cascade Mountains, Washington: Seattle, Washington University Ph.D. thesis, 205 p. (Fig. 2)


Tabor, R. W., Frizzell, V. A., Jr., Booth, D. B., Whetten, J. T., Waitt, R. B., Jr., and Zartman, R. E., 1982, Preliminary geologic map of the Skykomish River 1:100,000 quadrangle, Washington: U.S. Geological Survey Open-File Map OF 82-747, 31 p. (Fig. 2)


Tabor, R. W., Frizzell, V. A., Jr., Yeats, R. S., and Whetten, J. T., 1982, Geologic map of the Eagle Rock and Glacier Peak Roadless Areas, Snohomish and King Counties (scale 1:100,000): U.S. Geological Survey Miscellaneous Field Investigations Map MF-1380-A. (Fig. 2)

Vance, J. A., 1957, The geology of the Sauk River area in the northern Cascades of Washington: Seattle, Washington University Ph.D. thesis, 312 p. (Fig. 2)

Notes: Mentions that Straight Creek fault near west border of Glacier Peak Wilderness is a major dextral strike-slip fault largely predating Eocene age, with late dip-slip movements affecting rocks as young as mid-Eocene.


Notes: In part, describes Middle to Late Jurassic ophiolite (Stillaguamish) and associated Late Jurassic units (Darrington Phyllite and Shuksan Greenschist members of the Easton Schist) lying west of the Straight Creek fault in and near westernmost part of the Glacier Peak Wilderness.

Van Diver, B. B., 1964, Petrology of the metamorphic rocks, Wenatchee Ridge area, central northern Cascades, Washington: Seattle, Washington University Ph.D. thesis, 140 p. (Fig. 2)


Notes: Petrologic study, in an area north of the Skagit Valley, of a major rock unit that extends southeastward into eastern part of the Glacier Peak Wilderness.
GEOCHRONOLOGY AND ISOTOPE STUDIES


Notes: New K-Ar dates of 219 ± 9 m.y. and 221 ± 9 m.y. confirm earlier dating that some blueschists are pre-Jurassic. Others show younger ages suggesting Late Jurassic-Early Cretaceous blueschist metamorphism. Concludes that the North Cascades are a mid-Mesozoic accretionary wedge of tectonic terrane fragments, including Triassic and Jurassic-Cretaceous blueschists.


Notes: Restudy of Cascade volcanic rocks of Church and Tilton (1973), including samples from Glacier Peak. From lead isotope data, the author proposes a model of crustal contamination and (or) assimilation at the crust-mantle interface in the origin of magmas of Cascade volcanoes.


Notes: Contains lead and strontium isotopic and other chemical data from Cascade volcanoes, including Glacier Peak, for which isotopic composition of strontium is found to be remarkably constant ($^{87}$Sr/$^{86}$Sr averages 0.7037). Data are best explained by multistage partial melting of mantle material rather than by any major results of crustal processes such as melting of graywacke or contamination.


Notes: From $^{87}\text{Sr}/^{86}\text{Sr}$ analyses of three Glacier Peak dacite samples (average, 0.7037) suggests derivation of lavas from upper mantle. Percent of incorporated sedimentary material, if any, must have been minor (less than 20 percent) in order to satisfy isotopic data.


Notes: Based on radiometric age determinations on zircons, gneisses and schists of supracrustal origin comprise at least two age groups. In the area of the Glacier Peak Wilderness, the older includes Swakane Gneiss and possibly Skagit Gneiss that may have been deposited 2,000 m.y. ago or, alternatively, may be as young as early Paleozoic but derived from a 2,000-m.y.-old source terrane. The younger group are gneissic rocks of the Holden area and the Cascade River Schist that were deposited in Late Paleozoic or early Mesozoic time. Other Glacier Peak Wilderness rock units dated include Marblemount Meta-Quartz Diorite and Dumbell Mountain plutons (220 m.y.) and Eldorado Orthogneiss (91 m.y.). Ages of pegmatites, synkinematic intrusions, and metamorphic minerals indicate major metamorphic events of about 415 m.y. and 60-90 m.y. age.


Notes: Reports that $^{87}\text{Sr}/^{86}\text{Sr}$ ratios for Cloudy Pass and Sitkum Creek plutons are very uniform (0.7049-0.7052) and higher than Glacier Peak lava ratios (0.7032-0.7037), indicating possible magma contamination prior to intrusion. Data are compatible with derivation of magma and andesitic lava largely from upper mantle or lower crust sources.


Notes: Contains summary of all radiometric ages of units in quadrangle, including those in parts of Glacier Peak Wilderness (Duncan Hill and Tenpeak plutons and Swakane Biotite Gneiss, and a correlative--the Entiat pluton--of the Seven-Fingered Jack plutons).


Notes: Isotopic composition of lead is used to test possible genetic relationship between andesitic or dacitic lavas, including of Glacier Peak, and neighboring granodioritic plutons. Preliminary data for Glacier Peak (and Mt. St. Helens) show substantial differences in lead isotopic compositions between volcanic and plutonic rocks, suggesting either contamination of the lead or different sources for the two kinds of rocks.


Notes: The history of the Holden Mine begins with James Henry Holden's 1893 search of the Lake Chelan area for minerals and his 1896 discovery of the deposit in the Railroad Creek valley and subsequent staking of claims. The report covers the 42-year period of promotion and development until shipment of the first concentrate in 1938, precursory to the Holden Mine becoming the largest non-ferrous mine in Washington State, with production of 212,000,000 lbs copper, 40,000,000 lbs zinc, 2,000,000 oz silver, and 600,000 oz gold extracted from 10,000,000 tons of ore during 19 years (1938-57) of mining. Gross metal value was $66 million.


Notes: Dates of 6.25, 9.9, 16.2, 17.3, and 24.0 m.y. are given for deposits in the Cascade volcanic arc, western Washington, not including any from Glacier Peak Wilderness. Authors suggest that porphyry-type mineralization is constantly associated with volcanic-arc igneous activity and may be taking place now in the vicinity of magma chambers of active Cascade volcanoes.


Notes: Describes, among others, pumice and pumicite deposits in Chiwawa and Entiat Valleys that are related to Glacier Peak eruptions. Some have been worked for commercial use as light-weight aggregate in concrete blocks.


Crafts, E. C. (Chairman, North Cascades Study Team), 1965, The north Cascades, a report to the Secretary of the Interior and the Secretary of Agriculture: U.S. Departments of Interior and Agriculture, 190 p.

Notes: General summary of natural resources including timber, recreation, fish and wildlife, minerals, water and power, and range use, with recommendations for Wilderness and National Park designations.


Notes: Describes deposits of limestone (marble) on Circle Peak, the ridge between Circle Peak and Meadow Mountain, and the northern hillslope below Lime Mountain. Chemical analyses are provided for the Circle Peak and Lime Mountain deposits. No development on any, but 14 claims staked on the Lime Mountain deposit.


Notes: Provides detailed account of the geology, petrology, and structure of the area of the Holden mine. Describes mineralogy of the ore and gangue material, zoning of the deposit, wall-rock alteration, structural control of ore deposition, and gives a genetic interpretation that relates metallization to high-rank regional synkinematic metamorphism.


Notes: Outlines general geology and structure of the northern Cascades and describes granitic intrusive activity, alteration, and structural features associated with mainly copper mineralization. Many of the important mining districts seem to lie on transverse structural belts, or "lineaments," two of which in the vicinity of the Glacier Peak Wilderness are the "Buckindy belt" (Darrington-Mt. Buckindy-Cascade Pass-Thunder Creek mining district) and the "Glacier Peak belt" (Sultan Basin-Monte Cristo-Miners Ridge-Holden-Meadow Creek mining district on east side of Lake Chelan). Describes the geology and ore deposits of Miners Ridge and Mt. Buckindy areas.


Notes: A good early history of mining in the vicinity of Glacier Peak Wilderness.

Notes: Discusses Glacier Peak (Miners Ridge) porphyry copper deposit and its alteration zones, and points out that the best grade of hypogene ore occurs near the boundary of the potassic and phyllic zones. Points out that "That portion of the Cascade volcanic arc in which the porphyry copper deposits are found is distinct from many other arcs because it is not underlain by a Benioff zone nor is it fronted by a recognizable trench."


Notes: Describes molybdenite-bearing deposit at Crown Point near the head of Railroad Creek. Unusually well-formed crystals of the mineral, up to 5 in. in diameter, are scattered irregularly in a white quartz vein 3 in. to 3 ft thick. Aurelia Crown Co. reports that molybdenite masses of 5-11 lb weight were mined. Development work consisted of two short tunnels, 200 and 80 ft long. Production of 10-12 tons of high-grade ore occurred in 1901 and 1902.


Notes: Lists and briefly describes lode and placer gold prospects and mines in vicinity of Glacier Peak Wilderness. At Holden, mill feed averaged 0.09 oz gold and 0.344 oz silver in 1940, and 0.44 oz gold and 0.213 oz silver in 1951. 1951 metals production included 24,205 oz gold and 117,437 oz silver (along with 4,015 tons copper and 1,958 tons zinc) from 550,530 tons of ore.


Notes: Contains chemical data for the three thermal springs in the Glacier Peak Wilderness and vicinity: Gamma, Kennedy, and Sulphur Hot Springs. Of interest for evaluating possible geothermal resources, gives calculated temperatures of aquifers based on a variety of chemical geothermometers: Gamma, 178-216°C (352-421°F); Kennedy, 145-189°C (293-372°F); and Sulphur, 110-117°C (230-243°F). None of the springs are associated with siliceous sinter, a general indicator of high subsurface temperature.


Notes: Discussions of environmental issues concerning three wilderness areas. Chapter 1 deals with possible exploitation of copper deposit on Miners Ridge, Glacier Peak Wilderness.


Notes: Silver prospects and deposits in or near Glacier Peak Wilderness are chiefly Holden (Chelan district), Royal (Chiwawa district), and, of lesser importance, 10 properties near Cascade River and Cascade Pass (Cascade-Thunder Creek district). Holden was one of two leading producers of gold and silver in Washington State in the 1950's. From 1938 to 1958 Holden produced a total of 2,000,000 oz silver and 600,000 oz gold, along with 106,000 tons copper and 20,000 tons zinc. Combined production was $66.5 million, making it one of Washington's richest metal deposits. Holden closed in 1961. The Royal copper mine (Red Mountain) opened in 1935 and produced 7,694 oz silver in 1936 and 4,282 oz in 1937.


Notes: From 1938 through 1957 the Holden mine produced a total of 10.6 million tons of copper-gold-silver-zinc ore valued at $65.5 million.


Notes: Describes geologic setting of mines and prospects in the vicinity of Trinity. Chief development work by the Royal Development Company was the driving of a 10,957 ft adit at the Red Mountain Mine to intersect an ore body (St. Francis) discovered earlier. The chief ore mineral is chalcopyrite. Mill production of 10,000 tons of ore in 1936 and 5,825 tons in 1937 is reported. The mine was closed March 1, 1937. In the ore zone of the Trinity breccia, chalcopyrite is associated with pyrrhotite, sphalerite, pyrite, arsenopyrite, galena, scheelite, and very small amounts of molybdenite.

Notes: Provides description and discussion of regulations and laws related to prospecting, claim staking, patenting, leasing, rights-of-way, environmental safeguards, and other matters involved in metallic and nonmetallic resource development on private, State, and Federal lands, including wilderness lands. The 1964 Wilderness Act provides that wilderness areas designated by Congress in the act, such as the Glacier Peak Wilderness, or by later legislation, shall be open to entry under the location laws and the mineral leasing laws until December 31, 1983, but not thereafter.


Notes: Discusses molybdenite localities at Crown Point, near the head of Railroad Creek, and the Glacier Peak copper property on Miners Ridge. Production at Crown Point mine was minor, including shipment in 1903 of a "large crystal or cluster of molybdenite crystals" weighing 300 pounds. The mine produced some of the world's finest molybdenite crystals, but it is considered unlikely that many more will be found or that the mine will be a commercial source of molybdenum. For the Miners Ridge deposit it is estimated that there are several million tons of ore containing about 1 percent copper and 0.1 percent molybdenum, with average values of 0.0022 oz per ton gold and 0.283 oz per ton silver.

Added note: The Miners Ridge data precede the extensive explorations in the 1950's and 1960's by Bear Creek Mining Company. See reports by Grant (1982) and Stotelmeyer and others (1981).


Notes: Description of geology and ore deposit at Trinity.


Notes: Metals of porphyry deposits from calc-alkaline magmas in the northern Cascades were not derived from subducted oceanic crust, but were scavenged from upper crust. Deposits younger than 22 m.y. are of non-subduction origin. Shows location of Glacier Peak and Trinity deposits on Bouguer gravity map of U.S. that suggests a Basin- and Range-type structural setting.

Notes: Provides interesting early account of discovery and development of the Holden ore deposit. Gives detailed account, with numerous diagrams, of methods for sampling, drilling, blasting, ventilating, ore hauling, and other operations.


Notes: Brief descriptions of occurrences (in vol. 1, text) with maps showing location (vol. 2) of nonmetallic minerals of the state, including those of kyanite, asbestiform materials, beryl, garnet, quartz crystal, graphite, limestone, mica, pumice and pumicite, sand and gravel, and talc and soapstone in and near the Glacier Peak Wilderness.


Notes: Describes narrow veins of mostly galena and pyrite with minor chalcopyrite in a prospect about 4 miles northwest of Cascade Pass. Most veins show values in lead, zinc, and silver and some also in gold.