IDAHO BUREAU OF MINES AND GEOLOGY . . . R. R. REID, *Director*
STATE OF IDAHO . . . DON SAMUELSON, *Governor*

Evaluation of Minerals and Mineral Potential of the Salmon River Drainage Basin in Idaho

C. N. Savage

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EVALUATION OF MINERALS AND MINERAL POTENTIAL OF THE SALMON RIVER DRAINAGE BASIN IN IDAHO

Prepared as part of an Idaho Wild and Scenic Rivers Study
for the
Water Resources Research Institute
University of Idaho
Moscow, Idaho

by

C. N. Savage
Senior Geologist

IDAHO BUREAU OF MINES AND GEOLOGY
MOSCOW, IDAHO

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PREFACE

Public Law 90-542 provides for a National Wild and Scenic Rivers System. The purpose of the law is to protect for the enjoyment and benefit of the people of the United States certain rivers which in conjunction with lands bordering the waters possess outstanding scenic, recreational, fish and wildlife, geologic land forms, and other such desirable features.

Two categories of rivers are specified by the Act. "Instant Rivers" are authorized for immediate inclusion in the National Wild and Scenic Rivers System. The Middle Fork of the Salmon River and The Middle Fork of the Clearwater River are the two rivers located in Idaho included in this category. The second category "Study Rivers" includes rivers which are to be studied for possible inclusion in the Wild and Scenic Rivers System. The main stem of the Salmon, and the Bruneau, St. Joe, Priest, and Moyie Rivers are the five Idaho rivers placed in the second category.

The Act specifies three classes of wild rivers: wild, scenic, and recreational. A "wild river" refers to a river free from impoundments, with non-polluted water and essentially primitive shorelines. A "Scenic river" is free from impoundments with shorelines and watersheds still essentially primitive and undeveloped but which is accessible in places by roads. A "recreational river" is readily accessible by roads and railroads, may have development along the shorelines and may have undergone some impoundment or diversion in the past. Public Law 90-542 specifies a ten-year time limit on classification studies after which recommendations on the disposition of study rivers are to be made to the Congress.

There is little valid criteria available for evaluating rivers for wild or scenic classification. For this reason the Water Resources Research Institute of the University of Idaho has organized a Scenic Rivers Study Unit for the purpose of developing methodology to evaluate wild rivers. The goal of this study is to establish criteria which can be used to identify and determine the economic, aesthetic, and scenic and other values of wild rivers.

The Salmon River in Idaho has been selected as the study river. This river originates in central Idaho and flows about 410 miles generally through precipitous undeveloped canyon country and discharges into the Snake River 49 miles above Lewiston. The average annual discharge of the Salmon River at its mouth is about 8,000,000 acre feet.

The portion of the Salmon from its mouth to the town of North Fork has been designated as a "study river". However, for the methodology study the entire Salmon drainage basin will be studied. There are two reasons for this. First, because any economic development-impoundments, diversions, mining, paper, industry, logging, etc.,--would affect the main stem wild river section. Second, because it is more convenient and is more meaningful to include all the activities in a river basin. The hydrologic basin unit (the Salmon drainage basin) was used for some portions of the Idaho Economic Base Study for Water Requirements (1) and in the Idaho Water Resources Inventory (2).

The purpose of the methodology study is to develop information pertinent to decision-making and planning as it pertains to the selection, use, and management of wild and scenic rivers systems. The methodology study has four broad objectives:

1. Inventory present quantities and qualities of natural resources in the river basin area, and estimate future quantities and qualities of these resources, establishing their values in both situations.
2. Identify, describe, and quantify, where possible, benefits from scenic beauty, personal enrichment, and other aesthetic experiences derived from the river.
3. Develop a series of models to evaluate or determine the resource use pattern consistent with a wild rivers system, and the resource use pattern which would exist under various levels of development in the river basin area.
4. Present recommendations for alternative uses of resources for the entire river basin area, recommend restrictions if classification is applicable, and describe the economic and social ramifications of each of the alternatives considered.

The plan for the methodology study is to divide the research work into a series of subprojects, each covering an important economic activity related to the river. These subprojects consist of fourteen resource and service functions:

1. Forest and range resources
2. Minerals
3. Outdoor recreation
4. Commercial fisheries
5. Irrigation
6. Water for municipal and industrial use
7. Water quality control
8. Hydroelectric power
9. Flood control
10. Navigation
11. Transportation and access
12. Anthropology
13. History
14. Agriculture

Each of these fourteen resource and service functions will be examined on an individual basis at their present level of development and at projected levels of development.

Once the above subprojects have been completed, a series of economic models will be developed which will make relatively accurate estimates of costs and benefits for each of the resources included in the subprojects. This will permit comparisons of potential costs and benefits of alternative resource uses. The technique will be modified and extended to the years 2000 and 2020, consistent with the time projections of the Columbia-North Pacific Region Comprehensive Framework Study.

It is at this stage of the analysis that one purpose of the methodology study will be realized. This purpose is to make an economic evaluation of the Salmon River in its natural state. The evaluation will be made consistent with the present levels of resource use indicated by the subprojects. This evaluation at the current level of resource use will then be compared with simulated levels of development on the river, and within the river basin area. At this stage of the analysis

it will be possible to include in the study certain general considerations such as population, and economic growth, and the demand for recreation, electricity, timber, minerals and other resources in the area in the future.

Two general evaluations of the river resource base can then be made. First, the current and projected levels of economic activity based on the status quo. Second, a determination of the benefits foregone, (if this turns out to be the case) as a result of maintaining the river in its natural free-flowing state. Efforts throughout the study will be to try to identify and quantify the aesthetic and personal enhancement values for which the expressed national desire is to protect and conserve.

EVALUATION OF MINERALS AND MINERAL POTENTIAL OF THE SALMON RIVER DRAINAGE BASIN IN IDAHO

by
C. N. Savage

ABSTRACT

This report is part of a larger project: Development of Methodology for Evaluation of Wild and Scenic Rivers in Idaho, being directed by the University of Idaho, Water Resources Research Institute. For this minerals evaluation approach, the main Salmon River from the town of North Fork downstream to the mouth of the river has been chosen, because this stretch of river is being considered for wild and scenic classification.

A Wild and Scenic River designation for the main Salmon would set aside, under stringent control, a 320 acre-river mile corridor parallel to the river. A slightly wider corridor would be established for esthetic reasons as a zone to control sight-sound disturbances.

Anticipating the impact of a Wild and Scenic River classification along the Salmon in connection with mining anywhere in the entire watershed, this study deals with the entire basin and not just the proposed corridor. Wildlife and nature groups have already threatened to stop a major molybdenum development in the White Cloud Peaks portion of the Salmon watershed. If backed by a Wild and Scenic River designation for the main Salmon, any mining activity anywhere in the system will no doubt be opposed. Because this is a potentially valuable metallogenic region, the present and future of mining in the basin and the potential mineral values in the basin need to be considered.

Within the Salmon watershed, 16.5 percent of the entire State, are important and potentially important mineralized rocks. This area of concern contains reserves of antimony, tungsten, gold, silver, zinc, lead, molybdenum, mercury, iron, thorium and uranium, among the metallic minerals. Some nonmetallic minerals are also present. Nearly all these minerals are and will be needed by many industries in order to maintain American standards of living and a balance of mineral resource power among nations.

It is not possible to establish any formula for total evaluation of mineralized areas. Mineral exploration is difficult and mineral quantity, grade and dollar value are virtually impossible to assess accurately. Where mining has been carried on in the past, tunnels have caved and the mines are inaccessible. Written records of both reserves and past production have been lost. Furthermore, data on current mining operations and exploration are confidential company records, by reason of the competitive nature of industry. One can only make mineral evaluations using past and current best available knowledge and including knowledge of mineral potential based upon the geology of an area.

All available mineral data that could be found, related to the Salmon River region, are assembled in the body of this report. It is impossible to make any

estimates on possible mineralized areas that have yet to be discovered. However, recently (May 1970), during a conference between members of the U. S. Bureau of Mines, Idaho Bureau of Mines and Geology and University of Idaho College of Mines staff, the subject of mineralization in the Salmon River watershed was reviewed. Based upon the experience and knowledge of those present (representing the disciplines of mining, metallurgy and geology), it was unanimously agreed that the Salmon River watershed has known and potentially valuable mineral deposits. The growing tendency to ban mining in the area should be given careful attention.

Development of minerals need not be in conflict with the larger concept of good environmental practice. There need be no objection to the principle of a Wild and Scenic River classification for the main Salmon River. However, there should be concern that we safeguard the mining industry, while preserving large tracts of land in its natural state. The right to properly develop minerals or explore for minerals in the multiple use concept for Public Lands must be protected. The general public must also be presented with all the facts when any potentially valuable mineral deposit is discovered and development is necessary for our welfare and economy. Good development practices are and can be accomplished legally. If revised laws are needed, then they should not be so stringent as to completely discourage mining.

Serious contemplation will reveal that the mining industry may be compared to the bottom of an inverted pyramid, above it, all the larger portion of the pyramid consists of dependent industries. This includes everything from industries using metal machinery to fabricate their products, to the food industry. One must conclude if much of the mining industry is closed down by hasty, ill-conceived and prohibitive laws, then our standard of living and national safety will be in great jeopardy. The known and potential mineral deposits in the Salmon River drainage are important on both a State and National level.

INTRODUCTION

The following report was prepared at the request of the University of Idaho Water Resources Research Institute to be published simultaneously by the Institute and the Idaho Bureau of Mines and Geology. This is part of a broad project to develop a method of approach to be applied to any river in the State when it is being considered for Wild and Scenic classification.

Using the main Salmon in order to establish a general methodology approach and to determine the impact of the Wild and Scenic Rivers concept is very difficult. This entire watershed drains a large area containing many mineralized tracts of land. There are too many variables involved here because of the presence of a variety of rock types, structures and methods of mineralization, to arrive at a total volume or dollar value for the mineralized districts. Commonly, all mineralized districts differ somewhat in geologic characteristics and methods of mineralization. One cannot arrive at a clear-cut, formula-like methodology applicable to other potentially mineralized areas. I am told that somewhat formalized methodology can be established for timbered regions and the logging industry, or for soil and rangeland use.

This study may point the way to approach mineral evaluation for other proposed Wild and Scenic Rivers, but each proposal will have to be studied as a different metallogenic province. Furthermore, in all cases, because of the nature of the problems involved, entire watersheds will have to be analyzed. Data relative to State and Federal economic mineral needs and general economy must be included in any regional areal mineral evaluation.

The main stem of the Salmon, in this study, as with all rivers, has tributaries branching out into an elaborate drainage network. It is a fact that surface water and underground water must ultimately come to a confluence with or supply their master streams. Thus it is possible that parts of a specifically designated Wild and Scenic River could be affected ecologically by poorly conceived, badly operated, and unpoliced expoitation of tributary lands anywhere in a specific river drainage system. In my opinion, such secondary kinds of pollution, under proper multiple use concept, and under proper supervision, need not occur. Also, there is always the possibility of natural contamination of downstream water courses because tributary streams flow across, erode and take minerals into solution when they flow through any mineralized district. In the field of mineral exploration, natural mineral anomalies of undistrubed streams are used by geochemists in geochemical prospecting.

The possibility always exists that upstream activities by man, such as lumbering, mining, building dams, building roads, widespread areal and extensive ground spraying for forest insect control, development of public campsites, and other activities, without proper control, will affect downstream environments. Some environmental or ecological damage, however slight, will be produced by man wherever he traverses the forest lands. As with marine oil spills, accidents can occur as a result of any of the above activities within a given tract or watershed. In my opinion, all the activities listed above can be compatible with the concept of multiple land use and still not affect a downstream Wild and Scenic River. Proper practices and constant control will be necessary to accomplish the best objectives of clean environments.

The State of Idaho has an area of about 84,000 square miles. Included

in this area are approximately 14,000 square miles which constitute the Salmon River drainage basin (herein frequently referred to as the area of interest, or the area of concern, Fig. 1, Appendix).

The main Salmon River is about 425 miles long. In view of the foregoing remarks and comments relative to the transporting ability of tributary streams, the 16.5 percent of the State's area which is the area of the Salmon River drainage basin, is an area of concern. As a subject for methodology in the study of potential Wild and Scenic Rivers, the entire watershed of the Salmon must be reviewed from the standpoint of potentially valuable mineral deposits. The following discussion takes this fact into consideration. Because mineralized areas abound in the drainage basin, and there is a need for their development, as is brought out later, Tables I - A and I - B have been prepared. Study of these tables will permit the reader to have at hand knowledge of statistics relative to selected minerals that are consumed, produced, imported or exported by the United States. Table I - B represents, as accurately as available information will permit, Idaho's present role in U. S. mineral development and production.

Within the area of concern are parts of Lewis, Adams, Idaho, Valley, Nez Perce, Custer and Lemhi Counties. All of these counties have been or will be affected by mineral production. Also, within the Salmon River basin, there are whole or parts of some 49 areas bearing original designations as mining districts (Ross, C. P., 1941, map). These mining districts are part of an older system used to identify tracts that produced minerals or contained mineralized ground. Such districts are identified in this study (Table I - C), essentially for historic interest. Ross' bulky map of the districts is not herein included.

The mining district designation has fallen into disuse in many areas; therefore, there are many mineralized areas within the State, which are referred to as nonorganized districts.

An evaluation of mineral potential of organized or nonorganized districts within the Salmon River drainage basin, must take into consideration the fact that there is a wide diversity of rocks therein represented (Fig. 2, Appendix). Furthermore, the rocks present in the area of concern are types with which many kinds of minerals and mineralization are commonly associated elsewhere. Local rock structures, too, are favorable to mineralization. The fact that within this large area mines and prospects have been or are being developed, and ore containing strategic minerals (of military importance) and industrial minerals (of economic importance) have been shipped out of certain districts, further attests to the mineral potential of the drainage basin (Figs. 3 - 15).

Unfortunately, because mining companies, for competitive reasons, keep their mineral production and potential reserve figures confidential, it is not possible to produce total factual data of either past or present mineral production. The extent of present exploration and activity within the area of concern is not fully known; however, mineral exploration is known to be in progress. The region as a whole appears endowed with mineralized areas that could make them potentially as great as the world-famous Coeur d'Alene district in northern Idaho.

TABLE I -A

Selected ore, metal and mineral data: U. S. production, consumption, imports, exports and stockpiles, 1968-69

(Note: These minerals occur in the Salmon River drainage basin, along with ore containing the minerals recorded below. Table I - B may be used for general comparison with Idaho production data for 1969.)

In the table below, stockpile releases may cause apparent discrepancies in consumption, production, import and export figures. Symbols used are: W information withheld, confidential: cons refers to mineral concentrates; NA information no available; and e estimate. All quantities, except where indicated, are in short tons (2,000 pounds). Source of information: U. S. Commodity Data Summaries, January 1970 (with modifications).

Ore, mineral or metal	U. S. mine and/or byproduct production	Year	Consumption	General imports	General exports	Inventory (stockpile) 6/30/69	Comments
Antimony Imports· Yugoslavia (49% metal) Other countries 51% metals and cons	Mine 856 Primary and Secondary plants 36,188	1968	42,219	17,343	109	46,963	18% byproduct; 82% imported; 18% domestic Small reserves precarious supply-demand balance.
	Mine 980 Primary and secondary plants 36,500						
Barite Imports: Mexico, Canada and others	Mine 927,000	1968	NA	663	NA	None	Slow annual increase in demand.
	Mine 938,000	1969e	NA	600	NA		
Carbonate rock							Domestic sources more than adequate.
Clay							Wide spread more than adequate.
Cobalt Major Imports: Congo, Belgium - Luxemburg	Mine W Secondary 73	1968	6,500	4,534	1,270	All grades 44,000	Present supplies will meet demand if imports continue.
	Mine W Secondary 150	1969e	9,000	4,400	500		

TABLE I - A Con't.

Ore mineral or metal	U. S. mine and/or byproduct production	Year	Consumption	General imports	General exports	Inventory (stockpile) 6/30/69	Comments
Copper imports: Chile, Canada, Peru and others	Mine 1,205,000 Primary and secondary 1,854,000	1968	1,880,000	All forms 710,000	All forms 389,000	All grades 193,000	Annual increase use forecast 3.7 to 5.5% supply-demand imbalance.
	Mine 1,558,000 Primary and secondary 3,230,000	1969e	2,040,000	All forms 438,000	All forms 269,000		
Fluorspar Major imports: Mexico	Acid and metallurgical W Finished 252,000	1968	All grade 1,243,000	All grade 1,230,000	All grade 13,000	All grades 1,516,000	Annual increase use forecast 3.6 to 4.6%, domestic exploration encouraged.
	Acid and metallurgical W Finished 180,000	1969e	All grade 1,330,000	All grade 1,230,000	All grade 13,000		
Garnet	Mine 22,136	1968	22,136	None	NA	NA	Annual 3.7 to 6.1% indicated. Average grade adequate. High grade limited.
	Mine 20,500	1969e	20,500	None	NA		
Gemstones			NA				Idaho produces some star garnets and opal, fee-sites.
Gold Data in million Troy ounces (1/12th pound). Imports: Canada, Philippines and others	Mine 1.48 Refinery: New 1.54 Secondary 1.40	1968	6.60	5.94	23.96	NA	Price: 1968 $39.26-1969 $42.19 (per Troy ounce) U. S. support for mine development 75%. U. S. not buying. Price up, inadequate world supply.
	Mine 1.71 Refinery: New 1.70 Secondary 1.50	1969e	6.70	5.60	0.30		
Iron ore Data in thousand long tons (2240 pounds) Imports: Canada	Mine 85,865	1968	131,753	43,941	5,884	NA	Adequate, increasing U. S. will supply 65% of our demand.
	Mine 86,000	1969e	140,000	36,500	5,400		

TABLE I - A Con't.

Ore Mineral or metal	U. S. mine and/or byproduct production	Year	Consumption	General imports	General exports	Inventory (stockpile) 6/30/69	Comments
Lead Major imports: Peru, Canada, Australia, Mexico and others	Mine, byproduct and secondary 1,397,000	1968	1,329,000	Ore, cons & bars 426,000	9,000	1,162,000	Increasing demand, labor problems, technical and transportation problems
	Mine, byproduct and secondary 1,710,000	1969e	1,350,000	Ore,cons & bars 370,000	12,000		
Mercury (Data in 76-pound flasks.) Major imports: Spain, Italy, etc.	Mine and secondary 63,254	1968	75,422	23,956	7,599	200,093 U. S. being lowered	World consumption estimated to rise 2.5 to 4.5% per year.
	Mine and secondary 46,000	1969e	78,000	28,000	800		
Molybdenum Imports: Canada	Mine-pounds contained molybdenum 93,477,000	1968	75,647	1,000 cons	29,006 cons & oxides	54,641,000	Expect average annual rate of 4% increase. Probably from U.S. sources.
	Mine-pounds contained molybdenum 98,400,000	1969e	70,000	--	57,000 cons & oxides		
Niobium (Columbium) Data in thousand pounds. Import cons: Columbium Major: Brazil, Nigeria. Tantalum Major: Congo and Brazil (Columbium Tantalum data combined)	Mine none	1968	4,742 metal	Cons import 4,887	None	Columbium 9,577 cons Tantalum 4,072 cons	Columbium and vanadium are competitive. Foreign supplies adequate, U. S. imports may be uncertain. Possible Tantalum shortage predicted.
	Mine none	1969e	5,000 metal	Cons import 6,000	None		

TABLE I - A Con't.

Ore Mineral or metal	U. S. mine and/or byproduct production	Year	Consumption	General imports	General exports	Inventory (stockpile) 6/30/69	Comments
Rare-earths-oxides. Metal imports: Australia 66% Malaysia 28% others	W	1968	6,800 Industrial	Cons 2,400 Metals, alloys, etc. 49,067 lbs.	Ores, metals NA Some alloys 89,858 lbs.	14,273	Growth rate about 15% demand annually (expected). Supply-demand and price imbalances.
	W	1969e	8,200 Industrial	Cons 2,400 Metals, alloys, etc. 80,000 lbs.	Ores, metals NA Some alloys 97,000 lbs.		
Silver Data in million Troy ounces. Imports: Canada, Peru, Mexico, etc.	Mine 57.5 Refinery: New (U. S. & foreign) 73.3	1968	145.3 Industrial	70.7 (excludes coinage)	125.8 (excludes coinage)	U. S. Treasury balance in mint 62.0 Stockpile 165 million ounces 6/30/68	Demand for industrial silver suggests upward price trend. Recovery from coins and other sources cause price changes.
	Mine 65.0 Refinery: New (U.S. & foreign) 110.0	1969e	144.0 Industrial	70.0 (excludes coinage)	100.0 (excludes coinage)		
Silica	NA						
Tantalum	(See Niobium)						
Thorium Imports: Australia and Malaysia (Monazite a mineral source of thorium)	Mine W	1968	NA	Monazite 262e Metal, etc. 773 lbs.	Ores, cons 1,476 lbs. Metal NA	1,834	Slow use growth, unless used widely in advanced nuclear reactors as fuel. Need technologic knowledge.
	Mine W	1969e	NA	Monazite 171e Metal, etc. 200 lbs.	Ores, cons 165 lbs. Metal NA		

TABLE I - A Con't.

Ore mineral or metal	U. S. mine and/or byproduct production	Year	Consumption	General imports	General exports	Inventory (stockpile) 6/30/69	Comments
Titanium Imports: Major: Japan Ilmenite (titanium mineral) Imports: Canada & Australia	Sponge metal W	1968	14,237	3,443	2,756	29,726 Sponge metal No U. S. ilmenite stockpile	Sponge metal rate growth estimated 5.5 to 9.9% annual. Ilmenite usage rate growth estimated 2.5 to 5.0% (Source of 85% of world's titanium) Technological problems.
	Sponge metal W	1969e	19,500	6,500	3,400		
	Ilmenite 979,000	1968	1,102,000	246,000	4,000		
	Ilmenite 950,000	1969e	1,300,000	360,000	1,000		
Tungsten Imports: Canada, Peru, Bolivia, Australia & Portugal	Mine 10,188	1968	11,038	1,824	623	172,209	Domestic production increases about 5% annually. Greater demand expected.
	Mine 9,500	1969e	12,000	1,790	5,600		
Uranium Imports: Major: Republic South Africa & Canada	Uranium oxide 12,338	1968	NA	Cons 470	120,518 lbs.	W	Use as energy source will increase, unless breeder and converter reactors prove successful.
	Uranium oxide 13,500	1969e	NA	Cons 2,000	Cons 108,000 lbs.		
Zinc Imports: Major: Canada, Mexico & Peru	Mine 529,000 Primary slab 1,021,000 Secondary slab 80,000	1968	Slab 1,334,000	Ores & cons 546,000 slab 307,000	Slab 33,000	1,149,000	World as well as U. S. supply and demand well-balanced, may be slow increase in demand.
	Mine 550,000 Primary slab 1,050,000 Secondary slab 80,000	1969e	Slab 1,390,000	Ores & cons 600,000 slab 340,000	Slab 9,000		

TABLE I - A Con't.

Ore mineral or metal	U. S. mine and/or byproduct production	Year	Consumption	General imports	General exports	Inventory (stockpile) 6/30/69	Comments
Zirconium & Hafnium (occur together) Imports: Australia 99%	Zircon cons W Zircon metal W	1968	143,000	Zircon cons 59,900 Zircon metal 82	Zircon cons 2,026	Approximately 11,560	Hafnium data difficult to obtain. Predicted average annual growth rate for zirconium will range from 2.0 to 4.4%; for hafnium from 1.6 to 4.3%. U. S. reserves large, but imports will probably have to supplement domestic supply
	Zircon cons W Zircon metal W	1969e	160,000	Zircon cons 97,000 Zircon metal 280	Zircon, alloys, scraps, etc. 115		

TABLE I - B Mineral production in Idaho 1/

(U. S. Bureau of Mines, 1970)

Mineral	1968		p/ 1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrate . . . short tons, antimony content	853	W	980	W
Clays 2/. . . . . thousand short tons	12	$14	16	$15
Copper(recoverable content of ores, etc.). . short tons	3,525	2,950	3,321	3,151
Gem stones.	NA	200	NA	90
Gold (recoverable content of ores, etc.). . . Troy ounces	3,227	3/ 127	3,560	150
Gypsum. . . . . thousand short tons	3	13	-	-
Lead (recoverable content of ores, etc.). . . short tons	54,790	14,478	64,942	19,275
Mercury. . . . . 76 pound flasks	W	W	994	501
Phosphate rock. . . . . .thousand short tons	3,879	22,721	W	W
Pumice. . . . . ditto	135	259	W	W
Sand and gravel and stone. . . . . ditto	10,419	14,342	13,000	20,800
Silver (recoverable content of ores, etc) thousand Troy ounces	15,959	34,225	18,655	33,388
Tungsten ore and concentrate (60 percent WO_3 basis) short tons	W	W	30	63
Zinc (recoverable content of ores, etc.) ditto	57,248	15,457	58,157	16,982
Value of items that cannot be disclosed: Cement, garnet (abrasive), iron ore, lime, peat, perlite, vanadium, and values indicated by symbol W. . .	XX	9,467	XX	31,665
Total.	XX	114,253	XX	126,080

p/ Preliminary. NA = Not available. W - Withheld to avoid disclosing individual company confidential data. XX - Not applicable.

1/ Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

2/ Excludes fire clay and kaolin; included with "Value of items that cannot be disclosed."

3/ Based on average U. S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968, and the average New York selling price for the remainder of the year.

During a recent conference (May 1970) among personnel of the Idaho Bureau of Mines and Geology and the Western Field Operation Center, U. S. Bureau of Mines and the faculty of the University of Idaho College of Mines, the mineral potential of the Salmon River drainage basin was reviewed. Everyone with personal knowledge of the area concerned agreed that the basin has a good potential for development of mineral resources.

The fact that portions of land within the area of concern have mineral potential is reflected by the recently appraised, multimillion dollar body of molybdenum of ore grade east of the White Cloud Peaks. Few people are unaware of the controversy that has been stirred up by conservation groups because two or three mining companies and single individuals are now legally holding claims in the area east of the White Cloud Peaks. The controversy would be even greater if the downstream Salmon were now classified under the Wild and Scenic Rivers Act.

The real value of the known or unknown mineral deposits in the Salmon watershed never will be complete because some valuable minerals may be hidden at depth or are not easily identified. Only surficial mineralized rock exposures or placer deposits may lend themselves to discovery by thorough square yard-by-square yard exploration of the terrain. Man is not gifted with the ability to see through solid rock and assess potential mineralization at depth. Therefore, he supplements his mineral exploration by modern, costly geophysical and geochemical surveys and core-drilling. All are time consuming, which must be recognized before any shortages of strategic minerals arise. Even objective methods are no guarantee of success in mineral exploration. Not until actual development will ore of potential value become visible.

Another consideration involves the value of minerals. Values fluctuate from month-to-month and even day-to-day. Long and short term forecasts of values and needs are commonly educated predictions. World political situations and balance of international trade interfere with our export and import of minerals and prices. World market manipulation is not uncommon in the mineral industry, sometimes drastically forcing prices up or down. General labor shutdowns, mineral substitutes, rapid changes in the fabricating industries, new techniques of metal extraction, and new uses for better known or less-well-known minerals; all of these factors may abruptly affect demand, supply and price of mineral commodities. Again, it is essentially impossible to estimate need, supply and costs for a widespread metallogenic province like the area of concern.

It has been observed by various experts (Idaho Bur. Mines and Geology Special Report No. 1, 1964, p. 36) that at best, even known economic accumulations of metallic and nonmetallic minerals are difficult to assess. Undiscovered geologic structures commonly cut off ore bodies; or after operations have progressed, it may be revealed that early geolo gical processes and structures have greatly increased the value of mineral deposits at depth, where surficial indications warranted only an estimate as marginal or submarginal mineral values.

KNOWN MINERAL LOCATIONS AND DEVELOPMENTS WITHIN THE SALMON RIVER DRAINAGE BASIN

General comments

While this report has been updated where possible, the previously mentioned publication: Mineral and Water Resources of Idaho (Idaho Bur. Mines and Geology, 1964, Special Report No. 1) is the most up-to-date reference summarizing Idaho's mineral resources. This report contains the work of many people including specialists from the staffs of the U. S. Geological Survey, Idaho Bureau of Mines and Geology, Idaho Department of Highways and Idaho Department of Reclamation. Where more recent information could be obtained from reliable sources, proper acknowledgments are included. My own observations are also herein reported. I greatfully acknowledge the help of many knowledgeable people who read this report and made suggestions, many of which have been included herein. These people represent the U. S. Bureau of Mines, University of Idaho Water Resources Research Institute, and my associates in the Bureau and College of Mines at the University of Idaho.

There are numerous locations in the Salmon River drainage basin where minerals of economic or potential economic value have been or are being developed. As previously mentioned, the entire drainage basin, not only the proposed 320 acres per river mile, from the town of North Fork to the Salmon River's confluence with the Snake River, is being reviewed in this report. Nor has discussion been limited to the "sight and sound" corridor that has been proposed to broaden the limits of corridor control of the Salmon River as a Wild and Scenic River. Anticipating that any mineralized area within the drainage basin will be subject to challenge, for example, the White Cloud Peaks controversy, the entire drainage basin will be reviewed.

Within the area of interest gravel and sand, as well as construction stone are ubiquitous, and, in general, locations for these materials may be chosen without hazardous ecological effects on large areas. Recovery of these materials would result in only minimal disturbance of ecological or environmental balances. Other minerals known to be present in this area include some that we import entirely, obtain only from byproducts of mining other minerals, or minerals that may be obtained in Idaho outside of the area of concern. In the latter case, even Idaho's minerals may be insufficient and still leave us with short reserves. Metallic and nonmetallic minerals within the Salmon River basin include (Figures are all in the appendix):

Antimony and tungsten (Fig. 3)
Barite, Fluorspar and clay (Fig. 4)
Carbonate rock (Fig. 5)
Cobalt, copper and molybdenum (Fig. 6)
Garnet (placer) and mercury (Fig. 7)
Gemstones (Fig. 8)
Gold (Fig. 9)
Iron ore (Fig. 10)
Peat (Fig. 11)
Silica (Fig. 12)
Silver, lead and zinc (Fig. 13)
Titanium, zirconium and hafnium (Fig. 14)
Niobium (Columbium) and tantalum (Fig. 14)
Thorium and rare-earths (Fig. 14)
Uranium (Fig. 15)

The 49 "organized mining districts" in Idaho which are within or partially within the Salmon River drainage area and minerals known to occur therein, as recent or older discoveries are shown in Table I - C. It may be well to mention again that these districts are of "historic" interest, and that other nonorganized mineral or mining districts are present in the area of concern. Unless otherwise stated, production, imports and exports quoted are from the U. S. Bureau of Mines Commodity Data Summaries, January 1970 (References Cited). Table I - A is helpful in determining U. S. statistical figures on production, consumption, imports and supplies, as mentioned earlier.

Finally, in the following discussion the commonly used short ton refers to 2,000 pounds, the long ton is 2,240 pounds and the "ounce" or Troy ounce refers to 1/12th of a pound.

Antimony and tungsten

Production of antimony ore in the United States in the past 16 years has been principally from Idaho (Fig. 3). It is a strategic mineral in short supply. We normally import and export the ores, metals and concentrates, which is true of several minerals that are in short supply in the United States. Recurrent shortages and politically unstable import countries produce price fluctuations and a variable demand-supply situation.

Tungsten, a mineral of great strategic value, is most in demand for its metallurgical properties. In time of national crisis the U. S. would become seriously crippled without domestic sources of this mineral commodity. We commonly import more than we produce domestically. Furthermore, stockpiles may become exhausted over long periods of emergency.

Ores of tungsten occur erratically, ranging from mineral grains widely dispersed in host rocks, to ore-grade massive mineral deposits. Location of good potential reserves is difficult because of the nature of the occurrence of minerals containing recoverable tungsten. Because of favorable conditions in central Idaho, both antimony and tungsten deposits may occur in greater quantities than we have yet realized.

Antimony

The Yellow Pine and Antimony Ridge mines are near the old townsites of Yellow Pine and Stibnite, Idaho in Valley County. During World War II, stibnite was in such critical short supply that it became profitable to concentrate the ores at the rapidly growing town of Stibnite, and fly the concentrates out of the area by plane. In my opinion much more geological exploration is being and should be carried out in this area.

These better known antimony deposits are near the South Fork of the Salmon River (Fig. 3). Much of the ore in this region occurs in small quartz veins and local high-grade stringers (larger, branching vein-like deposits). The ore is related to northeast-trending faults and is associated with other sulfide minerals and quartz and feldspar. Ore has also been recovered from wide-spread disseminations in intrusive granitic rock types, and is also present as cementing materials

TABLE I - C

Early organized mining districts in the Salmon River drainage basin and minerals in these districts *

General District	Better known ore metals **	General District	Better known ore metals **
Green Mtn.	Cu, Ag	Musgrove	Au, Ag
Gibbonsville	Au	Gravel Range	Au, Ag
Indian Creek	Au, Ag, Cu, Pb	Yellowjacket	Au, Cu, Pb
Mineral Hill	Ag, Pb, Au, Zn, Th	Willson Creek	Pb, Ag
Chamberlain Basin	Au, Cu	Thunder Mtn.	Au
Dixie	Au	Yellow Pine	Au, Sb, W
Buffalo Hump	Au, Ag, Cu	Junction	Pb, Ag, Mn, Au
Florence	Au, Zr	Blue Wing	W
Bungalow	Au	Bayhorse	Ag, Pb, Cu
Simpson	Au	Parker Mtn.	Ag, Au
Mackinaw	Au	Yankee Fork	Au, Ag, Pb, Cu, U
Aurora	Au	Stanley	Au, U
Big Creek	Au, Cu	Loon Creek	Au, Cu, Pb
Edwardsburg	Au, Cu, Pb	Sheep Mtn.	Au, Ag, Pb
Ramey Ridge	Au, Cu, Pb	Seafoam	Au, Ag, Pb
Profile	Au, Cu, Pb, Sb	Warm Lake	Au
Warren	Au, Sb	Texas	Pb, Ag, Cu, Au, Zn
Marshal Lake	Au, Ag	Spring Mtn.	Pb, Ag, Cu
Resort	Au, Ag	Boulder Cr. (White Cloud Pks.)	Zn, Mo
Sandy Creek	Au		
Pratt Creek	Au	Robinson Bar	Au
Eldorado	Au	East Fork	Pb, Ag
Kirtley Creek	Au	Vienna	Pb, Ag, Sb
Carmen Creek	Au	Sawtooth	Pb, Ag
Blackbird	Cu, Au, Co, Ni, Ag	Eureka	Au, Cu

* Symbols for most common mineral exploited in the past or present, not only these mineral products are available in specific areas, but byproduct minerals may also occur as well.

** Key to symbols: Au-Gold, Ag-Silver, Cu-Copper, Pb-Lead, Th-Thorium and Rare-earths, Co-Cobalt, U-Uranium, Ni-Nickel, Zn-Zinc, Mo-Molybdenum, W-Tungsten, Sb-Antimony, Mn-Manganese, Zr-Zirconium

in broken and fractured (fault and shear) zones. Copper and gold are present in the ores and as byproducts would enhance development of the principal minerals. Considerable amounts of both gold and tungsten have been recovered from this area during past operations.

The area, known as the Yellow Pine district, is part of a large metallogenic province. Because of the types of known occurrence much more geological exploration needs to be conducted over this entire region, both surface and subsurface investigations. According to the most reliable report we have to date (Idaho Bur. Mines and Geology, Spec. Rept. No. 1, p. 44, 1964) and unverified rumors of exploration in this area, the Yellow Pine district may contain the largest deposit of antimony mineral (stibnite) in both Idaho and the United States. Dependent upon the market price, international crises, and other rapidly changing factors, this could become an important mining district again. It is stated that an estimated minimum of at least 15,000 to 20,000 short tons of known metallic antimony can be recovered here, and with little doubt even more ore than these previous estimates is present in this district.

In 1952 antimony prices sagged and principal supplies of the metal from Idaho were byproducts from Coeur d'Alene lead-silver ores. In 1962, Antimony Gold Ores Co. began mining ore in the Yellow Pine district. This company was still stockpiling and exploring for ore up to 1968, but no antimony sales or production have been reported.

Because of increasing prices and demand, Ranchers Exploration and Development Corporation reportedly have leased the Yellow Pine mine at Stibnite from Bradley Mining Co., of San Francisco (Eng. Mining Jour., 1970). It has been reported that exploration, engineering and metallurgical studies are being conducted; drilling and mill construction are planned; and open-pit mining will be started in late 1970.

West of the town of Yellow Pine, quartz-stibnite veins occur in granitic rock in the Antimony Ridge mine, and to the north, antimony ore has been reported in the Profile Summit area.

Exploration has indicated other antimony occurrences in the Salmon basin, but little information is available on their nature or on reserves available (Fig. 3). Among these locations are an occurrence on a tributary of the Middle Fork, southwest of Salmon City in Lemhi County. Associated with fluorspar, these deposits are at Myers Cove (Fig. 1). Other antimony showings in the region of concern have been found in the old ghost city in Vienna mining district. A few quartz-stibnite veins are known to occur in granitic rocks at this location.

Tungsten

As with antimony, because of any possible war-time import restrictions, Idaho's tungsten deposits are of strategic value. In the area of concern (Fig. 3), tungsten deposits (Livingstone, 1919) are located with the antimony producing areas, north, west and south of Yellow Pine. Commonly such deposits are similar to the previously described antimony occurrences.

In the Warren district in Idaho County south of the main Salmon River, scheelite and wolframite (tungsten minerals) occur in a number of gold-quartz veins in granitic rock. For example, at Charity, Trinity and Little Giant mines (Fig. 3) Big Creek district in Valley County; including the McRae (Red Bluff and

Snowbird groups), Nevitt (Joe Davis), Morning Star and Smith Creek mines and prospects, contain the tungsten minerals scheelite and huebnerite. These minerals occur in quartz veins and fracture (shear) zones in Precambrian Belt Supergroup rocks (schists and gneisses -- altered sediments). Some mineralization occurs in nearby granitic intrusive rocks.

The McRae Tungsten Corp. (above) shipped a small quantity of concentrate from stockpiles in 1964. From 1966-70 the Salmon River Scheelite Corp. shipped over $239,000 worth of tungsten concentrate (figure for 1968 not included) from its Tungsten Jim mine in Custer County, Bayhorse District.

Northwest of Yellow Pine are the Profile Gap, Quartz Creek, and Oberbillig tungsten mineral deposits. These deposits contain tungsten; principally the mineral scheelite, in quartz veins in sheared, altered rocks like those mentioned above, and also in granitic rocks. The Profile Gap deposits included antimony (as previously noted) and locally, copper-iron sulfides and molybdenite.

In the Yellow Pine district, the Yellow Pine and Springfield mines have scheelite and gold-antimony ore occurring in wide, sheared and shattered zones of rock (Meadow Creek fault). Three stages of mineralization are represented in the Yellow Pine ore producing bodies.

Production plus known reserves in the Warren and Yellow Pine districts, range from less than 10 up to 10,000 short tons of contained tungsten metal (Fig. 3). However, the wide-spread occurrences of antimony, tungsten and other metallic minerals, again indicate this region may be an important metallogenic province.

Southwest of Challis in the Custer County, Bayhorse mining district are the Thompson Creek and Buckskin mines. Scheelite is the tungsten mineral and it occurs principally in altered granitic rocks and in contact occurrences with Paleozoic sedimentary rocks. Known reserves are small, but the geologic situation is favorable to potentially large deposits (Fig. 3).

In the East Fork mining district are the Meadow View and Washington Basin (Empire vein) deposits (Fig. 3). Here tungsten (scheelite) minerals are associated in relatively small quantities with a number of sulfide minerals, all of which are associated with granitic and intruded Paleozoic sedimentary rocks (including some limestones).

Some fine-grained scheelite occurs northwest of Salmon at Shoup in Lemhi County. This is the Grunter mine in the Mineral Hill district. The tungsten mineral occurs widely disseminated with iron, copper, lead, silver and gold minerals. The mine may be operated mainly as a gold and silver mine, but as in many multiple mineral deposits, several metallic minerals might be extracted as byproducts. Such situations often produce profitable mines. In some instances recoveryof only one or two mineral ores may not be economically feasible.

The second of the larger tungsten producing mines in Idaho is the Irma mine in the Blue Wing district of Lemhi County. The mine has been operated intermittently yielding the minerals huebnerite and scheelite in complex quartz veins and shattered rock. Granitic rocks and Precambrian quartzites seem to be the host rocks for tungsten minerals, as well as for iron and copper sulfides,

fluorine, manganese, lead and zinc minerals. This is regarded as one of the more important mineral deposits in Lemhi County (Idaho Bur. Mines and Geol. Spec. Rept. No. 1, 1964).

Although many mineral and metal prices fluctuate erratically, as suggested earlier, the Engineering and Mining Journal, 1970 Market: (v. 171, no. 2) quotes the following (some other 1970 commodity prices in this report are cited from this same source):

1. Antimony: Metal prices moving upward: Imported metal $3.75-$4.00 per pound. Domestic metal (Laredo) $1.04 - $1.05 per pound
2. Tungsten: Ore containing 65 percent WO_3. Wolframite $43.00 per short ton. Scheelite $43.00 per short ton

Barite, fluorspar and clay

Barite, fluorspar and clay mineral commodity deposits, where known in Idaho, may be located on Figure 4, which indicates deposits within the area of concern.

Barite

Barite ($BaSO_4$) is used about 90 percent as "mud" in drilling deep oil wells. About 10 percent is used for industrial compounds. Since World War II the United States has been the world's leading producer and consumer of barite; however, to meet our demands some barite is imported.

Along with fluorite, barite occurs in a belt of mineralization crossing Fluorspar Ridge in the Meyers Cove district, Lemhi County (Figs. 1 and 4). Ore deposits are related to volcanic and intrusive igneous rocks of the Permian Period and of the Eocene to Miocene Epochs. The ore is in erratic veins, or within the fluorspar to the extent of 2 to 3 percent. A few ore-shoots contain as much as 10 percent or more barite.

At the present time, known barite deposits in the Salmon region might constitute byproduct material, but none has been shipped from the area.

Market prices for barite have remained reasonably stable. At the beginning of 1970 the following prices were quoted:

Barite: Chemical grade -- (95 percent $BaSO_4$, 1 percent Fe) $20.00 per short ton
Drilling mud-(83-93 percent $BaSO_4$, 3-12 percent Fe) crude bulk $12.00-$16.00 per short ton
Specific gravity 4.20-4.30: Ground $31.00-$34.00 per short ton

Fluorspar

Four fluorspar deposits with reportedly significant reserves, plus six locations where the mineral is known to occur, are shown on Figure 4 within the Salmon watershed.

Fluorspar (CaF_2) is used in the chemical, aluminum, steel and ceramic industries. It is the only important source of commercially important fluorine.

In the area of concern the most important fluorspar reserves are at Meyers Cove in western Lemhi County; the Bayhorse district near Challis, Custer

County; near Big Squaw Creek along the main Salmon River, in Idaho County; and in the Stanley area, Custer County.

The Meyers Cove deposits were operated by Fluorspar Mines, Inc. from 1951 to 1953, during which time 10,979 short tons of acid-grade material, 998 short tons of ceramic-grade material, and 100 short tons of metallurgical-grade material were recovered. After a fire destroyed the mill in 1953, the property was returned to Chamac Mines Co.

Reportedly (Wallace Miner, 1970) the Seaforth Mining Co. of Cleveland, Ohio is reopening the Meyers Cove deposit and will operate an open pit mine by the fall of 1970. The property is on private land. The operation plans a heavy media milling process where the water used will be recycled through a closed system. Concentrate will be sent to Mackay for shipment to a smelter. Fifty or more men will be employed.

At Meyers Cove a three-mile long and two-mile wide belt of complexly fractured volcanic and granitic rocks is mineralized. The fluorspar deposits fill veins and brecciated rock, ranging from small seams to lenticular masses as much as 20 feet thick and several hundred feet long. CaF_2 content ranges from 40-85 percent, averaging about 50 percent of average ore.

In the Bayhorse district, commercial deposits of fluorite have been exploited in the Daugherty Gulch area, with ore averaging about 88 percent CaF_2. Mining stopped in 1953. The fluorite also occurs in association with several silver and lead mines close to the old site of Bayhorse.

Near Challis fissures and breccia zones containing fluorite occur along crests, flanks and fault-offsets of the Bayhorse anticlinal structure in the Bayhorse Dolomite.

Along the northeast canyon wall of the Salmon River, near its confluence with Big Squaw Creek, fluorspar deposits are concentrated along the hanging wall of a broad quartz vein, occurring as a biotite-gneiss roof pendant in the Idaho batholith rocks. The spar bodies, containing about 70 percent CaF_2, are known to be at least 14 feet thick and 600 feet long. The occurrence is west of Shoup, Idaho, and about 25 miles downstream from the end of the Shoup road. Large reserves are reported (IBMG, Spec. Rept. 1, 1969).

Near Stanley, Idaho, the Giant Spar vein held by the Aluminum Company of America, contains about 70 percent CaF_2 in fluorspar associated with volcanic and granitic rocks.

The reserves and quality of the other CaF_2 bearing fluorite deposits located on Figure 4 are unknown.

Market prices for fluorspar quoted in February 1970 were:
Bulk metallurgic grade: \$43.50-\$47.50 per short ton
Ceramic grade: \$51.50-\$57.50 per short ton
Acid grade: \$56.00-\$60.00 per short ton

No fluorite production in the area of concern has been reported since 1953. Possibly this reflects the relative inaccessibility of some of the potentially valuable reserves.

Clay

Only one potentially economic clay deposit near Salmon City, Idaho is shown on Figure 4. However, other unmapped and/or unknown clay deposits probably do exist in the area of concern. Being a low unit value, bulky commodity and occurring with wide ranges in quality for various uses, clay is probably not of great present potential economic value in this drainage basin.

Carbonate rock

Figure 5 indicates the occurrence and kinds of carbonate rock in the Salmon River drainage basin. Much of this rock is remote or inaccessible. Higher grade calcium carbonate-bearing rocks are fairly common. Again as low unit value, bulky materials, demands for carbonate rock in Idaho in the future may be more than fulfilled outside the area of interest (Savage, 1969).

As a ballast stone or quarry rock for local use, some of the occurrences in the area might well be developed. Properly controlled development of quarry rock can be very inoffensively accomplished from the environmental-esthetic point of view. Such quarries often are no more than rock removal from a previously exposed series of rock cliffs, thus the cliff-like quarry exposure greatly resembles the original setting.

Cobalt, copper and molybdenum

Cobalt, copper and molybdenum deposits all occur in the Salmon River basin area, in known quantities of economic value. This fact warrants further exploration and development.

Cobalt

Compared with other metals, although important, relatively small quantities of cobalt are now used. Future large reserves may or may not be needed. In the United States, Idaho is one of the few producers of the commodity. As early as 1918, small amounts of ore were recovered, but during the time of increased demand provided by the stimulus of World War II, the well-known Blackbird district in Lemhi County was opened up (Fig. 6). Records show that from 1951 to June 1959, the Blackbird district recovered approximately 14 million pounds or 7 thousand short tons of cobalt. At the same time substantial amounts of copper and gold were also recovered. After termination of a government contract the mine continued to produce some copper and gold. By 1966 Machinery Center, Inc. was producing cobalt-copper ores, from which 1,051 pounds of cobalt were recovered. Idaho Mining Company took a lease on the Blackbird property in 1968 and is still carrying on an exploration program, including core drilling. Only minor shipments of copper were being made at that time. The mine has been idle since 1969 and no cobalt has been recovered here since 1966.

At the Blackbird mine, cobalt and other ores occur in a series of northwest or north-striking, northerly plunging lenses in tightly folded metamorphic rocks, a few miles east of granitic intrusions of the Idaho batholith. The host rocks are believed to be part of the Belt Supergroup, called the Yellowjacket Formation. Metallic minerals here include cobaltite, safflorite, chalcopyrite, pyrite and native bismuth. These ore minerals are associated with quartz, biotite, chlorite, ankerite, tourmaline and several rare minerals. A major problem involves expensive metallurgical techniques required to separate the cobalt from the ore. Competition with foreign ore cannot be met without premium domestic prices.

Cobalt is a byproduct of Coeur d'Alene mines in north Idaho and other occurrences are distributed over the State. Nickel also occurs in small amounts in most areas where cobalt is found.

As of February 1970, the price of cobalt was quoted as $2.20 per pound.

Copper

Copper ores also occur widely distributed in the Salmon River basin (Fig. 6). Copper is a vital commodity in various industries and also of widespread occurrence in most American mining districts. Price fluctuations, not uncommon in the copper industry, are believed by some to be the results of not only supply and demand, but also market manipulation. Present predictions are a continued increase in price. About 65 percent of Idaho copper output is a byproduct of the production of lead, silver, cobalt, gold and tungsten. Of the two main copper deposits in the area of interest, one area is located in the above-described Blackbird district in Lemhi County. It is associated with the cobalt and gold, with some nickel. This deposit is classified in the 20 million pound or 20 thousand short ton category (Fig. 6).

Smaller copper deposits are known to exist in other areas in Lemhi, Custer and Valley Counties; however, inferred reserves in the area of interest, based upon knowledge of geological characteristics, are rated as large. Some known occurrences have been insufficiently explored to warrant estimates of reserves.

In the Blackbird district the copper (and other ore minerals) are replacement deposits in sheared and faulted zones in metamorphic rocks (schists) of the Precambrian Belt Supergroup.

In Custer County, copper in the Bayhorse and Boulder Creek (White Cloud Peaks area) districts occur as replacement deposits of galena, tetrahedrite and other sulfides, in sheared fault zones associated with Paleozoic dolomite and intruded granitic rocks.

At Loon Creek copper-gold ores occur in schistose Belt host-rocks intruded by Miocene igneous materials.

In Lemhi County the Blue Wing, Eureka, Eldorado, McDevitt, Texas, Spring Hill, Junction, Mackinaw, Mineral and Indian Creek districts have ore veins and replacement deposits. These include copper ore and other associated minerals, including gold in schists (Precambrian). Some ores are in dolomites, limestones and quartzites (Paleozoic age); the host rocks are sheared and fractured. Granitic and volcanic rock are associated with these mineral emplacements. Recovery of ore was effected in the general area over two periods, however, from 1916 to 1961 most of these mineralized areas were producing some ore. Over the period 1964 to 1968 moderate amounts of copper were mined at the Blackbird mine, while exploration and development continued. However, in 1969 cessation of production at this mine resulted in a small decrease in Idaho copper production.

Other known copper producing areas include in Custer County, the Seafoam, Loon Creek and Yankee Fork districts; and in Idaho County, the Ramey Ridge district. Ore was recovered intermittently from these districtsfrom 1898 to 1950. No recent developments have been reported. One might conclude that all of these mineral occurrences are of minor significance, except that most deposits

have probably not been adequately developed or explored by modern methods, therefore, anything like a reasonable evaluation of reserves is not possible.

Engineering and Mining Journal (1970, v. 171, no. 2) noted that President Nixon has appointed a special study committee to find the reasons for continuing short supplies of copper in the United States. There appears to be a wide price gap between American producer prices and world prices. Shortages have persisted through the years, although a record world copper production output occurred in 1969.

One might predict that all copper deposits in the area of concern will never contribute a large percentage of copper to meet U. S. demands. However, again lack of development and data on actual reserves must preclude any hasty decisions. Major mining companies, both American and Canadian have shown interest in exploration for economically valuable copper deposits in Idaho.

Recent copper prices (February 1970) were up:

London 1969 prices up 42 percent to 75¢ per pound
U. S. 1969 prices up 33 percent to 56¢ per pound
Canadian 1969 prices up to 66½¢ per pound

Because of the uncertainty of a stable copper market, it would be unwise to make future predictions about demand, supply or price. It appears possible that the price will stabilize around 60 to 65 cents per pound and that demand will continue to rise with a normally increasing use of the metal.

Molybdenum

Molybdenum is called one of our most versatile and strategic industrial minerals. About 75 percent goes into the steel industry. The metal commonly occurs in widely disseminated deposits as the mineral molybdenite (MoS_2). Molybdenum may also combine in minor amounts with other sulfide metals, and thus occur in sulfide mineral provinces.

Several locations with occurrences of molybdenum minerals have been known in Idaho for many years. However, little is known about the possible reserves, mainly because of lack of exploration and development. Figure 6 has only the molybdenite occurrences in the area of interest located on the map. These are the Spring Creek prospect in Lemhi County; the Profile Gap mine in the Edwardsville district (copper and tungsten with traces of molybdenum); Virginia Beth prospect on Little Pistol Creek in Valley County (small quantities); the Irma mine in the Blue Wing district in Lemhi County (molybdenite occurs with other sulfides as solid masses and dense disseminations, and reportedly the content is insufficient to make recovery profitable); traces of molybdenum were reported in 1919 occurring on the South Fork of Salmon River about 12 miles east of Warren in Idaho County (in garnetized schist associated with hornblende sills), just opposite the mouth of Grouse Creek. Livingston (1919) described the latter deposit as located in a zone 150 feet wide and 2,300 feet long. I have no further knowledge of the actual potential of this deposit.

Most controversial is the so-called White Cloud Peaks (White Clouds) molybdenum deposit in the older defined mining district of Boulder Creek. The mineralization occurs at a lower elevation than the scenic White Cloud Peaks and east of the peaks in Custer County. This deposit is a mineralized quartzite

with about 0.1 percent molybdenum (in terms of dollar value, not unlike that of the copper values at the famous Bingham Canyon open pit copper mine southeast of Salt Lake City, Utah). Deposits of this nature, though low-grade ore, may be economically feasible to mine because of the quantities of ore available.

This deposit reportedly covers a large contact metamorphic area. The deposit is also said to be amenable to open pit production.

At the present time the mining industry is interested in this Boulder Creek mining district, and two or three companies have legal claims on mineralized ground. American Smelting and Refining Co., a major and responsible mining firm, has holdings reportedly amounting to 720 acres. An estimated 100 million dollars worth of ore-bearing rock here is of potential economic value (U. S. Bur. Mines, 1969, p. 4).

Although ASARCO has proposed to restore the area after operations, the expected cry of "environmental destruction" has been raised. This kind of thing, certainly justifies a reevaluation and assessment of minerals within the entire Salmon River drainage basin. The area falls into the area of concern of this report.

Even within their legal rights, ASARCO officials have agreed to await further study of the environmental aspects of the area. In my opinion, this does not suggest that all mining companies are greedy despoilers of the land.

It has been reported that Vernon Taylor and Associates of Denver also are interested in conducting exploration for molybdenum in the same area.

Pertinent to the White Cloud area, Mayor Willis Buxton of Challis, Idaho was recently quoted as stating, "I can't see why it's such a big deal about mining in the White Clouds ... we've had mining in the White Clouds for years." (Daily Idahonian, 1970b, p. 1).

The outcome of this controversy is uncertain; however, hopefully the mining industry is not going to be harassed wherever mineralization of potential value occurs within the Salmon River basin because of any poorly worded Wild and Scenic River Act, that may be hastily passed.

Preliminary operations and further exploration have been planned, and tentatively, operations would start about 1975 according to news releases by ASARCO. Presumably, ore production might come slightly later. This is a good example of how long a period of time is required to develop (along with proper environmental safeguards) mineral deposits. This also illustrates well, how some reasoning and cooperation is imperative among the mining industries and the preservationists.

Recent prices quoted on molybdenum (February 1970) are as follows:

Powder $4.00 per pound
Molybdic trioxide MoO_3, $1.91 per pound
Concentrate (95% MoS_2), $1.72 per pound

Garnet placers and mercury

Garnet placers

Garnet is ubiquitous in many mineral placer deposits, especially where contact metamorphism has occurred between igneous and former sedimentary rocks. In respect to the area of concern, garnet will probably never be so urgently needed by the mineral industry as to warrant opening a placer for garnet alone (Fig. 7). However, in several areas where placers are being worked for gold or blacksand minerals (Savage, 1961), garnet may be recovered (for abrasives industrial use), as a byproduct in multiple-mineral production. Bear Valley and the Burgdorf-Warren areas are examples of the latter. Several areas within the State and outside the Salmon River drainage basin are better known for their production of commercial garnet sand.

Mercury

Mercury occurrences are known in the area of concern. This heavy, liquid, silvery metal is probably one of the most common metal commodities which characteristically has an irregular, fluctuating price range. This results in reactivation or closing down marginal deposits of mercury ore from time-to-time.

Mercury has been called the "metal of a thousand uses". However, most uses require relatively small amounts. It has been stated that about 2000 tons is required annually by U. S. industry. The unit of world-wide trade is the flask containing about 76 pounds of liquid metal.

In Idaho our known deposits (Livingstone, 1919) are commonly opened for production only when the price per flask reaches toward the $600 per flask level. In 1961 and 1962 31,600 flasks of mercury were produced in Idaho (Fig. 7). In 1964 to 1965 because of sharp increases in price, mercury was produced in the Salmon River drainage basin at the Hermes property in Valley County. Open pit mining and underground methods were both used. In 1964 to 1965 the market price was about $570 per flask. In 1966 production slowed because the price fell to $422 per flask, but the price rose slightly in 1967. By 1968 to 1969 mercury brought as high as $536 per flask then dropped to $504 later in 1969. Over the last two years no known production of mercury has occurred in the area of interest.

It should be noted that several occurrences of mercury are known in the Hermes area (Bell, 1918). Ore bodies of the mercury mineral cinnabar, accompany stibnite (antimony), and realgar and orpiment (arsenic sulfides). The deposits tend to replace other minerals or fill fractures and shears in altered dolomitic limestone. Commonly these deposits are near granitic intrusives, including dikes and veins related to the Idaho batholith. In other parts of the State mercury is associated with younger volcanic rocks and hot springs. The true mercury reserves of this area cannot be adequately assessed. Only if much greater development takes place in the future, as the result of a major increase in the price of mercury, will we learn more about the economic potential of this mineral in the Salmon River basin.

As of February 1970, market reports indicated falling prices, e. g. $482.50 per flask (76 lbs.).

Gemstones

To the best of my knowledge no gemstones of significant economic potential occur in the Salmon River drainage basin. Locally small occurrences of agate, beryl, opal, zircon, petrified wood and quartz crystals have been of interest to amateur gemstone collectors (Fig. 8).

Gold

Gold in Idaho has been located in many places, both lode- and placer-type deposits (Fig. 9). (Wells, 1961 and 1963, and Staley, 1946).

For the record, it may be stated that small gold recovery operations (with gold pans and sluice boxes) have been continuing for many years along the main Salmon River and adjacent tributaries. The gold is recovered from small sand and clay deposits. However, the extent of these operations and the value of the recovered gold would be virtually impossible to determine.

Actually, in the past several years gold production in the State has been of relatively small importance. However, if the price of gold should rise in proportion to the increased costs of and in line with the rise in market price of other industrial commodities; then there would be a resurgence of gold mining in the State. Incentive for exploration and production are stagnant. In 1968 the U. S. Treasury stopped purchasing gold domestically, but the government will subsidize promising prospects up to 75 percent of the costs. In 1962 Idaho ranked ninth among the states in total gold production, however, total gold production in the State over the period 1863 to 1962 was on the order of 8,306,765 ounces (Ross and Savage, 1967). At 1969 prices ($42.00, U. S. Bur. Mines, 1970) this amount of gold would be worth over 350 million dollars; if priced at $70 or more per ounce in line with rising commodity costs, this amount of gold would be worth approximately 580 million dollars.

Lode gold is commonly found within areas invaded by igneous rocks, and especially within quartz veins and with sulfide mineral deposits. (With silver, lead, antimony, tungsten and copper ores). Placer gold occurs ubiquitously along streams over much of the State. These occurrences range from a few placers with moderately large gold content to a few flakes or colors. In recent years approximately 60 percent of our gold is produced as a byproduct from base-metal production. About 18 percent of Idaho gold production is a byproduct from silver ores. In 1964 seven placer deposits produced the lowest output from this source on record, a total of 104 ounces.

In our area of interest (Fig. 9), gold production has been widely scattered. By 1965, however, only the Blackbird mine in Lemhi County was contributing gold to the market. Production was small over the period 1966 to 1969. In 1969 production increased from the State's 1968 record low to 3,560 ounces. The estimated price for this year was about $42.20 per ounce, which would indicate an approximate value of more than $150,000. No gold production was reported in 1969 from the area of interest.

In the Salmon River drainage basin most of the past gold production came from the following areas listed in Table II (Idaho Bur. of Mines and Geology, 1964, Spec. Rept. No. 1):

TABLE II

Known gold occurrences, production and values

(Approximate total production in ounces and values in terms of the high 1969 approximate price of $42.20 per ounce).

Custer County:	(1)	Loon Creek: Placer - 26,000	$1,097,200
		Lode - 14,000	590,800
	(2)	Yankee Fork: Placer - 25,000	1,055,000
		Lode - 14,000	590,800
Idaho County:	(1)	French Creek - Florence: Placer - about 1,000,000	42,220,000
	(2)	Simpson-Camp Howard-Riggins: Placer - 38,000	1,603,600
	(3)	Warren-Marshall: Placer, some lode - 906,500	38,254,300
Lemhi County	(1)	Blackbird: Lode - 14,000	590,800
	(2)	Carmen, Eldorado, Pratt and Sandy Creeks: Placer - 24,500	1,033,900
	(3)	Gibbonsville: Placer and lode, about 100,000	4,220,000
	(4)	Mackinaw: Placer and some lode - 271,000+	11,436,200
	(5)	Mineral Hill and Indian Creek: Lode (mostly) - 87,000 (Leesburg Basin, Moose Creek Beaver Creek and Napias Creek)	3,671,400
	(6)	Kirtley Creek: Placer (mostly) 27,500	1,160,500
	(7)	Texas : Lode - 21,700	915,740
	(8)	Yellow Jacket: Lode - 25,000	1,055,000
Valley County:	(1)	Thunder Mountain: Lode - 17,500	738,500
	(2)	Yellow Pine: Lode - 310,000	13,082,000
		Grand Total (Approximate)	$121 ,809,200*

As of February, 1970, gold market prices, as cited, included the following: U. S. and Africa are trying to hold the price at $35.00 per ounce. In the world's free and black markets, prices are as follows:

Coins $43.50 - $63.00 per ounce
Bars $35.00 - $44.50 per ounce

* 1968 free market price. Early 1970 controlled market prices of $35.00 per ounce would reduce this Grand Total figure to $101,026,587.

Iron Ore

Iron ore has not been considered a major mineral commodity in Idaho; however, some has been used in the form of magnetite and limonite, as additives to heavy structural cement, and in cement production as a part of the process of making cement.

In the area of interest (Fig. 10), only two known iron lode deposits contain potentially commercial ore. In Lemhi County there is the McCann Creek deposit at the head of the creek, near the Idaho-Montana boundary. This is iron-oxide (magnetite) occurring as fracture filling and replacement ores in large bodies of breccia, a Precambrian quartzite (Anderson, 1961). Reportedly there is a potential here for development of fairly large, high-grade ore bodies. Further investigation has been recommended.

Also in Lemhi County are several other iron-oxide deposits (hematite) occurring as tabular veins paralleling complex zones of regional shearing. The deposits are in Precambrian (Belt) host rocks and probably related to Early Tertiary hydrothermal mineralization. Reserves are unknown because of lack of exploration and development.

Except when used as additives, iron ore deposits must be rather large to warrant exploitation. The above described deposits in Belt rock are probably not of sufficient volume to be regarded as commercial iron under normal conditions.

February market quotations list "Old Range" Mesabi iron (Gt. Lakes Region) at $10.55 - $11.00 per short ton.

Peat

There are undeveloped areas of peat known to be present (Fig. 11) in the Salmon River drainage area. These peat deposits probably would not constitute deposits of economic value because of the low unit value of such bulky commodities and their distance from possible markets.

Silica

High silica rock of a number of grades is in moderate demand. The area of concern contains silica (quartz, SiO_2) of unknown value, as well as large areas of quartzite (silica-rich) rock of some potential value (Fig. 12). However, only the highest-grade silica demands a premium price. Again, like some minerals mentioned above, unless of exceptional grade, silica must be relatively near a market.

Small deposits of silica sand and sandstone have been recorded and noted for their high silica content. Some of the Paleozoic quartzites average the following composition:

SiO_2	98.90%	Al_2O_3	0.37%
CaO	0.56%	Fe_2O_3	0.17%

In other parts of the State silica rock approaching this composition has been used as a flux in electrical furnaces producing elemental phosphorous. For

example, in southern Idaho. Locally, some quartz veins and quartz-cored pegmatites reach high-grade commercial silica standards. In general, however, because of the relative abundance of silica and its bulky low-unit value; known deposits in the Salmon River drainage basin will probably not be developed in the foreseeable future.

Dependent upon the quality, a February 1970 quotation on silica was as follows:

Amorphous quality ranged from $27.00 - $89.00 per short ton.

Silver, lead and zinc

Silver, lead and zinc commonly occur together. Locally, within a silver, lead and zinc metallogenic province, one or two of these metals may predominate over the others. Sulfide mineralization, including the iron and copper sulfides are often associated with silver, lead and zinc deposits, along with minerals containing other metals in less important quantities.

These are all widely used metals and in constant demand for many industries. Next to the Coeur d'Alene district in northern Idaho, the Salmon River drainage basin with its many mineral showings and older developed prospects and mines, has a good potential for development of mineralized localities. Idaho is already one of the greatest silver, lead and zinc producing states in the U. S. We rank first as a producer of silver. It is quite likely that we will hold this important position, particularly with continued further exploration and development in both the Coeur d'Alene and Salmon River drainage basin areas. In fact gold, silver, lead and zinc production in the past is a well-known, major factor in the development of our State (Wells, 1961 and 1964 and Idaho Bur. Mines and Geology, 1961).

Returning to the area of concern (Fig. 13) at least 15 known mineralized areas of importance to the silver, lead and zinc industries are summarized below in Table III.

Lead and zinc occur in a number of different minerals, however, the most common occurrences are lead sulfide(galena) and zinc sulfide (sphalerite).

Silver occurs as small inclusions in one or more of the lead-zinc ores, or other associated minerals. As common as any silver minerals are argentiferous galena ore and argentite. Primary silver and secondary silver (oxidized ores) are also commonly encountered in some mineral deposits (for example--anglesite and cerussite).

Some of the districts cited in Table III were once famous mining districts and with the rising market price of silver commodities, many well-known deposits are and should be revisited and reopened(Wells, 1961 and 1964). Further exploration is being considered by several mining companies. Reportedly, with newer techniques of exploration and development, some of the older known areas may well prove to be economically worthwhile deposits. Earlier mining operations often involved exploitation of only high-grade ores. Clayton Silver Mines produced over 290,472 ounces of silver in 1968 and production increased somewhat in 1969.

Reportedly, Universal Exploration Co. in the spring (1970) shipped about $20,000 of high-grade silver recovered from the Silver Moon mine at Gilmore near a tributary of the Lemhi River south of Salmon City, Texas district (Idaho Economic Image, 1970b).

Smelter byproducts often enhance the value of silver, lead and zinc ores. Among the more valuable of these byproducts are:

Arsenic	Cadmium	Selenium
Bismuth	Germanium	Tellurium

February 1970 market prices for silver, lead and zinc have been quoted as follows:

Silver - U. S. $1.876 per ounce (fluctuating)
Lead - U. S. $0.163 per pound (moving up)
Zinc - U. S. $0.155 - $0.160 per pound (signs of upturn)

It must be remembered that the prices of the above metals are subject to fluctuation, but are more stable than mercury, for example.

Titanium, zirconium and hafnium

Titanium, zirconium and hafnium are relatively newcomers in the metals industry, but because of good strength-to-weight ratio (important in the construction of aircraft, space vehicles and missiles), titanium metal has experienced an upsurge in use. Titanium and zirconium metals have excellent resistance to corrosion and desirable qualities as high-temperature metals. Zirconium and hafnium nearly always occur together, and hafnium is a byproduct of zirconium production.

All three of these metals are and have been undergoing extensive study in the fields of recovery, use and reserves. They are considered strategic metals, and are widely used in the metal, chemical and ceramic industries.

The minerals ilmenite ($FeTiO_3$) and rutile (TiO_2) are currently considered the best sources of the metal, although other titanium-bearing minerals do occur naturally.

Twenty-one known minerals contain over 10 percent of zirconium dioxide or zircon ($ZrSiO_2$) and baddeleyite (ZrO_2, theoretically); these are the principal commercial sources of zirconium. As mentioned above, hafnium is a byproduct of zirconium minerals and commonly present, ranging from 0.5 to 2.0 percent hafnium dioxide (HfO_2). Rarely hafnium content may range up to 17.0 percent in zirconium minerals. Other mineral resources often occurring with zirconium minerals include uranium, thorium, rare-earths, beryllium and phosphorous.

Many titanium, zirconium and hafnium-bearing minerals are widespread as accessory minerals in igneous, metamorphic and sedimentary rocks. Therefore, commercial deposits of these minerals occur as naturally concentrated, weathered products of multiple mineral-bearing blacksand placers (Savage, 1961). Such placers are widespread over the State (Fig. 14).

TABLE III

Known locations of silver, lead and zinc
(Idaho Bureau of Mines and Geology, 1964, p. 185-186)

County and District	Most Important Metal of Silver-Lead Zinc Group	Type of Occurrence
Idaho County		
Florence	Silver	Veins in granitic rocks of the Idaho batholith.
Marshall Lake	Silver	Veins in Precambrian schist and gneiss, near contacts with the Idaho batholith.
Warren	Silver	Veins in granitic rock of the Idaho batholith.
Valley County		
Yellow Pine	Silver	Disseminated material and veins along shear zones in the Idaho batholith.
Custer County		
East Fork	Silver	Veins in granitic rock of the Idaho batholith.
Seafoam	Silver, lead, zinc	Veins in granitic rock of the Idaho batholith and replacements in Paleozoic limestone.
Yankee Fork	Lead, silver	
Boulder Creek	Silver, lead, zinc, molybdenum	Replacements along faults in Mississippian rocks.
(ASARCO and others) Bayhorse	Silver, lead, zinc	Replacements and veins in Paleozoic dolomite and slate and contact metamorphic deposits in quartzite.
Lemhi County		
Eureka	Silver	Veins and replacements in Paleozoic quartzites.
Nicholia	Silver, lead, zinc	Replacements and veins in Paleozoic limestone.
Blue King	Silver, lead, zinc	Veins in Precambrian quartzite near igneous rocks.
Junction	Silver, lead, zinc	Replacements along faults in Paleozoic limestone.

Lode-type occurrences of the titanium minerals, ilmenite and rutile, are found associated with some iron deposits. Zircon may occur in some pegmatites and syenites, as lode material, but commonly these types of occurrence are not considered economic deposits.

In the area of concern, four categories of known deposits are shown on Figure 14, only placer deposits of known occurrences are presently considered of potential economic importance. However, again these deposits often occur with other strategic and industrial minerals, making potential multiple-mineral production economically feasible. Unknown potentially valuable placer deposits may well lie within the area of concern.

Because the U. S. imports much of its titanium, zirconium and hafnium for our industrial use, abrupt termination of any such major import quotas might well results in sudden future demands for Idaho blacksand placer development.

In the Salmon River drainage basin, known placer deposits with outstanding quantities of titanium, zirconium and hafnium are known to occur in Bear Valley. Other placers known to have significant reserves of these minerals occur in (Fig. 1 and 14) Florence, Stanley Basin-Upper Salmon region and Leesburg placers west of Salmon City. Areas where titanium, zirconium and hafnium placers of probable, but unknown economic value, occur along the North Fork of the Salmon, Lucile Bar on the main Salmon, Secesh River, Warren areas, Thorn Creek, Sater Meadow, Upper Yellowjacket, Beaver Creek and Lower Johnson Creek areas (Fig. 14).

February 1970 prices for titanium and zirconium have been quoted as follows:

Titanium ore: Ilmenite - 54% TiO_2 $20.21 per long ton
Rutile - 96% TiO_2, $160.00 per short ton

Zirconium sponge-powder: Low hafnium $7.00-$14.00 per short ton
Commercial - $5.00-$10.00 per short ton

Thorium and rare-earths

Thorium and rare-earths are present in the area of interest (Anderson, 1958 and 1961 and Savage, 1961). Minerals of these metals commonly occur in the blacksand placers described under titanium, zirconium and hafnium described above. Other types of disseminated thorium minerals are described later. At the present time the future demand for thse minerals is unpredictable. Markets at present are relatively small. At one time it was considered that thorium might take a place beside uranium as an important radioactive material; however, the development of plutonium breeder-reacters diminished this immediate possibility.

At the present time thorium and rare earths are used in relatively small quantities by several industries. Future expansion of uses cannot be predicted, but the possibility that thorium may be used as a future source of energy is still not wholly resolved.

Monazite (Ce-La-Y-Th) PO_4, one of the main sources of these commodities, is found in Idaho placer deposits. Euxenite (Y-Ca-Ce-U-Th) $(Cb\text{-}Ta\text{-}Ti)_2$ still is present in extensive reserves within the columbium-tantalum placer deposits

at Bear Valley (Figs. 1 and 14). Placer deposits containing thorium, zircon and hafnium also occur in Florence, Dixie, Warren and Stanley Basin districts (Fig. 14).

Other thorium and rare-earth minerals are widely distributed in Idaho, not only as hydrothermal veins and local masses in pegmatite rocks, but in many rock-types related to blacksand placers.

Rich concentrates of thorium minerals in the Salmon City area were discovered in 1949. Since then, Lemhi Pass area has become well-known as perhaps one of the richest thorium mineral deposits in the world. (Anderson 1958 and 1961, and Austin and others, 1970). The area and extent of these deposits is difficult to evaluate, but Austin and others (1970) note that veins crop out in a metallogenic province about 70 miles long by 8 miles wide. This is a northwestern trending area, including the Lemhi Pass region on the southeast and North Fork and Diamond Creek area on the northwest (Fig. 1). Concealed by deep soil and mantle cover locally, the veins are not easily observed, but may be discovered by surface radioactivity.

Host rocks here are quartzites and phyllites of the Precambrian Belt Supergroup. Gneisses and schists of the same age, or older, are also host rocks. It is reported that hand samples of ore from all these large deposits contain as much as 22 parts per million uranium oxide (U_3O_8), 140 parts per million thorium dioxide (ThO_2), and an unknown quantity of rare-earths might be representative of the whole area.

Anderson (1961, p. 88) states that somewhat larger estimates containing rich ore, for example Lemhi Pass deposits range from 0.1 to 2.0 percent. In general the average grade of seven local deposits is 0.72 percent thorium. The mineralized rocks tend to be stained red-to-pink by iron oxide, and thorium content seems to increase with degree of coloration. Local granitic rocks appear not to be host rocks of the mineral thorite. Most of the thorium and rare-earths are considered to occur in reddish zircon. The thorium deposits appear to be of two types: (1) base- and precious-metal veins with minor amounts of thorium, and (2) thorium veins with rare-earths and minor base and precious metals. Most of the deposits seem unrelated to local, older quartz and copper-bearing veins, but seem to be related to later zones of shearing and fracture (Anderson, 1961).

Rare-earth prices are subject to widespread fluctuation and demand is still relatively low because of production costs. Recent references to price quotations on thorium and rare-earths were not located, however, because of the relatively small quantities of the commodities used by industry, prices are probably fairly stable. In 1962 the price of thorium ranged from $1.75-$2.25 per pound of thorium dioxide (ThO_2) in 20 to 30 percent thorium concentrates.

Niobium (Columbium) and tantalum

Niobium(columbium) and tantalum are present in mineral deposits within the Salmon River drainage basin (Fig. 14). These two metals are refractory metals of strategic importance; both metals have properties useful to electronic, nuclear, chemical and high-termperature metallurgical applications within industry.

The metals do not occur free in nature, but occur as constituents of mineral compounds of niobium, tantalum and oxygen. They often contain minor amounts of titanium, tungsten, iron, manganese, rare-earths, uranium, thorium, calcium, sodium and other materials. Occurrence of these metals is largely restricted to granitic rocks and alkalic rock complexes and carbonatites. Placer deposits are commonly derived from the weathering of these kinds of rocks; in fact, essentially all commercial recovery of niobium and tantalum, plus other economic mineral byproduct commodities in Idaho have been recovered from these placers.

The United States is the world's largest known consumer of niobium and tantalum, but at present none is produced domestically. In 1958 domestic production reached a high of nearly 12 percent of our demands and Idaho was the largest producer (Bear Valley placer products) in the U. S. However, imports of mineral concentrates in 1962 were more than 6 million pounds; this was later reduced to about 5 million pounds. The Bear Valley placering operation could not compete with imported metals.

In the area of concern, the only known dike and vein-like bodies of niobium and tantalum occur in the Mineral Hill district, approximately 30 miles northwest of Salmon City. The niobium (columbium) and tantalum-bearing mineral is ilmenorutile 8-10 percent $(Nb,Ta)_2O_5$, including rare-earth minerals. The mineralization occurs in amphibolites or gneisses as bodies resembling carbonatites, near granitic rock of the Idaho batholith. Potentially commercial deposits have been found in the area of concern.

In the Burgdorf-Warren districts, placer deposits contain some niobium-tantalum minerals, as does the Stanley Basin-Yankee Fork area. In general these metals are probably too sparse to warrant commercial exploitation, except by multiple-mineral production from sources where other minerals could be recovered for the mineral market.

The Bear Valley niobium-tantalum deposits of blacksand placers were exploited under contract to the U. S. Government because of subsidy arrangements. This placer ground is about 23 miles northeast of Lowman, Idaho in Valley County Recovery operations spanned a period from 1955 to 1959, until the contract was filled. It then became necessary to suspend production because of competition with mineral imports. Standby operations were maintained until about 1964. By 1970 the operation was still closed down. It was operated by Porter Bros. Co., Division of Michigan Chemical Company of Chicago, Illinois.

The placer minerals here are believed to have been derived from disseminated minerals weathered out of granitic rocks of the Idaho batholith and roof-pendants of older (Precambrian) schists, gneisses, marble and generally siliceous rocks (Savage, 1961). Placer materials consist of clay, silt, sand, cobbles and boulders in the form of glacial moraines, glaciofluviatile and fluviatile floodplain materials along the broad valley of Bear Valley Creek, a tributary to the Middle Fork of the Salmon River.

Potentially valuable economic minerals in the blacksand placer ground include ilmenite, magnetite, garnet, zircon, columbite (niobium mineral), monazite and euxenite. The minerals are notable because of the high yield of complex niobium-tantalum-uranium metals. One square mile of the richest ground at

Bear Valley yields good percentages of euxenite. Euxenite has the following percentages of constituents (Savage, 1961):

niobium pentoxide 23.9 percent	thorium oxide 2.5-5 percent
tantalum pentoxide 1.5-3 percent	titanium oxide 22 plus percent
uranium oxide 10-13 percent	yttrium and erbium oxides 24-28 percent

Production averages for Bear Valley sands in pounds per cubic yard of gravel reportedly are (Savage, 1961):

magnetite 5.0	ilmenite 20.0
garnet 5.0	monazite 0.5
zircon 0.05	euxenite 1.05
	columbite 0.2

Also, at least eight different rare-earth minerals occur here, ranging from 7 to 60 percent of some of the minerals recovered.

In 1957 it was predicted that known placer reserves here were sufficient to last 30 years at a production rate of 2.5 million yards of gravel per year (Savage, 1961). The investment in the original operation was more than five million dollars. Reserves at Bear Valley probably still compare favorably with those of the foreign sources from which we import niobium and tantalum.

During exploration and exploitation, and at the termination of production, the Bear Valley placer management was exemplary, an excellent contradiction to the belief of conservationists that mining and ecological balance are incompatible. It can be stated without reservations that the environment of Bear Valley was improved over its original state after cessation of restoration (under our present State Dredging and Placer Mining Protection Act -- Idaho Code: Chapter 13, Title 47).

Before the operations the undisturbed flats of Bear Valley Creek were covered with short natural grass and small shrubs with a rare conifer here and there.

During operations great care was exercised to avoid mudding or silting the stream. The discharged waters from two large dredge boats went through, settling and treatment processing so efficient that it reentered the main stream, according to chemical analysis, in a much better state than the natural waters.

After the operation was terminated the valley floor was leveled, and top soil and grass seed applied. Several years later, ranchers informed me that the cattle grazing (normal useage of this area) was much better than it had been before the dredging began.

February price quotations for niobium (columbium) - tantalum ore, with prices moving upward, were as follows:

Average GSA combined pentoxides up 5¢ per pound
Niobium ore: 65% niobium-tantalum pentoxide - $1.15-$1.20 per pound
Niobium metal ingots $16.00-$17.00 per pound

Uranium

With the highest specific gravity of any naturally occurring element uranium is a mixture of three somewhat unstable radioactive isotopes U^{234}, U^{235} and U^{238}. Because U^{238} can be altered to plutonium (Pu^{239}) by neutron bombardment, the so called "breeder reactor" fueled with plutonium can produce needed materials for industrial use. Also under neutron bombardment, energy can be released for production of highly efficient atomic and hydrogen bombs, that may be used for war or for useful underground explosive operations. In addition, atomic energy may be used to produce efficient electrical energy for power plants. The main problem faced by the use of these materials for power is disposal of radioactive wastes and hot water. Included with the current major uses and affecting the demand for uranium commodities are other uses in ceramics, chemical, medical and electrical fields.

Perhaps the most important of the uranium-bearing minerals is an oxide, uraninite and its variant pitchblende. Multiple uranium oxide minerals, also of economic value, include the "radioactive blacks" (Savage, 1961). Uranium hydroxides, phosphates, arsenates, uranates, carbonates, silicates and sulfates are all commonly derived by alteration from uraninite.

In the United States the largest sources of uranium minerals are found in terrestrial deposits of sandstones, arkoses and conglomerates. These minerals occur as matrix between individual grains of rocks, fracture fillings and veins associated with granitic rocks. Coaly materials, black shales and phosphate rocks may yield uranium as a byproduct. Finally, placer sands have yielded some uranium products among other minerals.

Although regarded as a very strategic metal, with production and sale controlled by the U. S. Government, recent demand has fallen off. Any new, rich deposit, however, would undoubtedly be of interest to mining companies. In spite of these facts, it was recently reported that facilities on the Uravan mineral belt of western Colorado and eastern Utah were being closed down because of the weak demand for uranium.

Idaho, in the past, has not been a major source of radioactive uranium minerals (Fig. 15). However, in the area of interest, vein and vein-like uranium mineral occurrences have been found around Gibbonsville in Lemhi County. These include autunite (a hydrous phosphate of uranium and calcium) and other minerals found in the Garm-Lamoreaux, Surprise and Moon prospects (Anderson, 1958). Reserves are unknown but probably small.

Insignificant vein deposits have also been found in the Stanley area and nearby Williams Creek in Custer County. Here uraninite-quartz veins and stringers fill fractures in the granitic rocks of the Idaho batholith. Bedded uranium deposits also occur in the Stanley Basin area, as replacements in carbonaceous shales, siltstone, sandstone and conglomerates in the Tertiary Challis Volcanics (Choate, 1962). Kelley and Stanley Creek areas are known to have uranium-bearing pegmatites, as well as placers bearing radioactive, black uranium minerals. Similar placers occur in nearby Williams and Gold Creeks. All the above Stanley Basin areas have not been fully assessed, but it is probably safe to comment that presently known reserves may not warrant commercial development. It must be added, however, that small quantities of uranium-bearing ore were recovered at both the Stanley Basin and Gibbonsville areas from 1955 to 1962. The total production of uranium from Idaho bedded and vein-type deposits has been estimated to be 34,110 pounds, averaging 0.18 percent U_3O_8.

In Valley County uranium-bearing pegmatites are known to occur in Howard and Casner Creeks, and in the Whitehawk Mountain area west of Bear Valley.

In the area of concern the most interesting uranium occurrence in placer deposits is in Bear Valley Creek meadow (Figs. 1 and 15). These placer deposits have been described above under the niobium and tantalum metals section. The estimated range of uranium content in the euxenite mineral concentrates within the Bear Valley placer are derived from production of the main commodities niobium and tantalum. Yields are estimated at 233,387 pounds of U_3O_8 in euxenite concentrate.

Better known uranium resources in Idaho lie outside the Salmon River drainage basin.

Market prices during Idaho's past production period were controlled by the only legal buyer, the Atomic Energy Commission. Prices were established at $8.00 per pound of U^{238}. With currently changing circumstances, a maximum of $6.70 per pound is expected through 1969-70.

CONCLUDING COMMENTS

Projected need for minerals

Antimony, tungsten, gold, silver, zinc, lead, molybdenum, mercury, iron, thorium and uranium are among the strategic minerals (needed in case of war). The need for these minerals for industry and to maintain a balance of international power will increase moderately-to-rapidly in the future. The future amounts of these minerals that will be required depends upon a multiplicity of predictable and unpredictable events. It must be recognized that whatever Public Lands are set aside by State or Federal Acts, no matter how stringent the controls, these designated areas may be freed again in a state of emergency by legislative bodies. However, the time required to move into areas where known or unknown mineral resources exist, and to conduct essential exploration and development programs is such that we might be too late to save a failing economy or protect our country.

At a conference on mining and Public Land Laws (University of Idaho, 1966) held in Boise, statements by Dr. W. R. Hibbard, Jr., formerly Director of the U. S. Bureau of Mines, were cited relative to U. S. future mineral needs. He predicted that by the end of the 1970 decade the United States will double its needs for minerals (Table I-A). Discussing America's growth and national security, Hibbard underscored the nearly total unawareness of the general public to the "...threats we are facing if our mineral sufficiency is not maintained". Rightly, he pointed out how our living standards and general economy, all depend upon minerals and mineral fuels.

Examination and study of Table I-A, at the beginning of this report,will indicate the need for many of the minerals described as being present, or potentially present,in the Salmon River drainage basin. While examining this table, one should keep in mind the fact that a country may export some minerals that are in short supply domestically and may import the same minerals from several sources at the same time. This stems from the concept and necessity for a balance of international trade. Table I-A indicates a good example of such situations under Antimony and Nickel: consumption, imports and exports.

Mining laws in Idaho

Existing mining laws, both State and Federal, have been demonstrated as adequate to control mining by reputable firms, as noted earlier in the discussion of Porter Brothers Co. during their Bear Valley placer dredgingoperations. (Refer back to section on Niobium and Tantalum). However, if the laws are not adequate, then revision is necessary, but not in such a fashion as to be prohibitive to the mining industry. If such restrictive laws were hastily enacted, it would surely drive many mineral exploration and mining firms out of Idaho, to the south or north, and even to Canada and Alaska. I have recently heard one unconfirmed report that some company exploration geologists are already leaving the State, because of undesirable controversy over legitimate mineral exploration and development programs.

The need is for suitable but not impossible mining laws; law enforcement in respect to mining (perhaps lax in the past); and when necessary, advice and studies relative to a potential mining district by knowledgeable scientists. These studies should certainly include, among others, soils scientists and

ecologists. Above all the studies should be made objective and remain uninfluenced by sensationalism or distorted public statements by either trained or untrained environmentalists, newspaper editors or columnists.

However we legislate, we cannot put the mining industry out of business because of the "sins of our fathers". In my opinion, most of the "horrible examples" of the effects of mining, now cited, were imposed upon the land in the 1800's and early 1900's. Mineral exploitation was by men to whom environment was of little concern and typical of the times.

Unfortunately, mining and complete, nonrestorable destruction of our natural environment is equated by some well-meaning groups or organizations.

Yankee Fork and Boise Basin were early mining districts, where by hand, or by dredge stackers, mounds of cobbly gravel were left unleveled. These are often cited as examples of mining damage, esthetically unpleasant, but not permanently harmful to the fish population. I have personally observed fingerling trout in the natural spawning pools formed by such artificial methods!

Again, if our present laws are inefficient or not enforced, then they should be properly revised. Present laws will not be cited herein, but may be found for review in the following References Cited at the end of this report: University of Idaho, 1966; Idaho State Inspector of Mines, 1959 and 1966; and Idaho Code, Title 47, Chapter 13, 1969.

Clean and efficient mineral development and Public Land use is possible (Tables IV and V). If we are not capable of running all of our industries properly, then our country's economy, constitutional rights and freedom are in jeopardy. Our decision seems clear enough: On the one hand, proper mineral exploitation and higher costs; and on the other hand the alternatives of greatly reduced living standards and imbalance of power among the nations.

It should be noted here, that responsible mining firms have concerned themselves with environmental problems and have spent large sums of money to control effluents from their smelters and mines, to the atmosphere and to natural drainage systems. These companies have made grants of money for research on pollution problems. This is not the time to strangle or harass such vital industries.

Some economic aspects

Newell and Peterson (1968) prepared a study: Idaho's Minerals Industry--A Flow-of-Product Analysis containing worthwhile information quite applicable to our Idaho mineral industry and hence to the potential of proposed Wild and Scenic Rivers programs. In my opinion, some of their conclusions suggest that we must consider our mineral resources in the light of calmness, with peaceful, thoughtful and constructive down-to-earth attitudes.

The people of Idaho and the entire country need to listen and carefully evaluate for themselves all that is being written and publicly stated about the mining industry. Rhetoric, beautiful scenic slides and movies are enjoyable; however, when down-to-earth reason takes over, I believe our people

TABLE IV [1]

EXAMPLES OF FEASIBLE LAND USE GROUPINGS

MULTIPLE USE OF LAND IS POSSIBLE		EXCLUSIONARY USE IS A NECESSITY
MULTIPLE USES OF SURFACE The uses listed are NATURALLY COMPATIBLE at least with Hunting, Fishing and MINERAL EXPLORATION - Grazing - Forests (logging) & Tree Farms - Recreation --National Parks* --National Monuments* --Recreation Areas* - Wilderness** - Reservoirs - Pipe Lines - Power Lines	EXCLUSIVE USES OF SURFACE Usually COMPATIBLE with UNDERGROUND MINING in good and/or deep ground, and, with mineral EXPLORATION. - Farming*** - Towns, Villages, Cities, Subdivisions - Factories & Industrial Uses --Refineries --Mills --Mine Plants --Waste Dumps --Tailings Ponds & Dams - Railroads, Highways - Colleges, University Campuses - Airfields - Military Installations* - Penal Institutions	- Dams - Dangerous Testing Facilities - Underground mines in weak and/or shallow ground - Open pit mines

NOTE:

* Use is usually exclusive by legislative or administrative decision.

** Law allows only restricted exploration, development & mining.

*** Hunting sometimes compatible.

[1] (University of Idaho, 1966, p. 82)

TABLE V

EFFECTS OF MODERN MINERAL EXPLORATION-DEVELOPMENT-OPERATION ON SURFACE RESOURCES *

Activities & Installations	Effect on Land Surface Resources
Geologic Exploration	No effect on land resources.
Geochemical Exploration	No effect on land resources.
Airborne Geophysical Exploration	No effect on land resources.
Ground Geophysical Exploration	May involve cuttinglines for access in heavy timber/brush. Such lines normally obliterated within months. Seismic surveys require drilling of shallow holes and detonation of small explosive charges in holes. No permanent damage to surface resources.
Three-Dimensional Sampling	Drilling requires construction of drill-site (50' x 50') with access by road or helicopter. Helicopter access requires flat, cleared area 200' x 200'. Access roads and drillsites usually constructed with bulldozer. Roads provide access to otherwise inaccessible areas, but unless maintained, are usually erased by nature within 2-3 years. Re-contouring and reseeding accelerate disappearance of construction work to one year or less.
Strip Mine (e.g. flat bedded coal deposit)	Requires total removal of soil and rock to expose valuable mineral. After removal, area can be re-contoured, re-seeded and re-forested, yielding crop land, forests, recreational areas, fishing and hunting sites, etc. Elapsed time varies with size of area, but reclamation benefits can be derived in less than ten years after cessation of strip mining.
Open Pit Mine (Three-dimensional deposit)	Requires excavation of a pit with dimensions up to several thousands of feet in diameter and several hundreds of feet deep. Involves use of heavy earth-moving equipment, blasting agents, etc. Time involved varies with size, but may take 5 to 100 years. Such pits are often very significant tourist attractions; i.e. Bingham Canyon, Utah.
Underground Mine in Non-Caving Ground	Mine shaft, mill and surface yards and buildings may occupy a few acres to 1/10 square mile of level, cleared land. Little or no waste is removed from the mine; hence, no large waste dumps are needed. Beyond mine site, there is little effect on surface resources except for access roads and power lines. Presence of underground mine has little effect on scenic and other uses of surface except in near vicinity of mine.
Underground Mine in Caving Ground	Surface plant area same as above, but additional damage to surface may result from caving of underground workings (process similar to sink hole formation in limestone terranes). Extent of surface damage varies, but hazardous conditions

* (University of Idaho, 1966, p. 85)

TABLE V (Con't)

Activities & Installations	Effect on Land Surface Resources
	of caving ground preclude surface uses other than the most necessary during life of mine. Subsequent to mining, caved areas, if topographically low, may fill with water, forming attractive recreation sites.
Concentrator (Mill) and Ancillary Surface Facilities	Should be located close to mine site. Requires a cleared site of several acres suitable for heavy construction.
Leach Dumps and Precipitation Plant	Subgrade ore is stacked on dumps and subjected to leaching by mildly acid solutions. Site may be level or hilly, but must have adequate solution collection charateristics. Leach dumps must be near mine site.
Mine Waste	Non-ore material which must be removed to reach ore is stacked on waste dumps near mine site. Waste dumps need not be on level ground, but surface resources are completely destroyed over the area.
Tailings Disposal	Mill waste (finely ground rock) is placed in a tailings pond surrounded by a containing dam to restrict movement of material. In high relief areas, areal extent of tailings pond is quite small but is larger in areas of low relief. Tailings disposal destroys natural surface values beneath pond, but certain kinds of vegetation can be cultivated on the surface of abandoned tailings pond.

can find solutions to our problems without drastic and often regrettable, emotional acts.

Public Lands in this State belong to everyone, but a relatively small portion of the U. S. population lives here. We cannot afford the luxury of large tracts of non-taxable, non-productive lands advocated by the more affluent minorities from within or from without the State. In my opinion, it is economically unsound to neglect our mineral resources and other industries and to promote a vast wilderness playground for the nation. No one in Idaho wants the State's environment wantonly destroyed by any industry or industries. This includes action against improper industrial practices involving mining, lumbering, ranching, agriculture, or any developmental malpractice.

In the minds of some, including Edward Abbey (1968), a well-known conservationist, "...industrial tourism..." can be excessively oversold. Eagerness for the tourist's dollar has commonly lead to regrettable results. This includes the construction of paved roads, building of crude campsites, boat launching ramps, concessions, etc. In Abbey's opinion a majority of tourists, therefore a large part of our population, will not go where they cannot drive, whether it be to the top of a scenic mountain or along a river valley. I am not opposed to tourism, if it is treated equally with other industries as a possible source of environmental pollution. We need the tourist's dollar because we are a large State with a small population (Table VI). It is impossible to determine the amount of money that tourists bring into our economy. In my opinion, it is wrong to state that tourism is or should be our most important industry. One might guess that in Hawaii, tourism probably is one of the state's greatest industries.

Also on the economic side, Newell and Peterson (1968, p. 30) have uncovered pertinent summary facts related to our minerals industry and interrelation with the State's total economy. In summary, they point out that their study demonstrates, among other things, that many of our mineral industries' products move out of the State and return dollars. Labor is reportedly "... the greatest single input to the minerals industry." Much money to operate the State's financial structure is derived from taxes levied on the minerals industry and its payrolls; and includes support industries which depend upon continued and expanding output of mineral commodities. Newell and Peterson draw these final conclusions from their data:

(1) The minerals industry is strongly labor oriented because human resources are the greatest single input for each of the processing sectors. For example, wages and salaries amounted to $39,264,000 in 1965.

(2) The minerals industry is a basic industry because it sells to markets outside Idaho and thereby brings dollars into the State's economy. In this regard, export sales amounted to approximately $188,298,000 in 1965.

(3) The minerals industry supplies tax dollars to support State and local government. In fact, $4,306,000 in taxes were paid during 1965.

(4) The minerals industry buys from facilitating firms and thereby supports indirect employment and other industries. To illustrate in 1965, purchases from retail-wholesale services and capital improvements amounted to $55,266,000.

(5) Expansion of mining and processing firms, or attraction of new mineral processing firms into the state, would increase the economic benefits derived from minerals industry firms.

It should be pointed out that there are gaps in our dollar-value knowledge in respect to the minerals industries, and in my opinion, the figures cited above probably represent minimal figures. In long terms, especially in Idaho's early mining history, much mineral production is known to have gone unreported through lack of control of early-day mining. Also, the above figures are already 5 years old, and are undoubtedly too small to represent current totals. Table VI is an abbreviated record of some of Idaho's industrial operations and merits inspection.

Recommendations and the future

Mining and other Public Lands operations need not blight the environment. Modern methods, responsible people and proper (not prohibitive) laws are essential to recovery of natural resources, or use of Public Lands in the best interests of the public.

I would suggest that during this decade, we move rapidly with nationwide efforts to clean our planet by taking action on all general environmental pollution, including the mining industry where it is necessary. If we neglect this industry or bring it to doom, however, then we will be without adequate minerals to meet our needs, and high environmental standards will be a lost cause, because normal living standards will become so low that even human existence will be threatened.

As a first recommendation, although others have appeared in the text above: I would emphasize that potentially valuable mineralized areas (metallogenic provinces), such as those in the 16.5 percent of our State constituted by the Salmon River drainage basin, be protected and developed where mineral potential is present.

As a second recommendation: I believe that a reasonable Act making a portion of the main Salmon River part of a Wild and Scenic River, should proceed; but such an act should include built-in safeguards that would protect and permit growth and expansion of all industries, including any development of potential or known mineralized areas in the drainage basin.

As a third recommendation: I suggest that no roads, other than those now in existence be built along the main Salmon, nor erosion be permitted adjacent to the main river by any activity.

As a fourth recommendation: I strongly suggest that the number of people taking trips down the Salmon River, if and when it becomes a Wild and Scenic River, be restricted, and they not be permitted to pollute the canyon or river.

TABLE VI

Some indications of Idaho's industrial economic position

(Source: Idaho State Department of Commerce and Development, May 1970, Idaho Business Indicators p. 8)

Production and Trade	Units	Year 1969
Electricity produced	Million KWH's	5121
Gasoline sold	Gallons 000's	377647
Construction major cities	$ 000's	88272
Passenger car sales (new)	Number	24404
Trucks sold (new)	Number	13692
Mining*		
Lead	Short tons (2000 lbs.)	64942
Zinc	Short tons	58157
Silver	Thousand Troy ozs. (1/12 lb.)	18655
Finance (At end of period)	Millions of dollars	
Loans	" " "	696
Investments	" " "	299
Demand deposits	" " "	535
Time deposits	" " "	539
Retail		
State total reported	$000's	3276072
Agriculture		
Total cash receipts	$000's	620332

* See Table I-B for other mineral data and values. Note also, lumbering and other industries are not included in this table above.

As a fifth recommendation: I suggest that a competent, scientifically trained committee, or committees, continue to examine current State and Federal laws, pertaining not only to mining, but to other industrial activities that may be conducted in the Salmon River basin area. The situation should be studied, reviewed, and if necessary, revisions of all laws considered, pertaining to environmental contamination. I especially recommend that State and/or Federal Agencies make provisions for adequate, unbiased enforcement of any and all such laws. In the area of mining, the proper staking of claims and required assessment work clauses should be enforced.

As a sixth recommendation: I suggest that all State and Federal Agencies concerned with our citizen's welfare and standards of living; as well as their legal rights under all constitutional law; be protected by farsighted, watchful programs looking to future mineral needs, and the right to exploration and development of strategic and industrial minerals.

This report, in a sense, departs from the purpose of establishing a "Methodology Study for Designating Requirements for Wild and Scenic Rivers"; however, in my opinion, the Salmon River and its drainage basin constitute a valuable and unique situation, where a complete and thorough analysis of mineral potential should be made. Several stretches of other rivers, being suggested for Wild and Scenic status, will not require more than a brief study of mineral economic potential. Because of the nature of the rocks and terrain within their drainage basins or adjacent to their main channels, mineral potential is small.

In the long-term view, this discussion of the Salmon River and minerals within its drainage basin, in relation to possible inclusion of the Salmon River under the Wild and Scenic Rivers Acts, points out the need for stepping-up our programs for mineral exploration by using our best known, modern means of mineral exploration and development. We must recognize that much work has to be done before critical situations come up. Any impending shortages of strategic minerals must be recognized early, particularly relative to minerals that occur in Public Land areas. It requires from two to seven years, depending upon the situation, to put a mining operation into production. Just knowing where potentially valuable and important economic minerals may be located is not enough. Furthermore, we must keep in mind that less than one-percent of the area of our State is or will be affected by mining sites of importance.

If our very freedom is endangered by any important mineral shortage, then for survival, there must be complete collaboration and an end to bickering among people of the mining, agricultural, lumbering, power, environmental, ecological and preservation groups. There is need for cooperation between State and Federal governments and knowledgeable scientists representing all facets of the mineral problems we will encounter.

The Daily Idahonian, of Moscow, Idaho recently summarized some of the comments made by Dr. Duncan Pattern, an Arizona State University associate professor of Botany (1970, v. 77, no. 205). As a consultant to the National Public Land Review Commission, he commented strongly against open pit mining and was quoted as saying that "...mining companies have for years considered the environment something to utilize and in many cases to spoil...". Dr. Pattern's statement was unfair to many mining companies operating today, and his statement was too general, if reported correctly. However, even Dr. Pattern

after making his statements about the carelessness of mining companies stated strongly in his conclusions that the emphasis should be placed on solving problems, as many of us believe. There is no need for destroying our mining industry, but as he indicated, since mining and mining products are necessary for society and our welfare, the obvious solution of banning mining is not viable. Meaning that our lives depend upon this industry.

Finally, I would like to quote a recent report from Western Mining News, 1970, Mining hi-lights, v. 2 no. 28, p. 6:

> 'Mineral exploration and development should have a preference over some or all other uses on much of our Public Lands,' the Public Land Law Review Commission said in its five-year, $7 million study of public land laws. The Commission said the availability of minerals is a substantial element in the American standard of living and our survival as a leading nation depends upon our mineral supplies.

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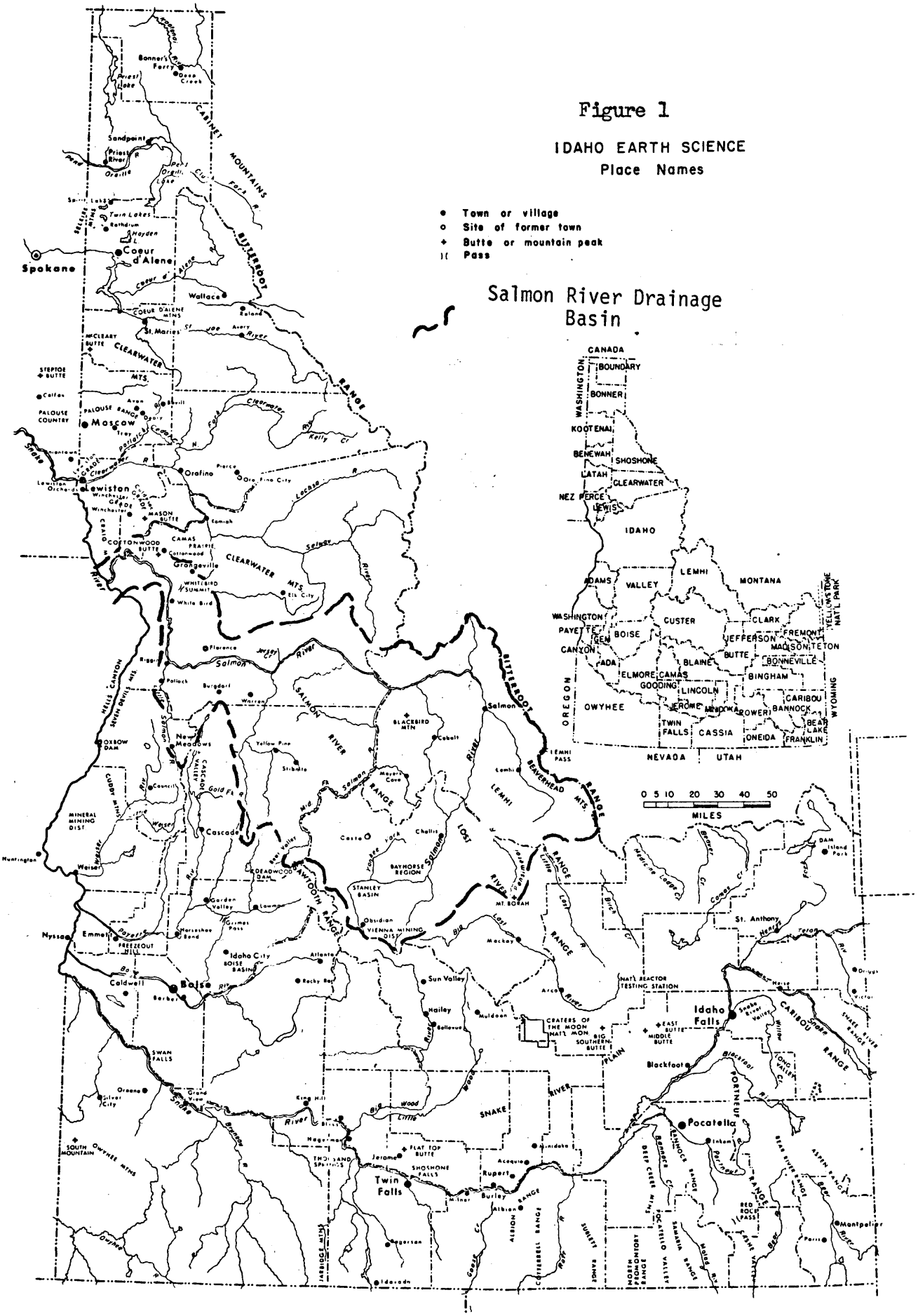

Figure 1

IDAHO EARTH SCIENCE
Place Names

Figure 2

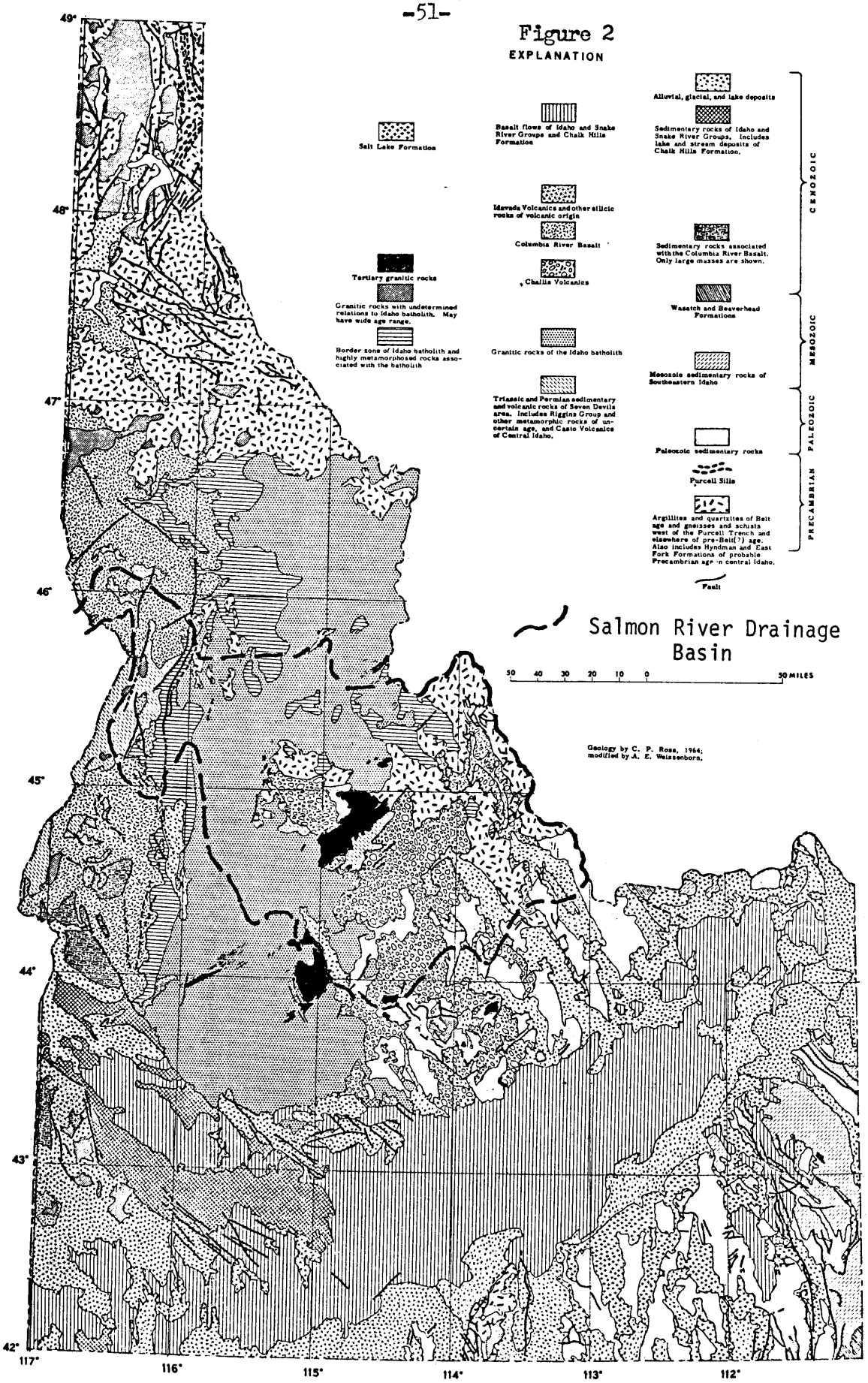
EXPLANATION
Salt Lake Formation
Tertiary granitic rocks
Granitic rocks with undetermined relations to Idaho batholith. May have wide age range.
Border zone of Idaho batholith and highly metamorphosed rocks associated with the batholith
Basalt flows of Idaho and Snake River Groups and Chalk Hills Formation
Idavada Volcanics and other silicic rocks of volcanic origin
Columbia River Basalt
Challis Volcanics
Granitic rocks of the Idaho batholith
Triassic and Permian sedimentary and volcanic rocks of Seven Devils area. Includes Riggins Group and other metamorphic rocks of uncertain age, and Casto Volcanics of Central Idaho.
Alluvial, glacial, and lake deposits
Sedimentary rocks of Idaho and Snake River Groups. Includes lake and stream deposits of Chalk Hills Formation.
Sedimentary rocks associated with the Columbia River Basalt. Only large masses are shown.
Wasatch and Beaverhead Formations
Mesozoic sedimentary rocks of Southeastern Idaho
Paleozoic sedimentary rocks
Purcell Sills
Argillites and quartzites of Belt age and gneisses and schists west of the Purcell Trench and elsewhere of pre-Belt(?) age. Also includes Hyndman and East Fork Formations of probable Precambrian age in central Idaho.
CENOZOIC
MESOZOIC
PALEOZOIC
PRECAMBRIAN
Fault
Salmon River Drainage Basin
50 40 30 20 10 0 50 MILES
Geology by C. P. Ross, 1964; modified by A. E. Weissenborn.
49°
48°
47°
46°
45°
44°
43°
42°
117°
116°
115°
114°
113°
112°

Figure 3 Antimony and Tungsten

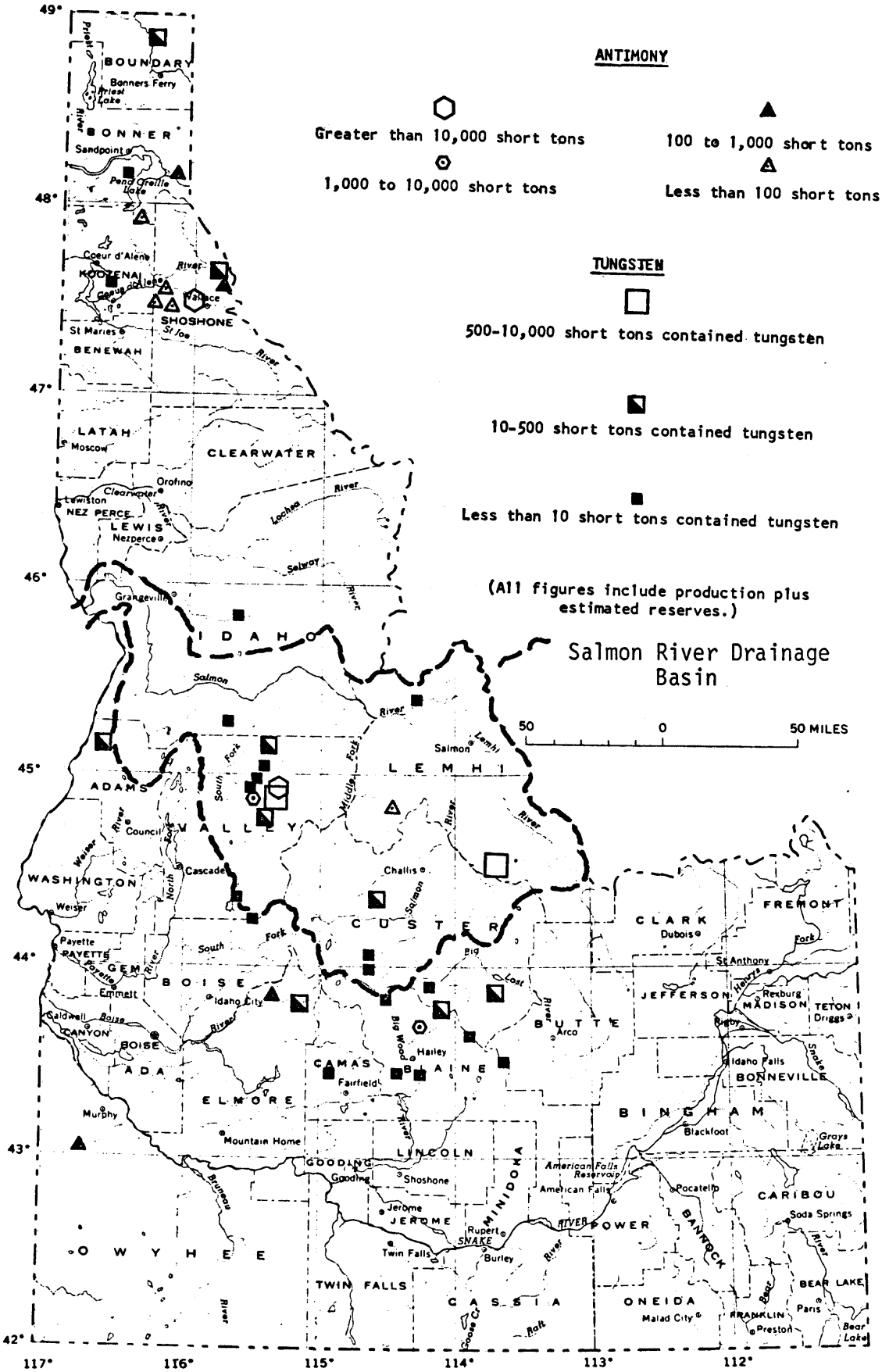

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Figure 4

Barite, Fluorspar, and Clay

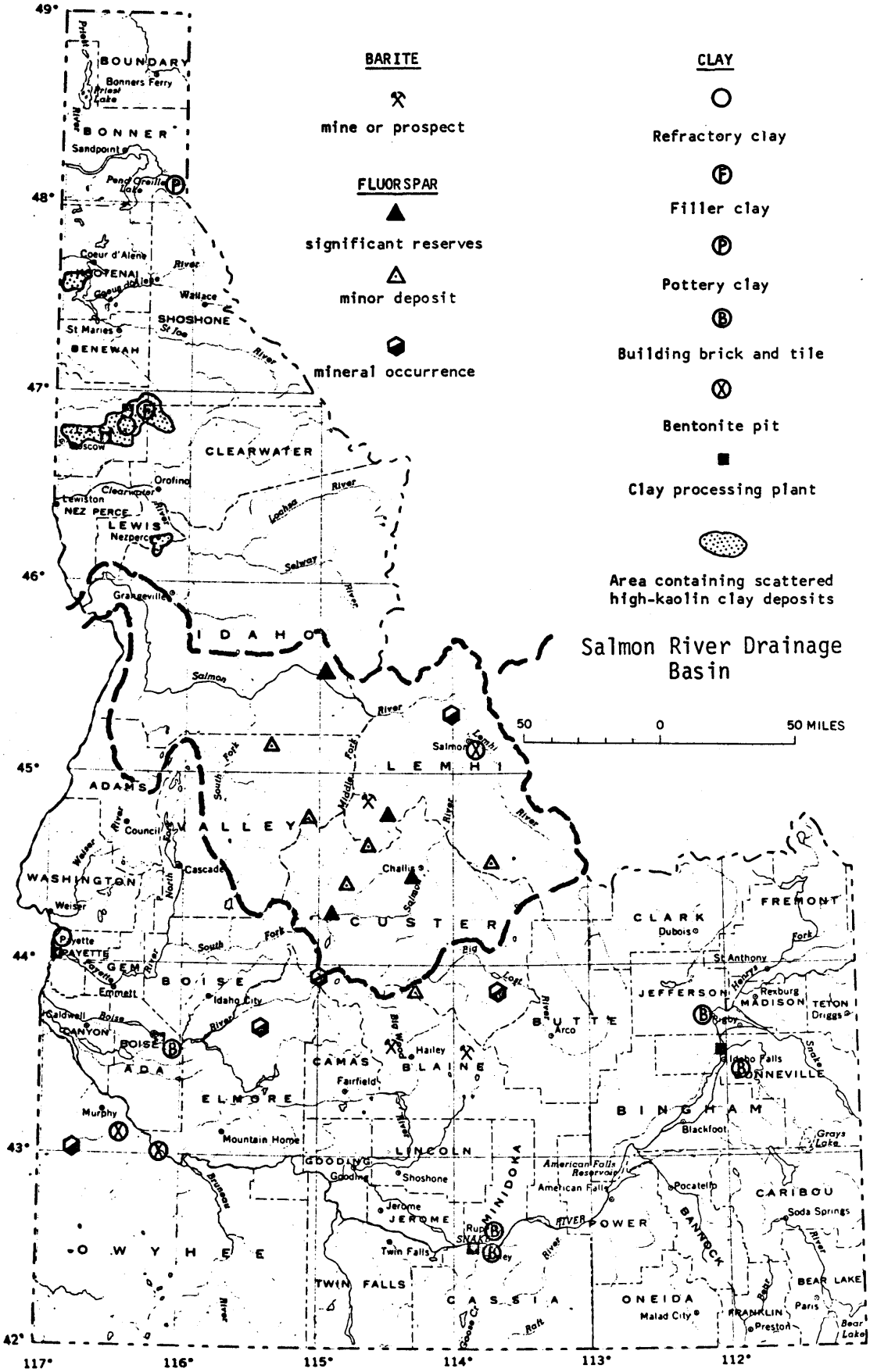

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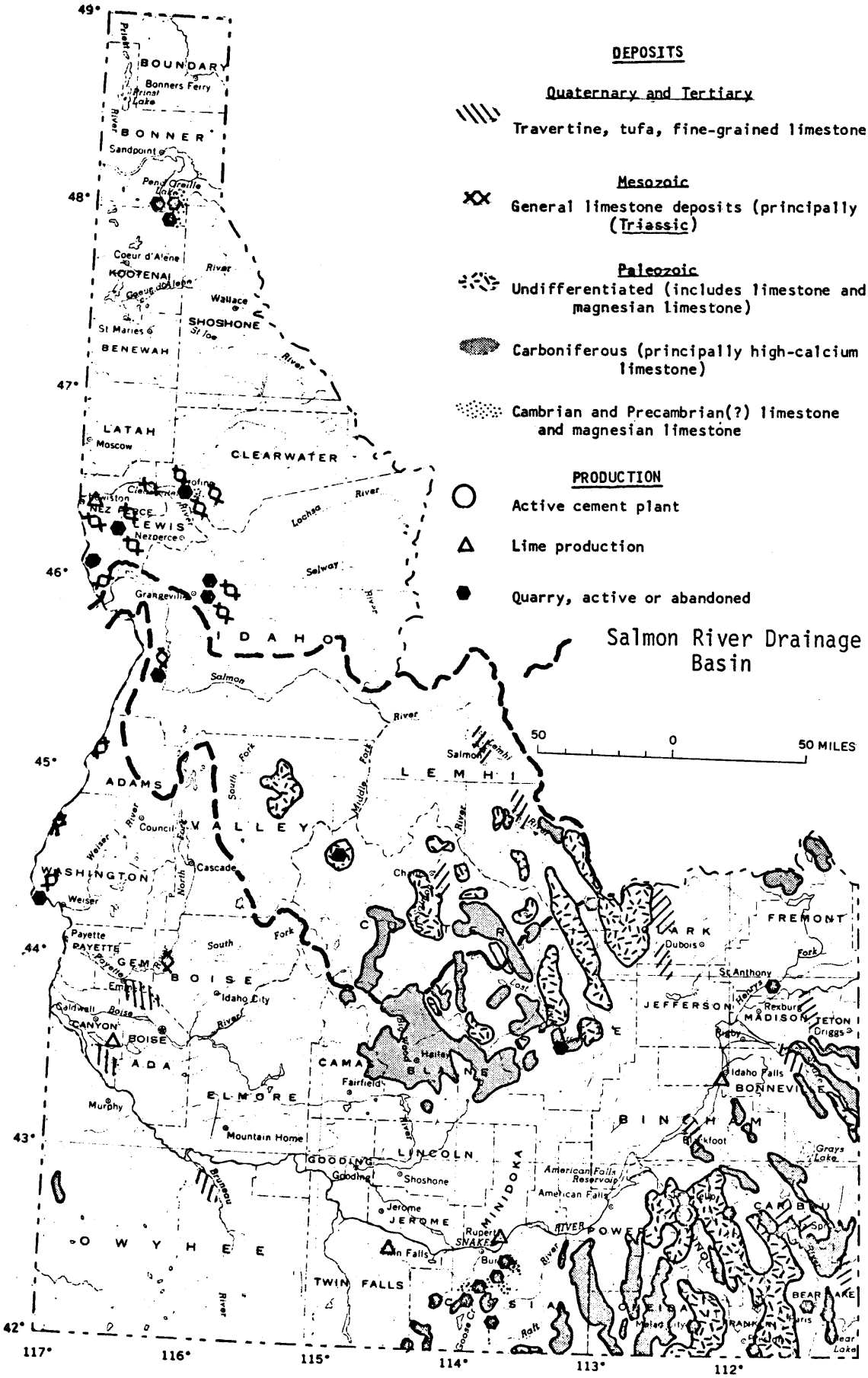
Figure 5 Carbonate Rock



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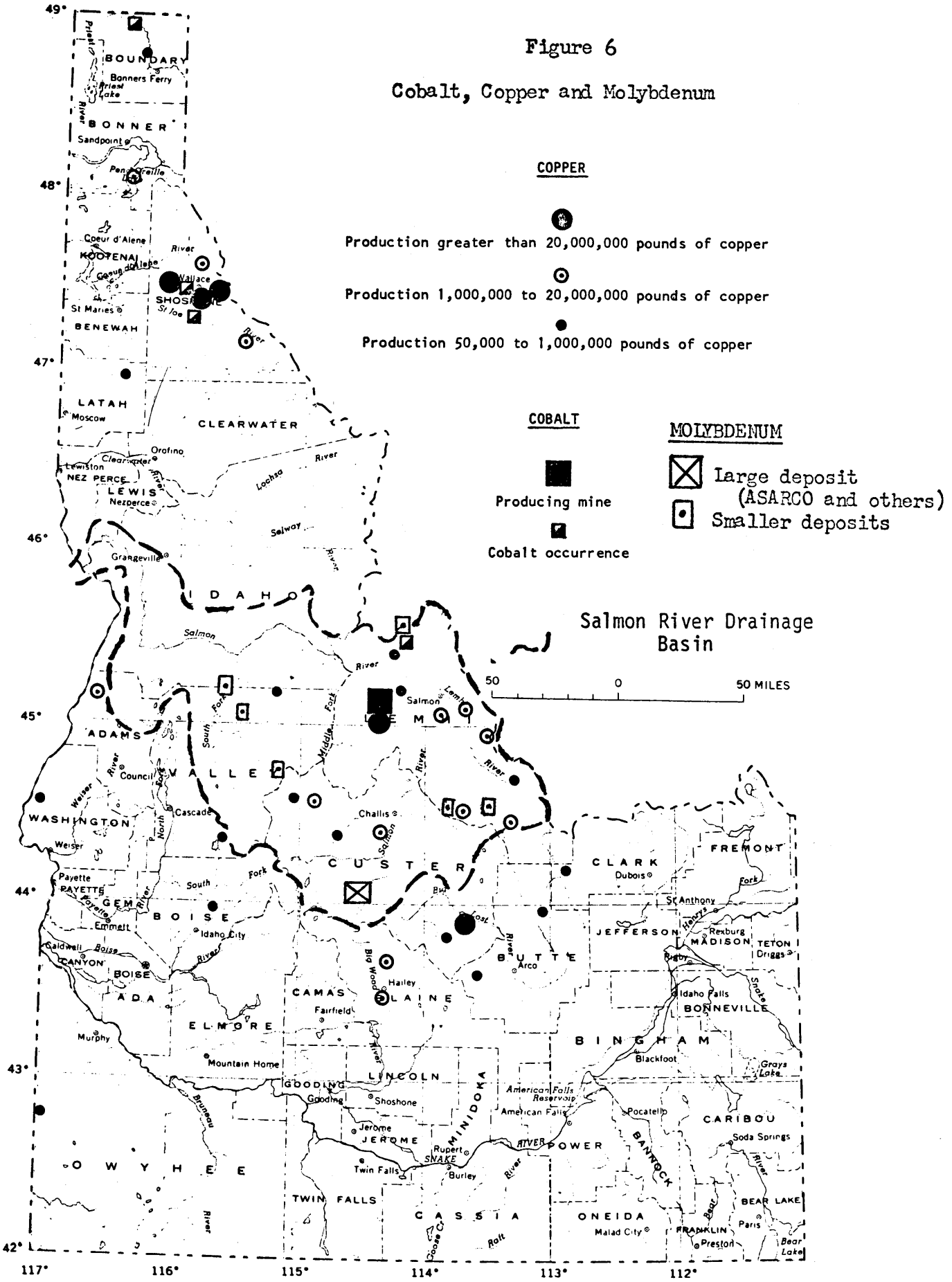

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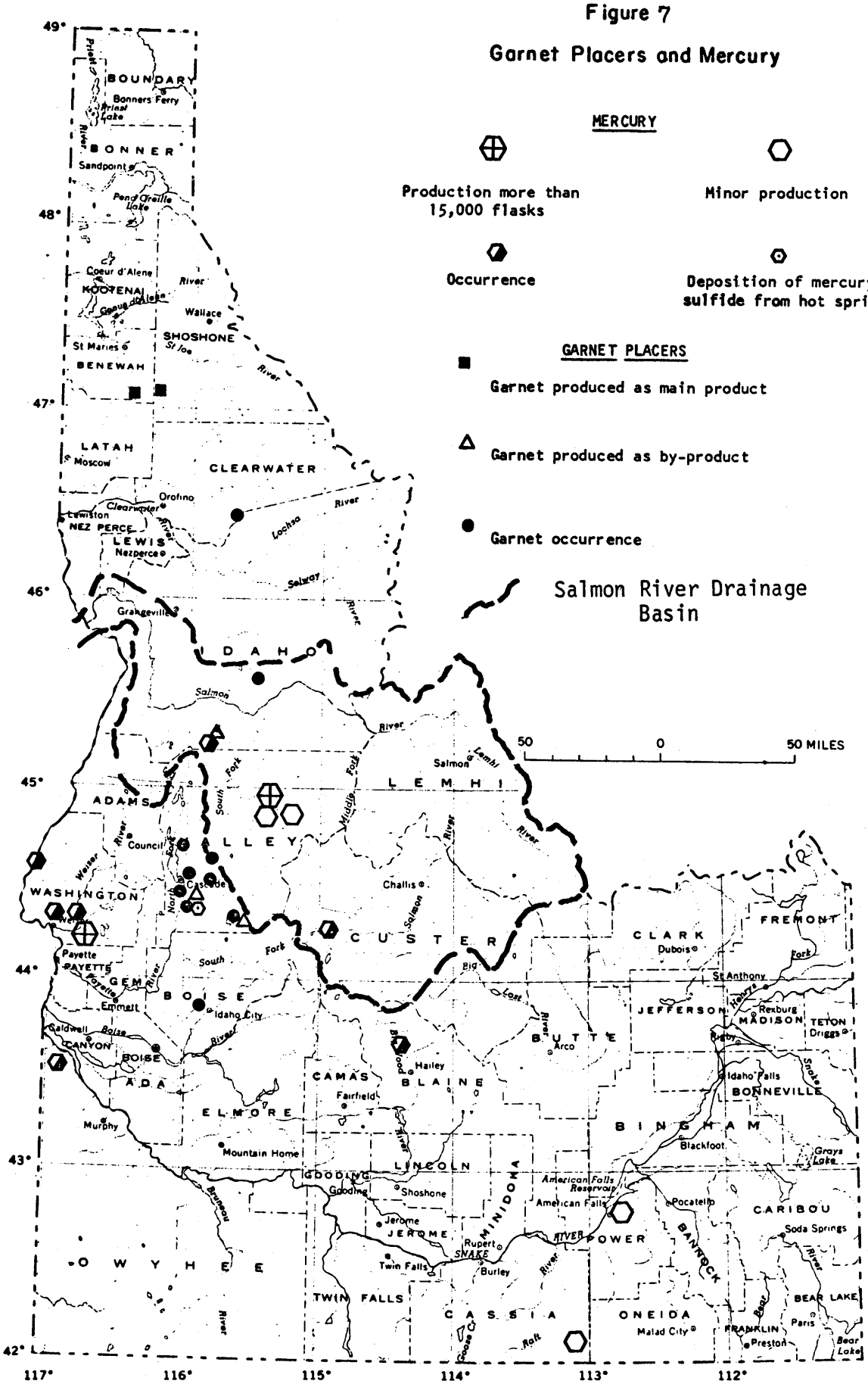
Figure 7

Garnet Placers and Mercury



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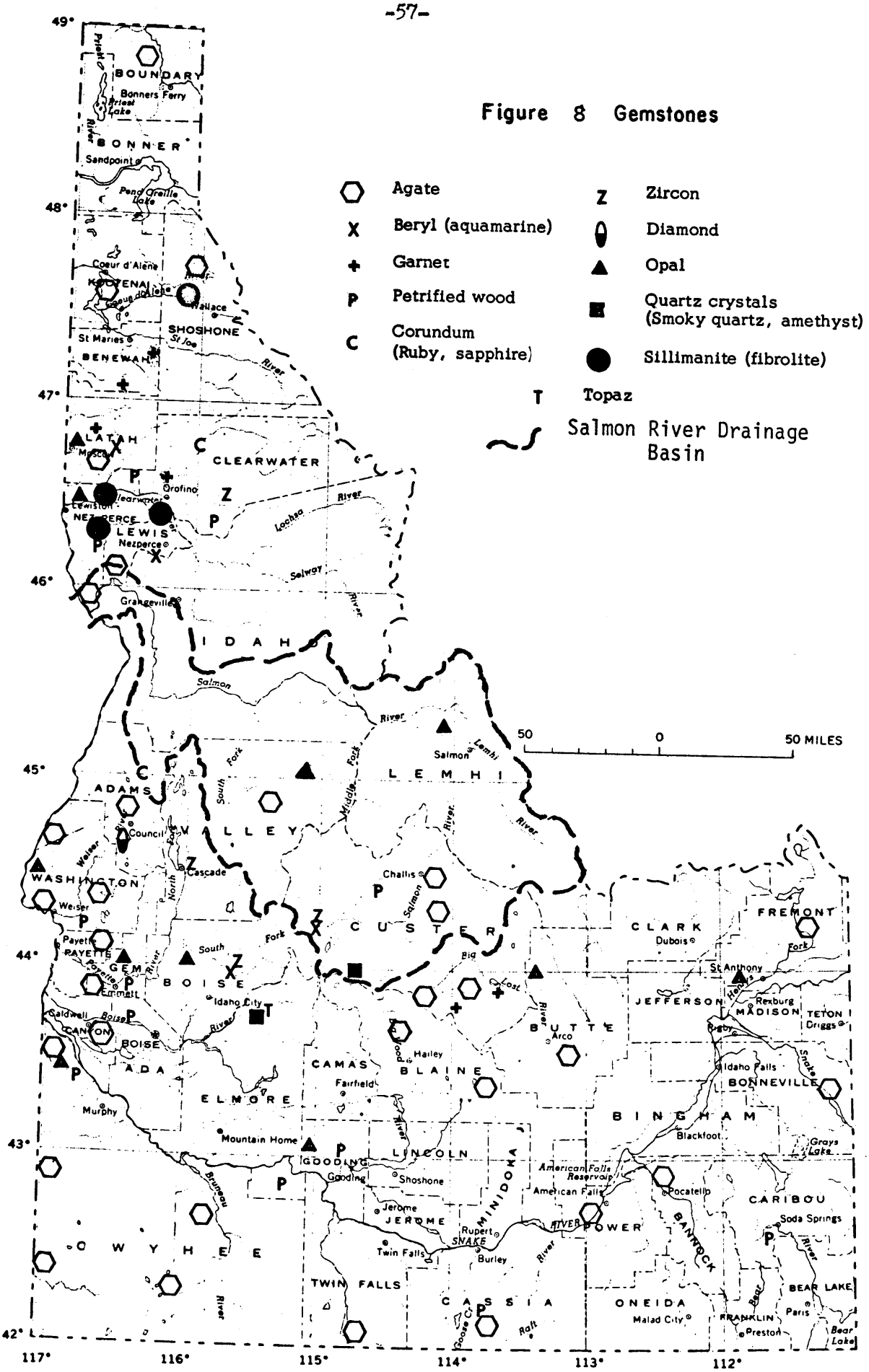

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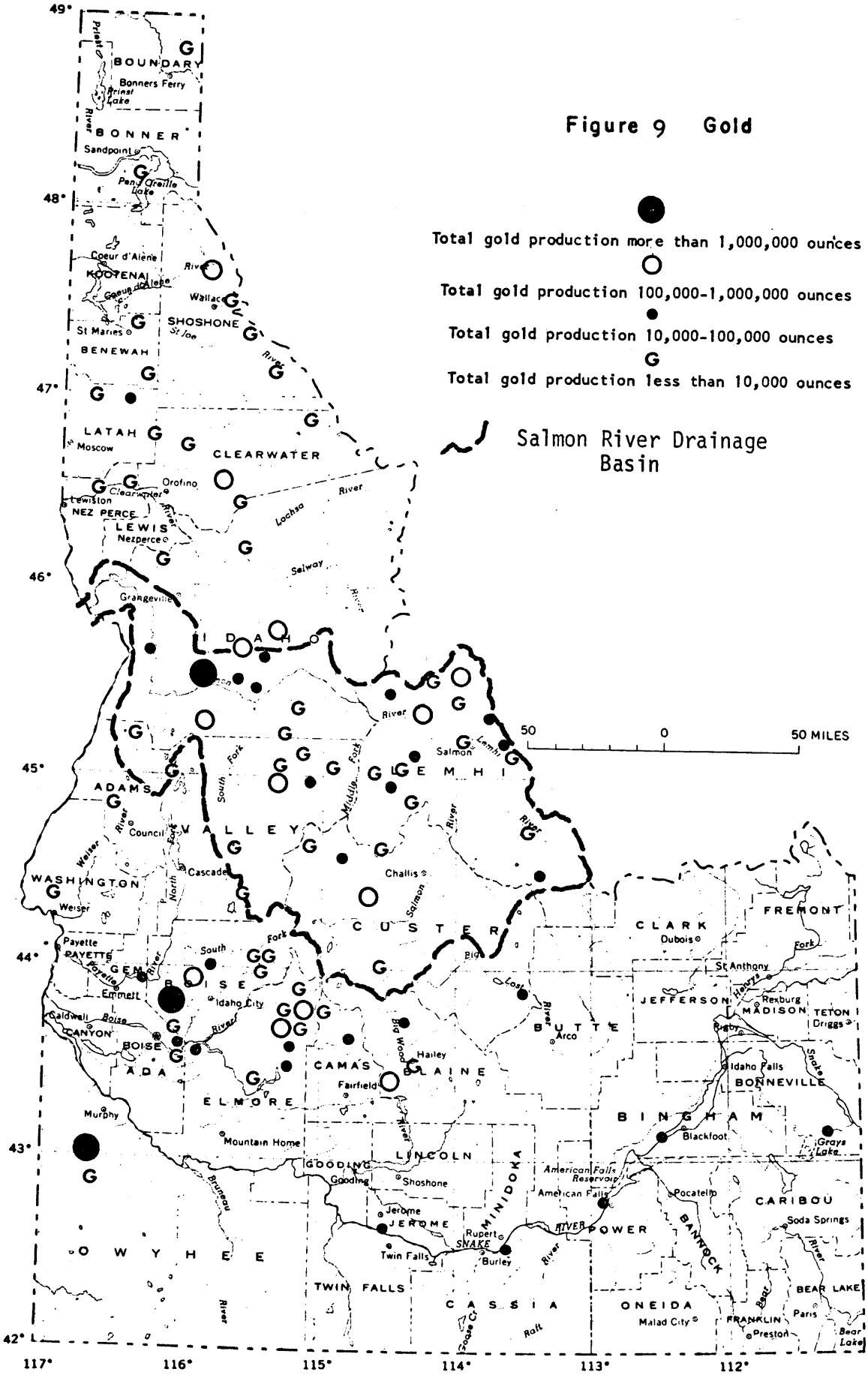

Figure 9 Gold

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Figure 10 Iron Ore

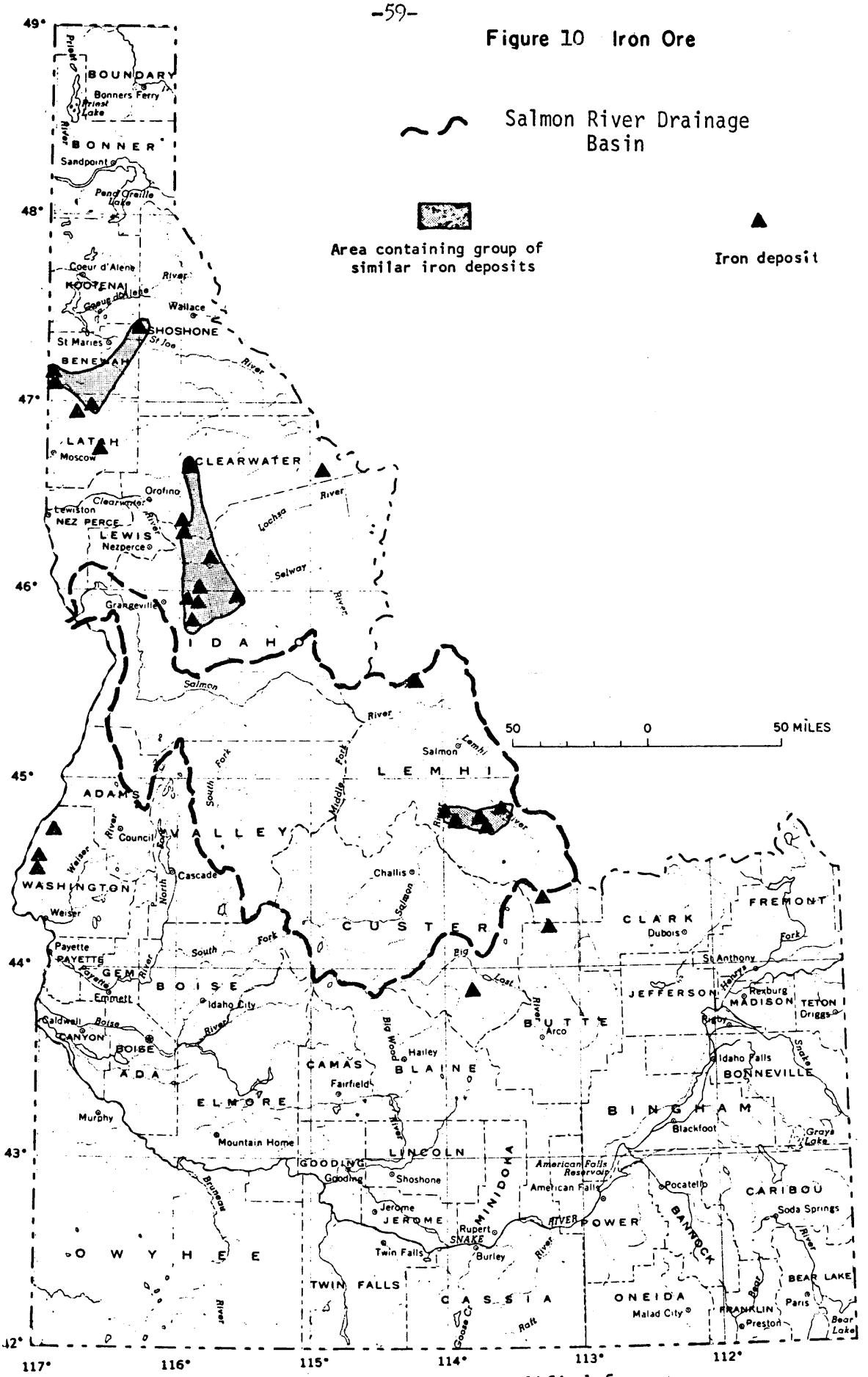

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Figure 11 , Peat and Phosphate Rock

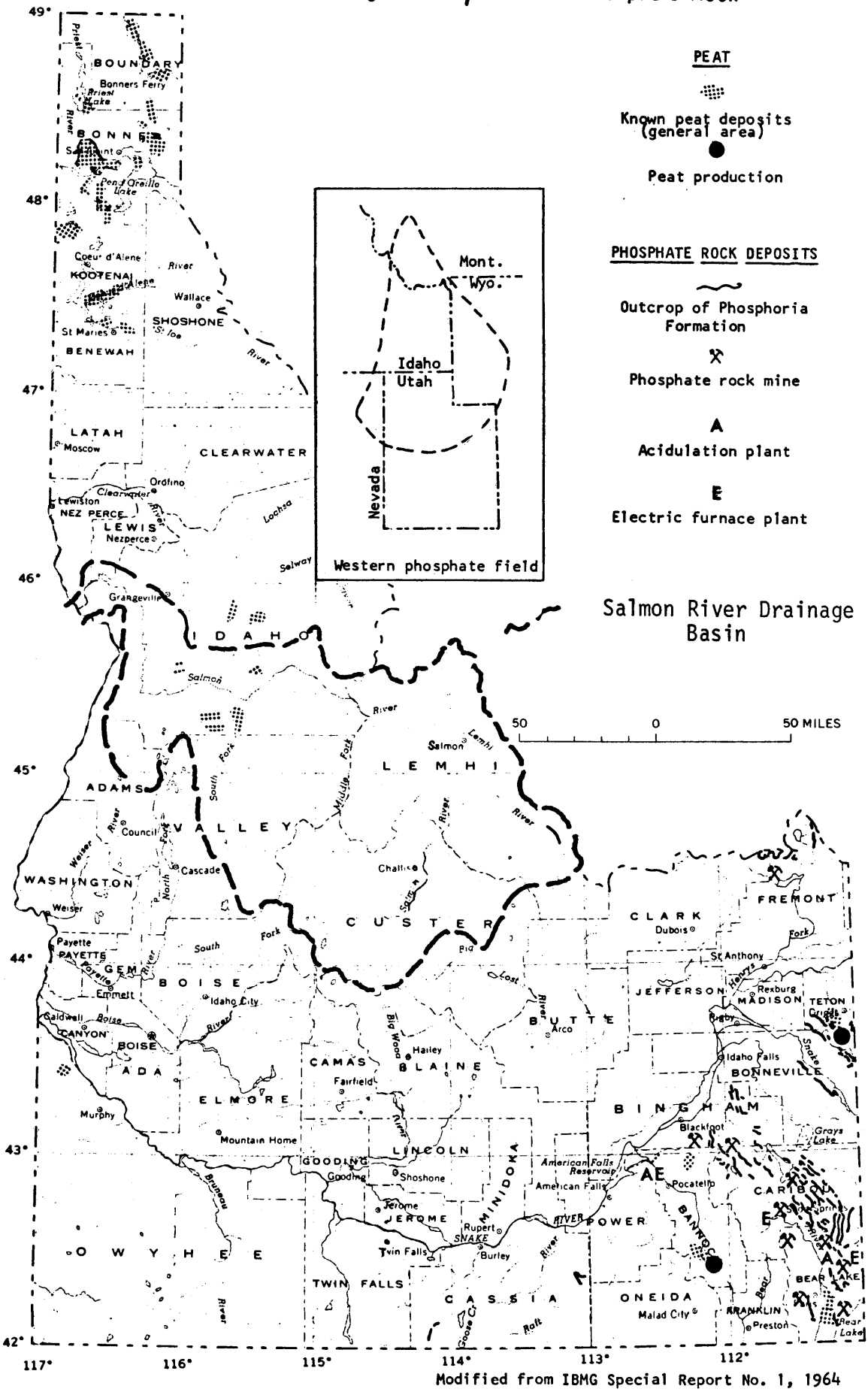

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Figure 12. Silica

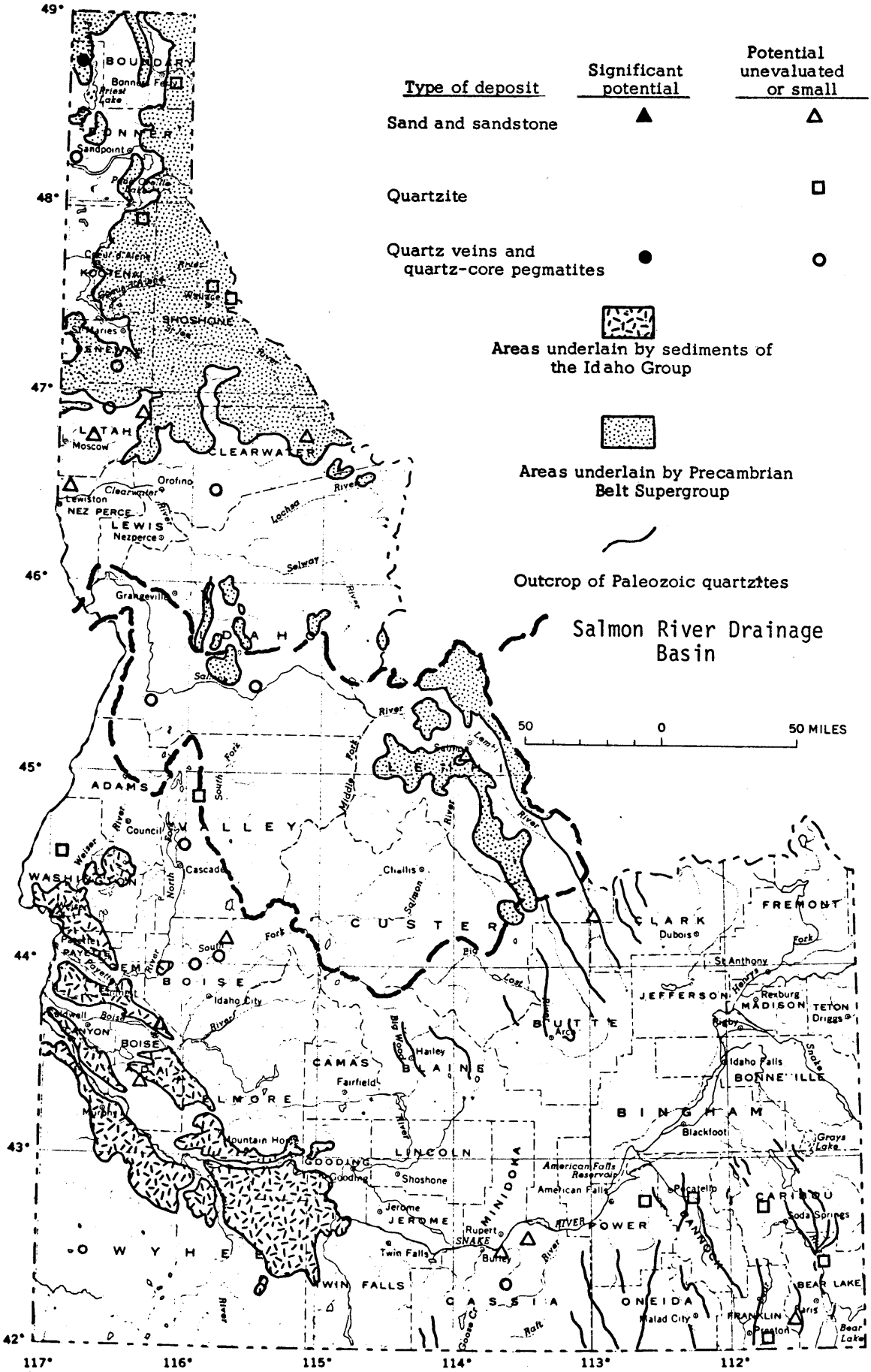

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Figure 13

Silver, Lead, and Zinc

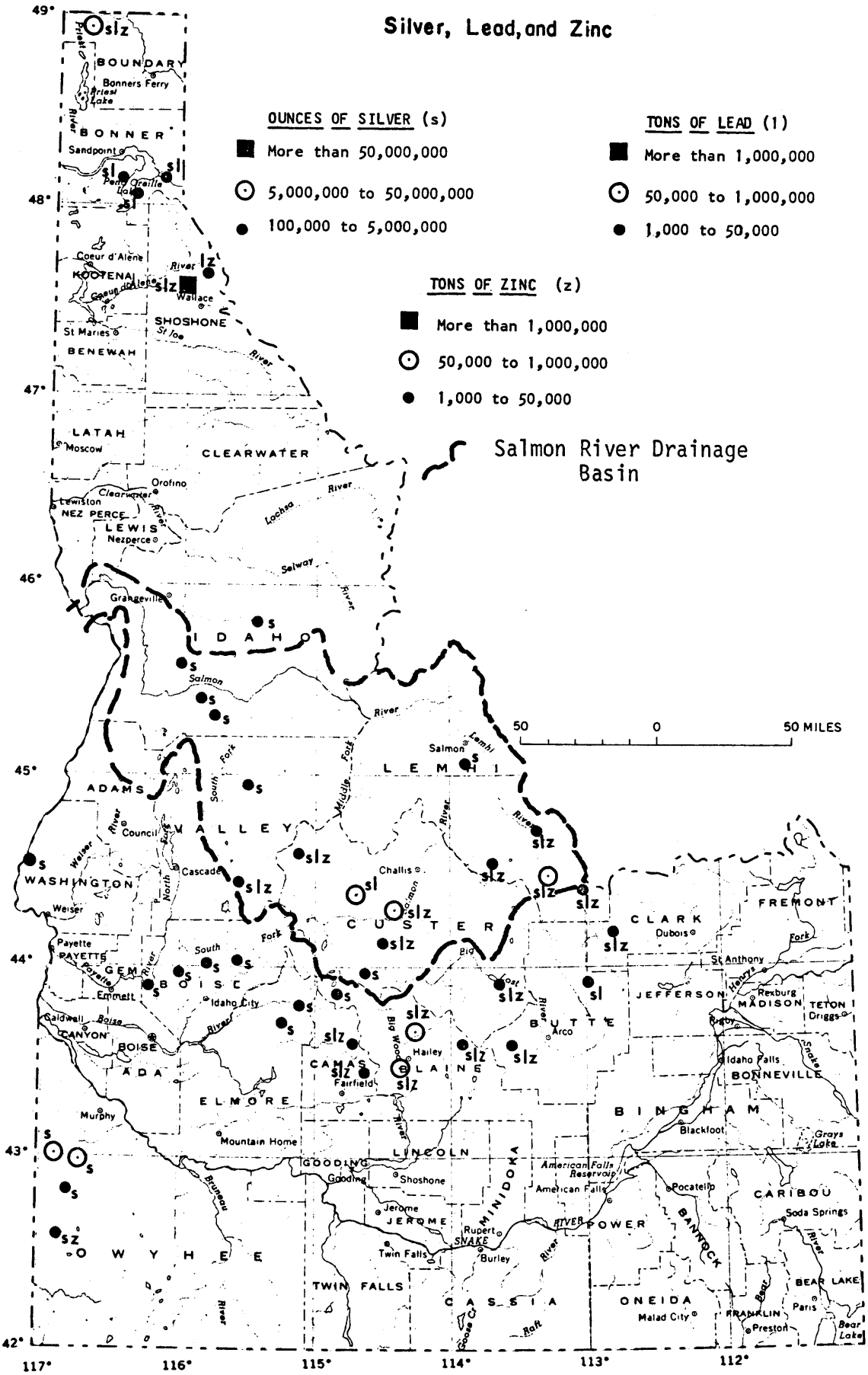

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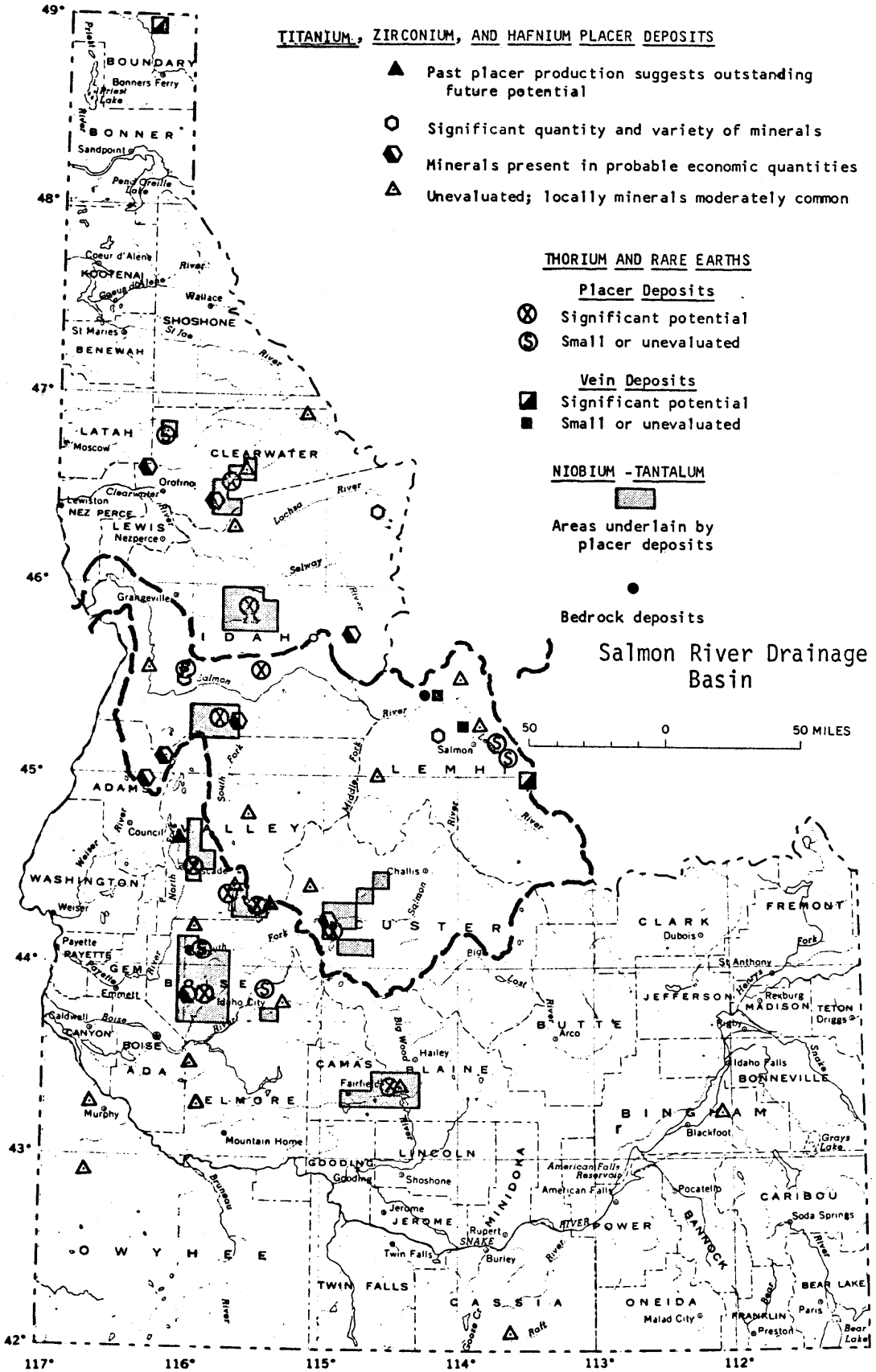
Figure 14.

Titanium, Zirconium, and Hafniun, Niobium-Tantalum, and Thorium and Rare Earths



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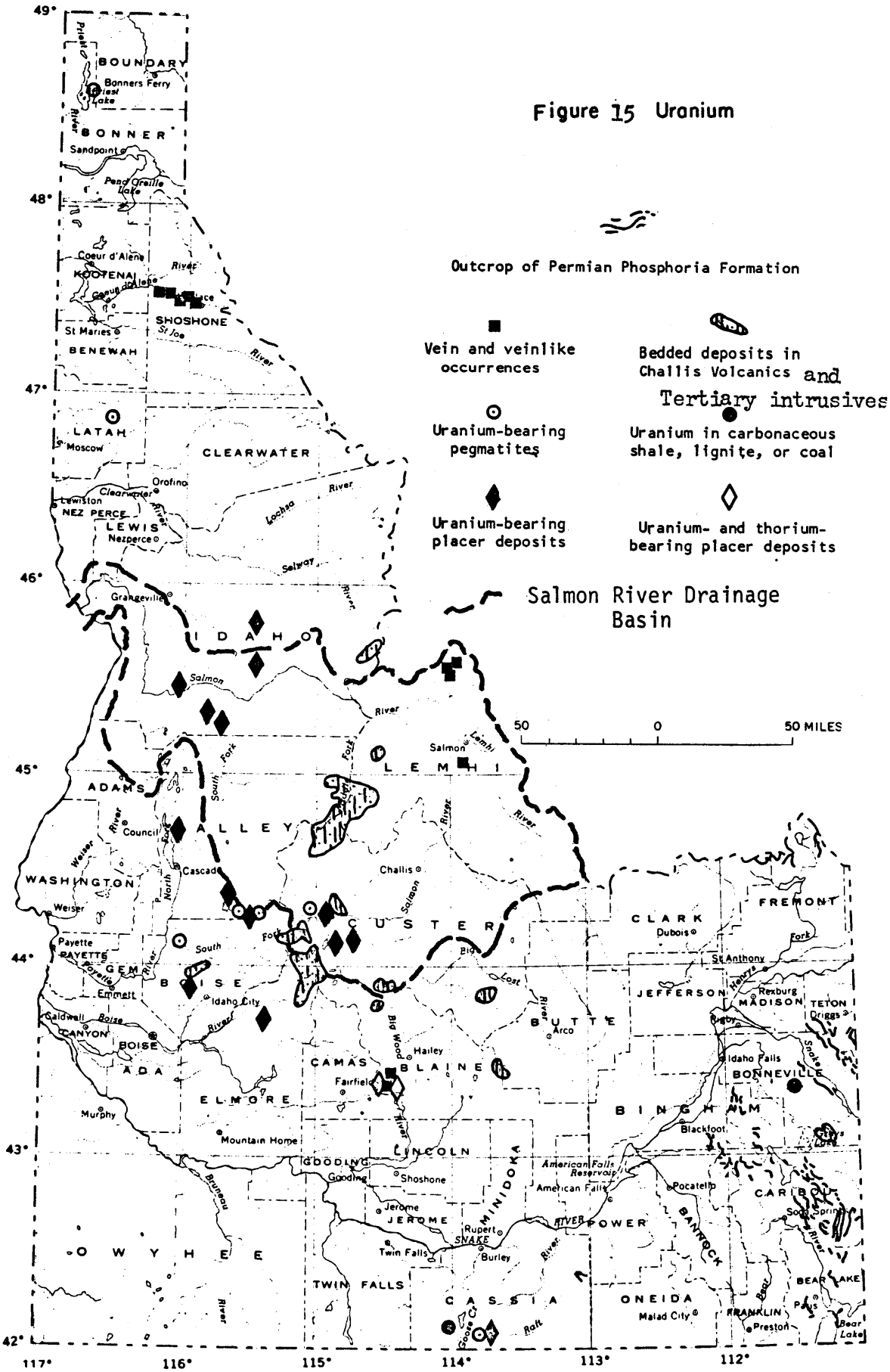

Figure 15 Uranium

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