

Environmental Quality Council
May 27, 2020

John Metesh
Montana Bureau of Mines and Geology

Assessment of mineral resource potential in Wilderness Study Areas (WSAs)

Began with Wilderness Act of 1964 that required the Geological Survey and the Bureau of Mines to conduct mineral surveys of Forest Service (and later, BLM) lands.

Studies were completed by 1983 that included:

- multiple publications of each WSA
- statewide publications
- comprehensive publications
 - by USGS in 1984: “Professional Paper 1300”
and
 - by USBOM in 1993: “Availability Special Report”

General process

- Geologic map compilation and new mapping
- Compilation of past producing mines
 - production records, reports etc.
- Geochemical sampling and assays
 - “prospecting”
- Assessment of resource potential
 - Reports and maps

Typical description from a report (emphasis added):

“The staffs of the Geological Survey and the Bureau of Mines collaborated on the many investigations required to assess the mineral resources of the wilderness lands designated by Congress for study. The work involved geologic, geochemical, and geophysical studies by the Geological Survey. The Bureau of Mines sampled and mapped mines and prospects, compiled information on claims, and compiled data from exploration, mining, and production records.

A geologic map was prepared for each area. Data from field observations and measurements, with existing geologic maps as a starting point, were used to compile the map that shows the distribution and structure of the various types of rocks-features that generally control the location of mineral resources. The geologic maps were prepared at scales appropriate to show the information necessary to make the assessment, generally at scales between 1:50,000 and 1:100,000 (1 inch equals 0.8 miles and 1 inch equals 1.6 miles).”

Mineral potential defined

Wilderness mineral potential: Assessment of mineral-resource potential in U.S. Forest Service lands studied in 1964-1984: Volume 2, Professional Paper 1300- 2, Prepared in cooperation with the U.S. Bureau of Mines, Edited by: S.P. Marsh, S.J. Kropschot, and R.G. Dickinson.

“**USGS** Professional Paper 1300” (emphasis added)

Areas that have substantiated mineral-resource potential are shown in red on the maps. The term "substantiated" is based on a record of past production or the occurrence of identified resources, and (or) on an assemblage of geologic data that strongly indicate the presence of undiscovered mineral resources.

Areas that have probable mineral-resource potential are shown in pink on the maps. The term "probable" is based on an assemblage of data that support the interpretation that undiscovered mineral resources may be present. In some areas, probable and substantiated mineral-resource potential overlap. In these areas, a darker shade of red is used.

Mineral potential defined

“**USGS** Professional Paper 1300” continued...(emphasis added)

Identified resources are those whose location, grade, quality, and quantity are known or estimated from specific geologic evidence.

Demonstrated resources is a term for the sum of measured and indicated resources whose quantity is computed from dimensions revealed in outcrops, trenches, workings, or drill holes and whose grade and (or) quality are computed from the results of detailed sampling.

Inferred resources is a term for resource estimates that are based on assumed continuity beyond those of the measured and (or) indicated categories for which there is geologic evidence that might or might not be supported by samples or measurements.

Mineral potential defined

US Bureau of Mines (Mineral Resource Potential of the West Pioneer Wilderness Study Area, Beaverhead County, Montana, Byron R. Berger, Lawrence W. Snee, William Hanna, U.S. Geological Survey and John R. Benham, U.S. Bureau of Mines, 1983)

“In this report, mineral resource potential refers to the extent to which characteristics suggestive of the presence of concealed mineral deposits fit various mineral-deposit models that are based on our professional experience, geological theory and reasoning, and field and laboratory observations. The mineral resource potential of mines and prospects was effected by detailed geologic mapping of vein exposures and bulk-sampling vein material for assaying. The degree of geological resource potential was determined by comparing all of the observations made and data accumulated to descriptive ore-deposit models. The models used are based on three categories of mineral occurrence: (1) the types of mineral deposits actually known to occur in the study area; (2) the types of deposits that occur in the region around the study area; and, (3) the types of deposits that may occur in the geological environments recognized in the study area based on geological inference but were not recognized in or around the study area.”

(emphasis added)

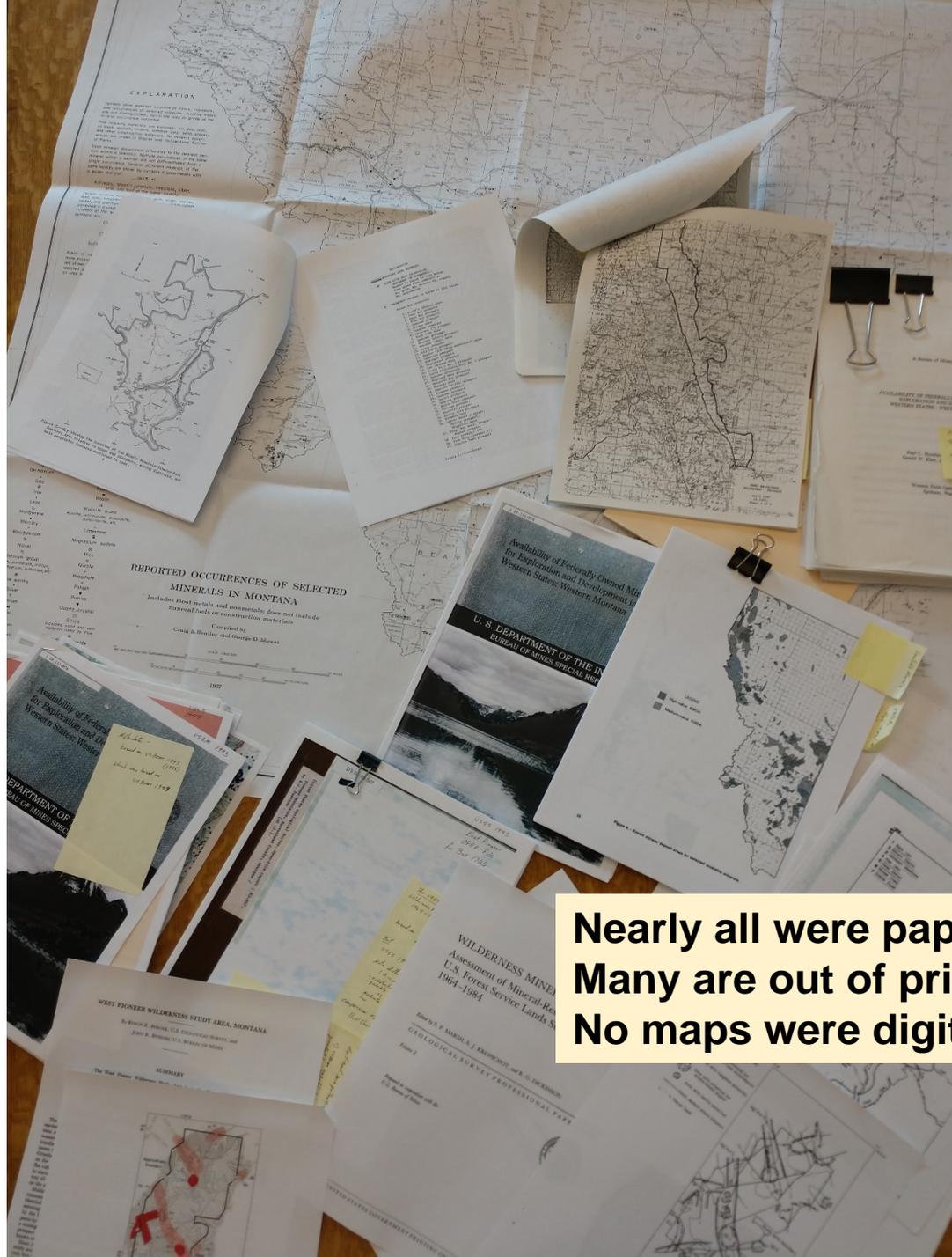
Mineral potential defined

US Bureau of Mines continued...(emphasis added)

A high mineral resource potential is deemed to exist where geologic, geochemical, and geophysical characteristics favorable for resource accumulation are known to be present, or where enough of these characteristics are present to give strong support to genetic models favorable for resource accumulation and where evidence shows that mineral concentration-- mineralization in the broad sense has taken place. This category includes not only known mining districts but also other areas where data are adequate to demonstrate or indicate an excellent possibility that mineralized rock exists. Where available, data on the size, grade, and location of individual deposits are important in making this assessment, but the availability of these data is not a primary requisite. Areas with high mineral resource potential are more closely judged with respect to current economic conditions than those with lesser resource potential.

Moderate mineral resource potential exists where geologic, geochemical, and geophysical characteristics favorable for resource accumulation are known or can reasonably be interpreted to be present but where evidence for mineralization is less clear cut or has not yet been found.

Low mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics are unfavorable, where evidence indicates that mineral concentrations are unlikely, or where requirements of genetic models cannot be supported, such as a lack of source or mechanism of accumulation



**Nearly all were paper only
Many are out of print
No maps were digitized to GIS**

MBMG activities

USFS and BLM Abandoned Inactive Mines (AIM) inventory (1990-2003)

Included mineral assessment studies where appropriate (some studies extended beyond the WSA boundary) and available.

MBMG Data Preservation Program

- General
 - Acquisitions of reports, maps, data related to WSA/RAs
 - We may have the only copy...
- Senator Jon Tester request:
 - selected WSA/RAs in southwest Montana
- Senator Steve Daines request:
 - selected information for mineral withdrawal near YNP
 - MBMG AIM and Ground Water Assessment Program data
 - expanded request to include statewide WSA/RAs
- Earth Mapping Resource Initiative
 - USGS funding (w/matching funds)
 - excludes WSA/RAs, Tribal Lands, etc.

Data sources

67 publications or reports

31 BLM WSAs

80 maps scanned and georeferenced

10 USFS WSAs

60 maps scanned and georeferenced

8400 AIM sites

Base maps

topography

county, roads, streams

geology (MBMG)

Ref #	Document authors	Title	wh
4	Stotelmeyer, Ronald B., 1994	Mineral Resource Investigations of Selected Roadless Areas in Montana National Forests: U.S. Bureau of Mines MLA 9-94, 41 p	Pegg
5	O'Neill, J. Michael, Cather, E. J., Simons, Frank S., Tysdal, Russell G., Van Loenen, Richard E., Lambeth, Robert H., Schmauch, Steven W., Mayerle, Ronald T., and	Mineral Resource Potential Map of the Middle Mountain-Tobacco Root Roadless Area, Madison County, Montana: USGS Map 1590-C, 17 p	Pubs or USG
6	Simon, Frank S., Tysdal, Russell G., Van Loenen, Richard E., Lambeth, Robert H., Schmauch, Steven W., Mayerle, Ronald T., and	Mineral Resource Potential Map of the Madison Roadless Area, Gallatin and Madison Counties, Montana; USGS Map MF 1605-A, 7 p	Pubs or USG
7	Pearson, R. C., Hanna, W.F., James, H. L., Loen, J. S., Moll, S. H., Ruppel, E. T., and Trautwein, C. M., 1990	Map Showing Mineral Resource Assessment for Silver, Cobalt, and Base Metals in Proterozoic Sedimentary Rocks and for Iron, Chromium, Nickel, Talc, Chlorite, Gold, and Graphite in Archean Crystalline Rocks, Dillon 1° x 2° Quadrangle, Idaho and Montana: U.S. Geological Survey Map 1-1803-D.	Pubs or USG
8		Maps Showing Mineral Resource	

	right) only scan MF-1590C	Yes	https://ngmdb.usgs.gov/Prodesc/proddesc_7673.htm
	scan entire map and legend (not text on right) only scan MF-1605-A	Yes	https://ngmdb.usgs.gov/Prodesc/proddesc_7671.htm
	scan map & legend but not text/ only work with areas covered by roadless or WSA	Yes	https://ngmdb.usgs.gov/Prodesc/proddesc_9927.htm

**Layers**

- AIM_database
- State boundary
- County boundaries
- Towns
- Major Roads
- Major Streams
- Major Lakes
- Township, range & section
- Quad boundaries
- Topography - scale changes as zoom in
- DEM & Topography
- USFS Admin Boundaries
- US BLM Admin Boundaries
- Emigrant/Crevise Proposed Withdrawl
- 100k geology (map service)
- 1° x 2° Geology tiffs
- 500k geology MBMG 62
- Montana Mining Districts
- BLM Wilderness & WSAs Boundaries
- USFS Wilderness, WSAs, Roadless Areas Boundaries
- USGS MRDS Hardrock Commodities Only
- Mineral Potential Maps of Large Tracts of Public Lands
- Mineral Potential Maps of Multiple USFS Roadless Areas
- All Roadless & Wilderness Study Area Individual Mineral Potential Maps


 USFS WSAs & Roadless

- Flint Creek Range WSA
 - USGS Prof Paper 1300 - Flint_C
- Elkhorn WSA
 - USGS-OFR-78-325 Figure_1.tif
 - USBOM MLA_9_94_Elkhorn_Study_Area_Pg_14_rr.tif
 - USGS_I-2050-D_clip.tif
 - USGS I-2050_E_plate-1_crop.tif
 - USGS_I-2050-F_A_rr.tif
 - USGS_I-2050-F_B_rr.tif
 - USGS OFR-96-683-A
 - USBOM Special Report - Elkhorn.tif
 - USGS Prof Paper 1300 - Elkhorn_WSA_rr.tif
 - USGS_Bull_1805_Elkhorn_WSA_PS_rr.tif
- USFS Roadless
 - USGS_Map_MF_1605-A_PS_rr.tif
 - USBOM_Madison_Rare_II_Areas_Map_2_rr.tif
 - USGS OFR 78-972 Mt Rare II Rdless Areas W Map_rr.tif
 - USGS OFR 78-972 Mt Rare II Rdless Areas E Map_rr.tif
 - USGS OFR 84-637 Mt Rare II Rdless & Wilderness Areas Plate 1_rr.tif
- Big Snowies WSA (USFS)
- Blue Joint WSA (USFS)
 - USBOM MLA_9_94_Blue_Joint_Study_Area_Pg_5_rr.tif
 - USGS_Prof_Paper_1300-report-Blue_Joint_rr.tif
 - USGS MF 1557-A
- Hyalite-Porcupine-Buffalo_Horn_WSA (USFS)
- Middle Fork of the Judith River (USFS)
- Sapphires WSA (USFS)
- Ten Lakes WSA (USFS)
- West Pioneer WSA (USFS)
 - USGS Prof Paper 1300
 - USGS OFR-96-683-A
 - USGS I-1803_D_plate_crop_rr.tif
 - USGS I-1803_E_sheet_2_crop_rr.tif
 - USGS_I-1803-F_clip.tif
 - USGS I-1803_G_sheet_3S_rr.tif
 - USGS I-1803_G_sheet_3T_rr.tif
 - USGS OFR 78-972 Mt Rare II Rdless Areas W Map_rr.tif
 - USGS OFR 84-637 Mt Rare II Rdless Areas Plate 1_rr.tif
 - USGS OFR-2007-1011
 - USBOM MLA 9-94
 - USGS Map 1585-A
 - USGS_MF_1585-A_Fig3_rr.tif
 - USGS_MF_1585-A_Fig4_rr.tif
 - USGS_Map_1585-A_Fig5_PS_rr.tif
 - USGS_MF_1585-A_Fig6_PS_rr.tif
 - USGS_MF_1585-A_Fig7_rr.tif

US Forest Service WSAs

Multiple reports/maps for each WSA



- Mineral Potential Maps of Individual
 - Antelope Creek WSA (BLM)
 - USBOM Special Report
 - Axolotl Lakes WSA (BLM)
 - USGS I-1803_D_plate_crop_rr.tif
 - USGS I-1803_E_sheet_2_crop_rr.tif
 - USGS_I-1803-F_clip.tif
 - USGS I-1803_G_sheet_3S_rr.tif
 - USGS I-1803_G_sheet_3T_rr.tif
 - USBOM Special Report - Axolotl_Lakes.tif
 - Beaver Meadows WSA (BLM)
 - USBOM Special Report - Beaver_Meadows.tif
 - Bell/Limekiln Canyons WSA (BLM)
 - USBOM Special Report - Bell_Limekiln_Canyons.tif
 - Big Horn Tack On WSA (BLM)
 - USBOM Special Report
 - Big_Horn_Tack_On.tif
 - Burnt_Timber_Canyon.tif
 - Pryor_Mountain.tif
 - Black Sage WSA (BLM)
 - Blacktail Mountains WSA (BLM)
 - USGS I-1803_D_plate_crop_rr.tif
 - USGS I-1803_E_sheet_2_crop_rr.tif
 - USGS_I-1803-F_clip.tif
 - USGS I-1803_G_sheet_3S_rr.tif
 - USGS I-1803_G_sheet_3T_rr.tif
 - USBOM Special Report - Blacktail_Mountains.tif
 - Burnt Timber Canyon WSA (BLM)
 - Centennial Mountains WSA (BLM)
 - Cow Creek WSA (BLM)
 - Dog Creek South WSA (BLM)
 - East Fork of Blacktail Deer Creek WSA (BLM)
 - Elkhorn WSA
 - Ervin Ridge WSA (BLM)
 - Farlin Creek WSA (BLM)
 - Henneberry Ridge WSA (BLM)
 - Hidden Pasture Creek WSA (BLM)
 - Hoodoo Mountain WSA (BLM)
 - Humbug Spires WSA (BLM)
 - North Fork Sun River WSA (BLM)
 - Pryor Mountain WSA (BLM)
 - Quigg West WSA (BLM)
 - Ruby Mountains WSA (BLM)
 - Sheep Creek WSA (BLM)
 - Sleeping Giant WSA (BLM)
 - Square Butte WSA (BLM)
 - Stafford WSA (BLM)
 - Twin Coulee WSA (BLM)
 - Wales Creek WSA (BLM)

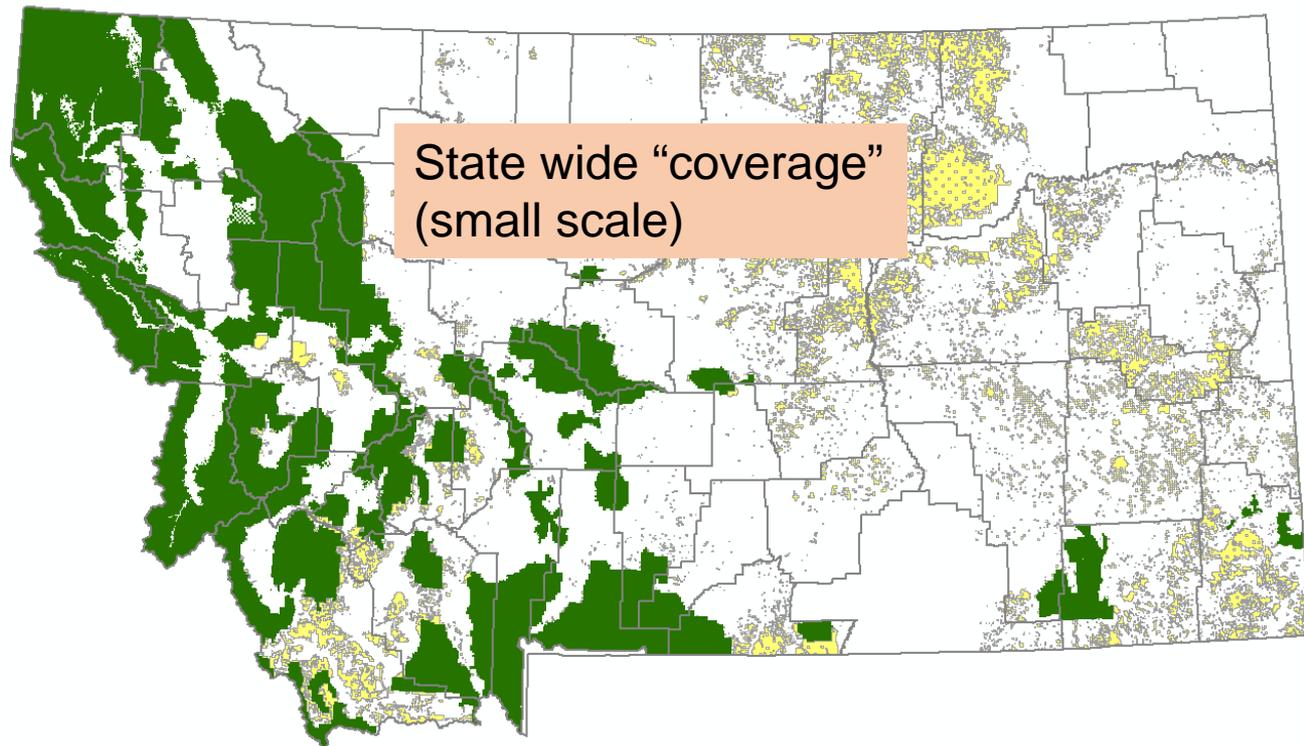
US Bureau of Land Management WSAs

USFS (green) and BLM land (yellow)

Table Of Contents

Layers

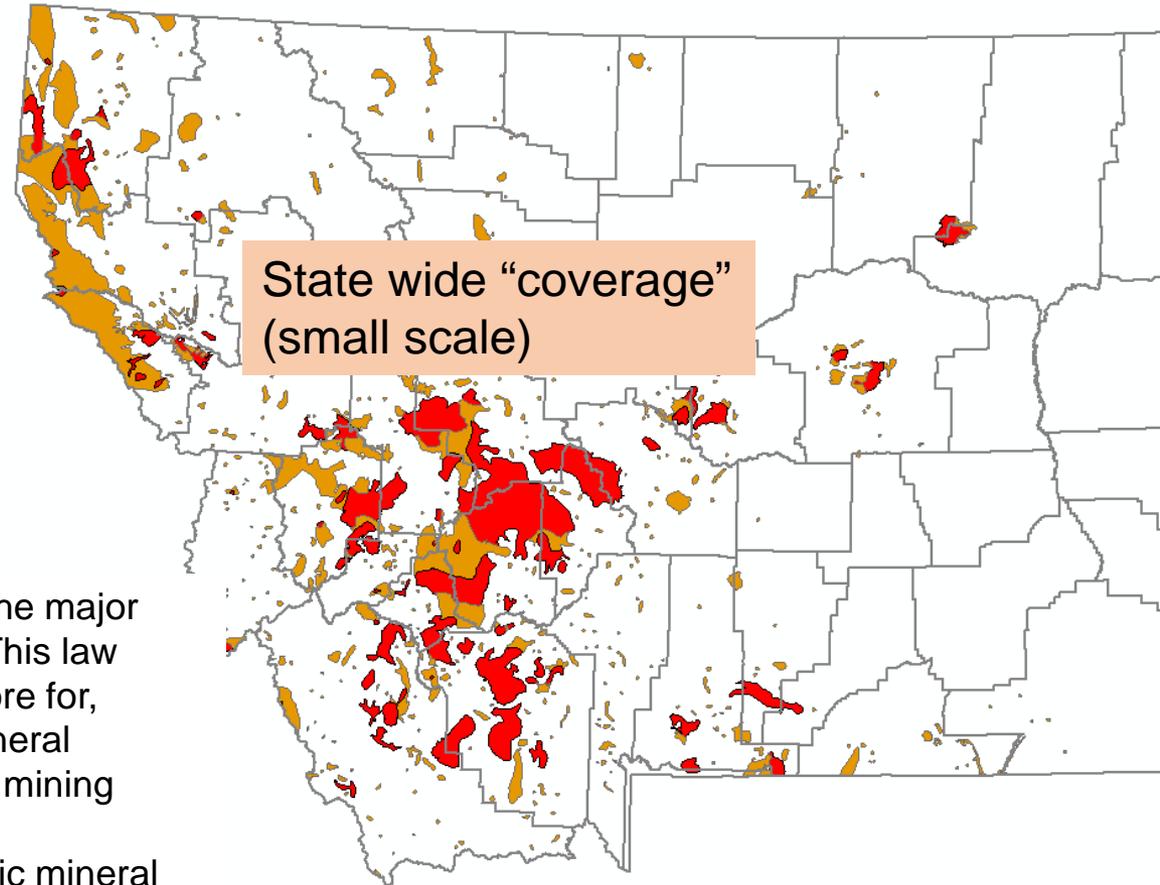
- AIM_database
- State boundary
- County boundaries
- Towns
- Major Roads
- Major Streams
- Major Lakes
- Township, range & section
- Quad boundaries
- Topography - scale changes as zoom in
- DEM & Topography
- USFS Admin Boundaries
- US BLM Admin Boundaries
- Emigrant/Crevise Proposed Withdrawal
- 100k geology (map service)
- 1" x 2" Geology tiffs
- 500k geology MBMG 62
- Montana Mining Districts
- BLM Wilderness & WSAs Boundaries
- USFS Wilderness, WSAs, Roadless Areas Boundaries
- USGS MRDS Hardrock Commodities Only
- Mineral Potential Maps of Large Tracts of Public Lands
- Mineral Potential Maps of Multiple USFS Roadless Areas
- All Roadless & Wilderness Study Area Individual Mineral Potential Maps



US Bureau of Mines Locatable Mineral Potential

Table Of Contents

- Layers
 - AIM_database
 - State boundary
 - County boundaries
 - Towns
 - Major Roads
 - Major Streams
 - Major Lakes
 - Township, range & section
 - Quad boundaries
 - Topography - scale changes as zoom in
 - DEM & Topography
 - USFS Admin Boundaries
 - US BLM Admin Boundaries
 - Emigrant/Crevice Proposed Withdrawal
 - 100k geology (map service)
 - 1" x 2" Geology tiffs
 - 500k geology MBMG 62
 - Montana Mining Districts
 - BLM Wilderness & WSAs Boundaries
 - USFS Wilderness, WSAs, Roadless Areas Boundaries
 - USGS MRDS Hardrock Commodities Only
 - Mineral Potential Maps of Large Tracts of Public Lands
 - USBOM Statewide Locatable Mineral Potential
 - High
 - Moderate

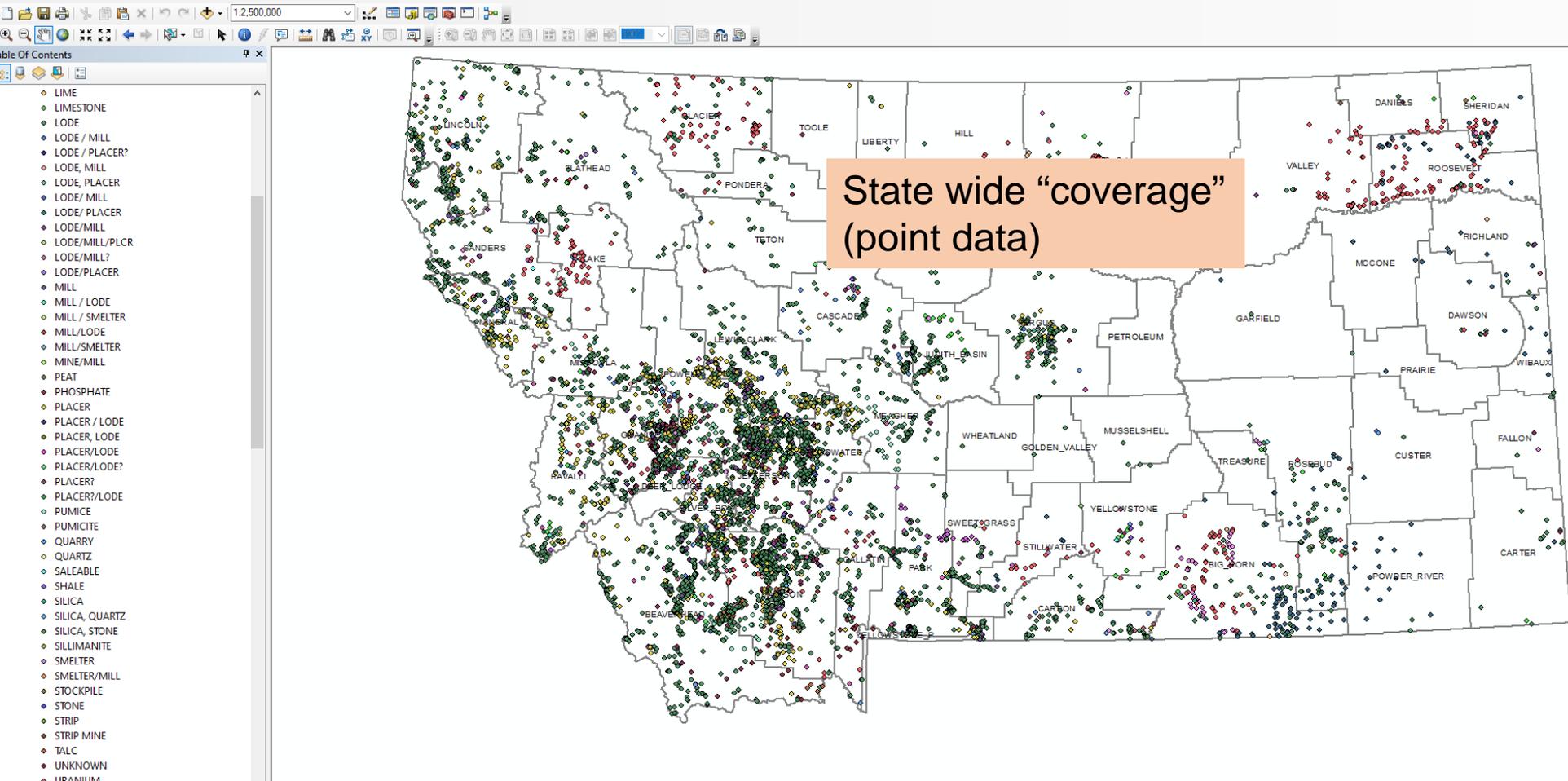


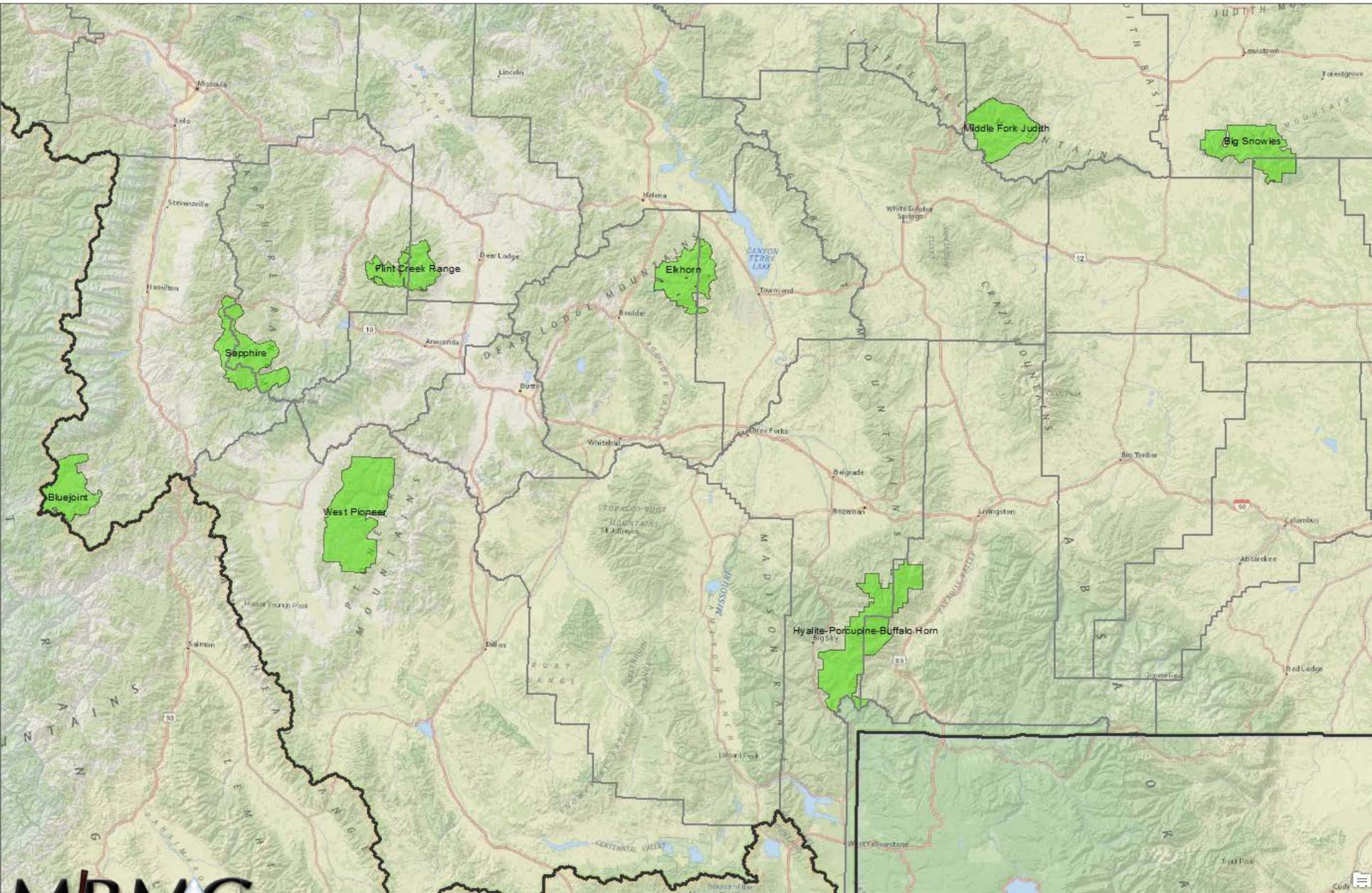
The **Mining Law of 1872**, as amended, is the major Federal law governing locatable minerals. This law allows U.S. citizens the opportunity to explore for, discover, and purchase certain valuable mineral deposits on Federal lands that are open for mining claim location (open to mineral entry).

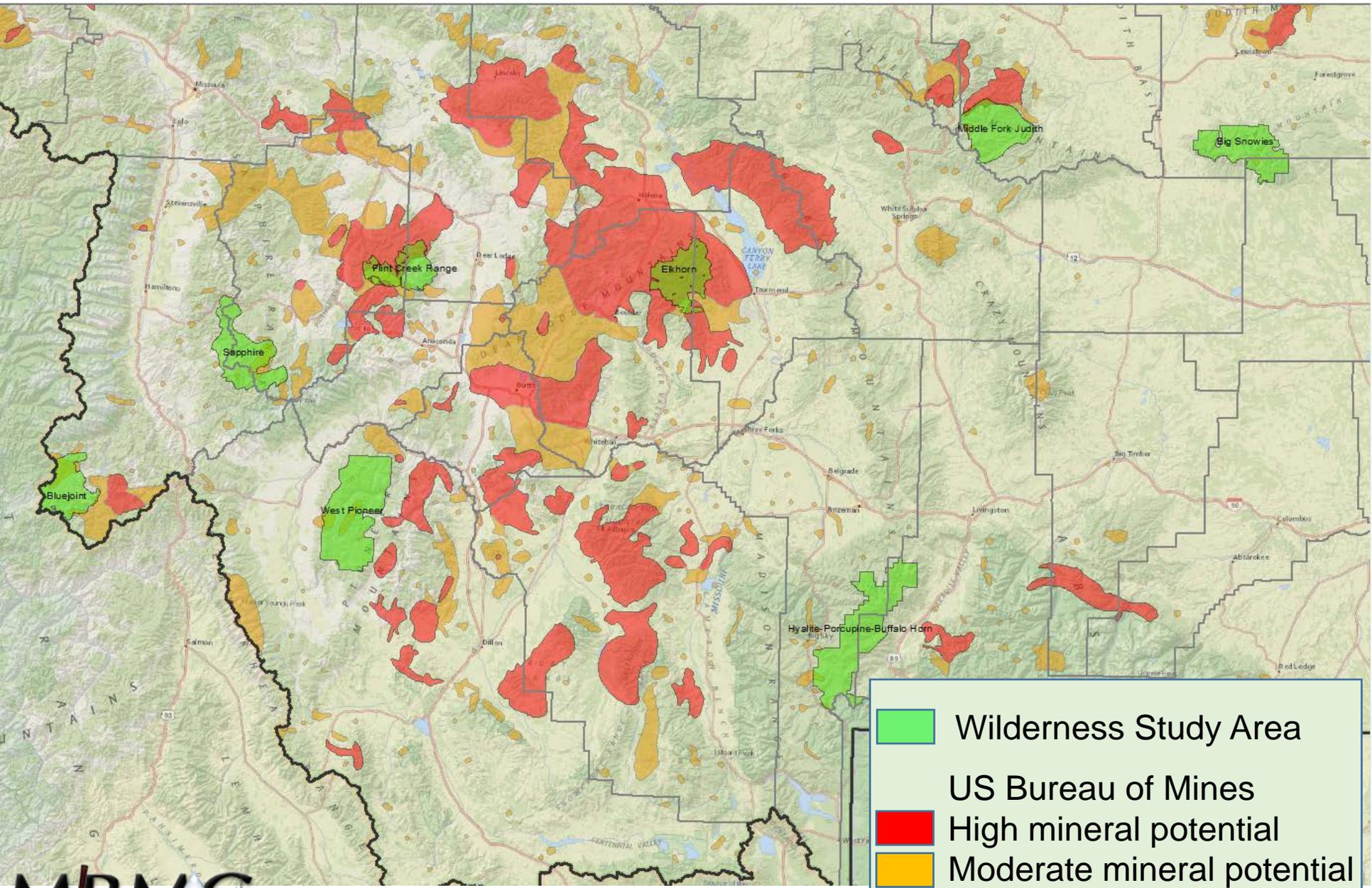
These mineral deposits include most metallic mineral deposits and certain nonmetallic and industrial minerals. The law sets general standards and guidelines for claiming the possessory right to a valuable mineral deposit discovered during exploration.

USBOM in 1993: "Availability Special Report" – Digitized by MBMG

MBMG Abandoned Inactive Mines







Wilderness Study Area

US Bureau of Mines

High mineral potential

Moderate mineral potential

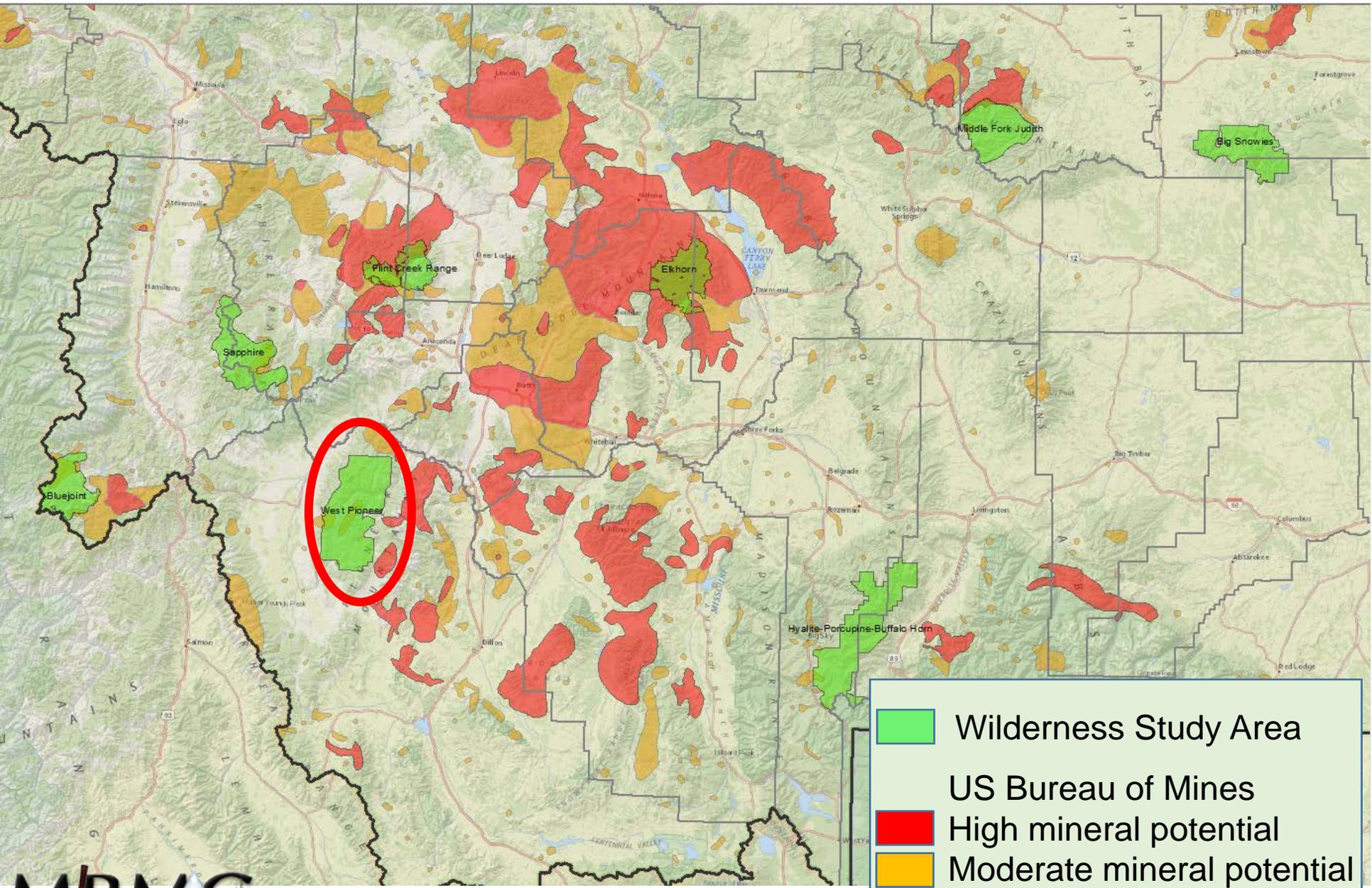


Table Of Contents

- 100k geology (map service)
- 1" x 2" Geology tiffs
- 500k geology MBMG 62
- Montana Mining Districts
- BLM Wilderness & WSAs Boundaries
- USFS Wilderness, WSAs, Roadless Areas Boundaries
- USGS MRDS Hardrock Commodities Only
- Mineral Potential Maps of Large Tracts of Public Lands
- Mineral Potential Maps of Multiple USFS Roadless Areas
- All Roadless & Wilderness Study Area Individual Mineral Potential Maps
 - Mineral Potential Maps of Individual USBLM WSAs
 - Mineral Potential Maps of Individual USFS Roadless Areas
 - Mineral Potential Maps of Individual USFS WSAs INSERT!!!!!!
- USFS WSAs & Roadless
 - Flint Creek Range WSA
 - Elkhorn WSA
 - USFS Roadless
 - Big Snowies WSA (USFS)
 - Blue Joint WSA (USFS)
 - Hyalite-Porcupine-Buffalo_Horn_WSA (USFS)
 - Middle Fork of the Judith River (USFS)
 - Sapphires WSA (USFS)
 - Ten Lakes WSA (USFS)
 - West Pioneer WSA (USFS)
 - USGS Prof Paper 1300
 - USGS_Prof_Paper_1300_East_Pioneers_WSA.tif
 - USGS_Prof_Paper_1300_West_Pioneer_Wilderness_Study_Area.t
 - page_690_rr.tif
 - page_758_rr.tif
 - USGS OFR-96-683-A
 - USGS I-1803_D_plate_crop_rr.tif
 - USGS I-1803_E_sheet_2_crop_rr.tif
 - USGS I-1803-F_clip.tif
 - USGS I-1803_G_sheet_3S_rr.tif
 - USGS I-1803_G_sheet_3T_rr.tif
 - USGS OFR 78-972 Mt Rare II Rdless Areas W Map_rr.tif
 - USGS OFR 84-637 Mt Rare II Rdless Areas Plate 1_rr.tif
 - USGS OFR-2007-1011
 - USBOM MLA 9-94
 - USGS Map 1585-A
 - USGS_MF_1585-A_Fig3_rr.tif
 - USGS_MF_1585-A_Fig4_rr.tif
 - USGS_Map_1585-A_Fig5_PS_rr.tif
 - USGS_MF_1585-A_Fig6_PS_rr.tif
 - USGS_MF_1585-A_Fig7_rr.tif
- Topography - scale changes as zoom in

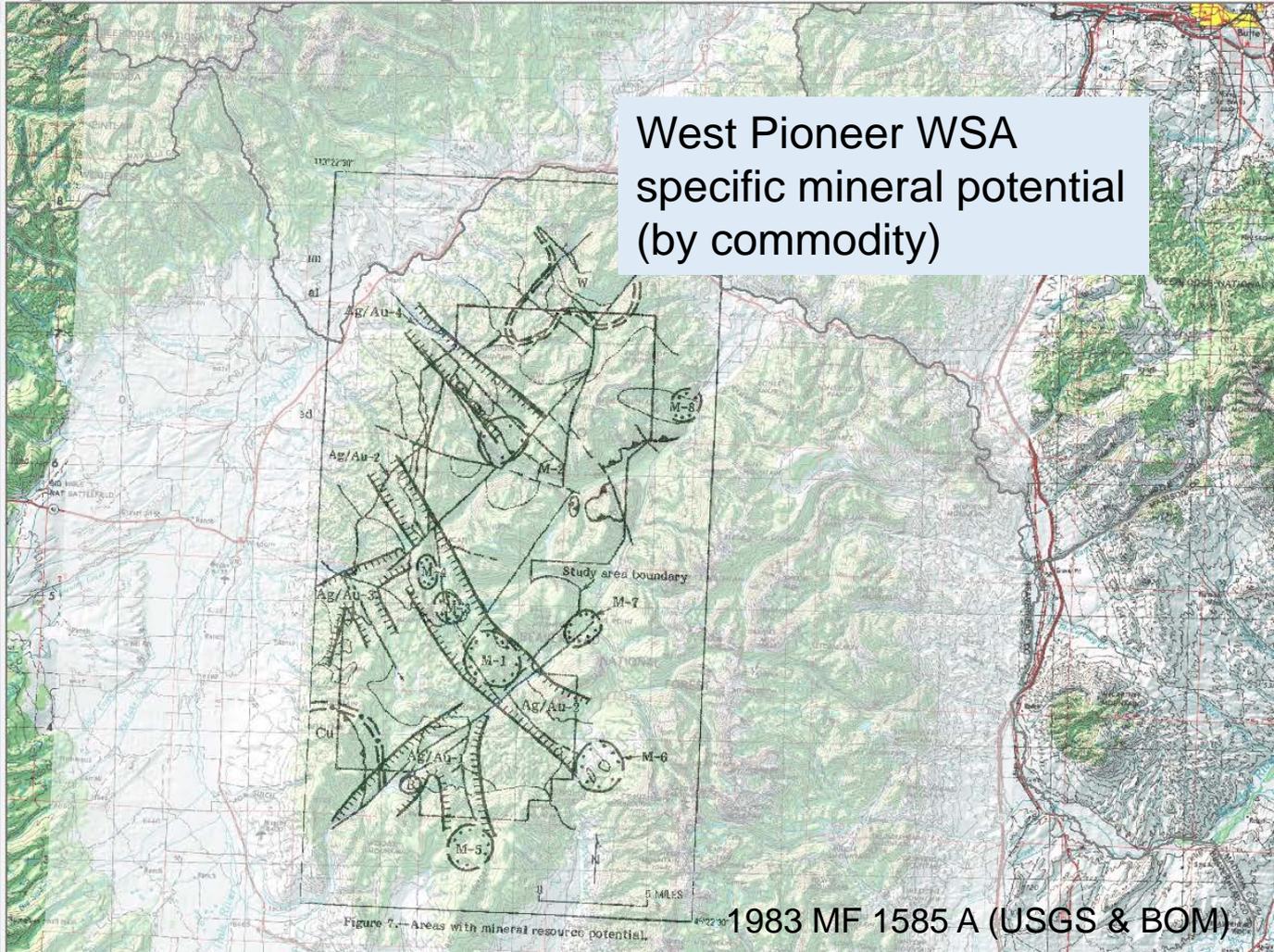


Table Of Contents

- 100k geology (map service)
- 1" x 2" Geology tiffs
- 500k geology MBMG 62
- Montana Mining Districts
- BLM Wilderness & WSAs Boundaries
- USFS Wilderness, WSAs, Roadless Areas Boundaries
- USGS MRDS Hardrock Commodities Only
- Mineral Potential Maps of Large Tracts of Public Lands
- Mineral Potential Maps of Multiple USFS Roadless Areas
- All Roadless & Wilderness Study Area Individual Mineral Potential Maps
 - Mineral Potential Maps of Individual USBLM WSAs
 - Mineral Potential Maps of Individual USFS Roadless Areas
 - Mineral Potential Maps of Individual USFS WSAs INSERT!!!!
- USFS WSAs & Roadless
 - Flint Creek Range WSA
 - Elkhorn WSA
 - USFS Roadless
 - Big Snowies WSA (USFS)
 - Blue Joint WSA (USFS)
 - Hyalite-Porcupine-Buffalo_Horn_WSA (USFS)
 - Middle Fork of the Judith River (USFS)
 - Sapphires WSA (USFS)
 - Ten Lakes WSA (USFS)
 - West Pioneer WSA (USFS)
 - USGS Prof Paper 1300
 - USGS_Prof_Paper_1300_East_Pioneers_WSA.tif
 - USGS_Prof_Paper_1300_West_Pioneer_Wilderness_Study_Area.tif
 - page_690_rr.tif
 - page_758_rr.tif
 - USGS OFR-96-683-A
 - USGS I-1803_D_plate_crop_rr.tif
 - USGS I-1803_E_sheet_2_crop_rr.tif
 - USGS_I-1803-F_clip.tif
 - USGS I-1803_G_sheet_3S_rr.tif
 - USGS I-1803_G_sheet_3T_rr.tif
 - USGS OFR 78-972 Mt Rare II Rdless Areas W Map_rr.tif
 - USGS OFR 84-637 Mt Rare II Rdless Areas Plate 1_rr.tif
 - USGS OFR-2007-1011
 - USBOM MLA 9-94
 - USGS Map 1585-A
 - USGS_MF_1585-A_Fig3_rr.tif
 - USGS_MF_1585-A_Fig4_rr.tif
 - USGS_Map_1585-A_Fig5_PS_rr.tif
 - USGS_MF_1585-A_Fig6_PS_rr.tif
 - USGS_MF_1585-A_Fig7_rr.tif
- Topography - scale changes as zoom in

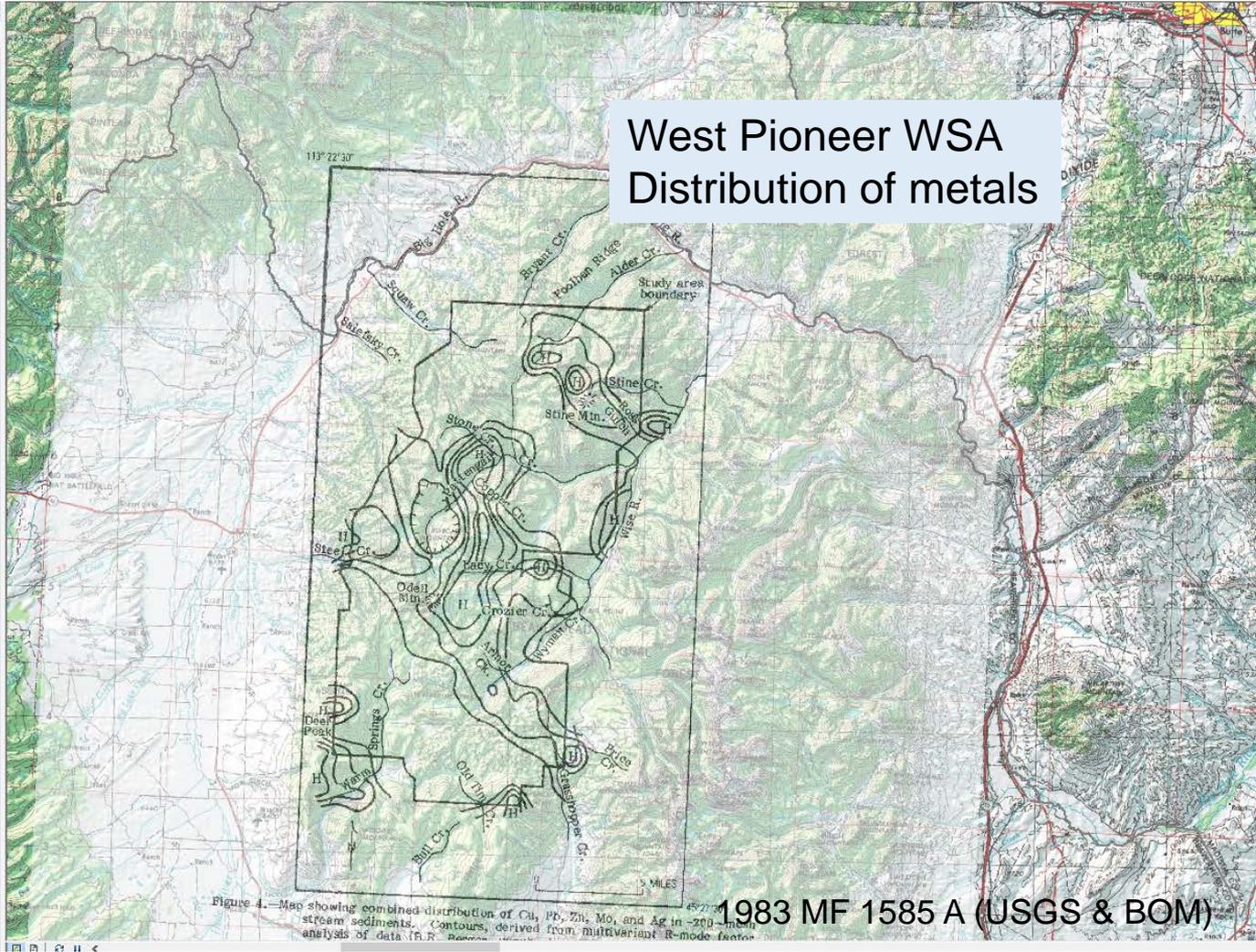


Table Of Contents

- All Roadless & Wilderness Study Area Individual Mineral Potential Maps
 - Mineral Potential Maps of Individual USBLM WSAs
 - Mineral Potential Maps of Individual USFS Roadless Areas
 - Mineral Potential Maps of Individual USFS WSAs INSERT!!!!
- USFS WSAs & Roadless
 - Flint Creek Range WSA
 - Elkhorn WSA
 - USFS Roadless
 - Big Snowies WSA (USFS)
 - Blue Joint WSA (USFS)
 - Hyalite-Porcupine-Buffalo_Horn_WSA (USFS)
 - Middle Fork of the Judith River (USFS)
 - Sapphires WSA (USFS)
 - Ten Lakes WSA (USFS)
 - West Pioneer WSA (USFS)
 - USGS Prof Paper 1300
 - USGS_Prof_Paper_1300_East_Pioneers_WSA.tif
 - USGS_Prof_Paper_1300_West_Pioneer_Wilderness_Study_Area.tif
 - page_690_rr.tif
 - page_758_rr.tif
 - USGS OFR-96-683-A
 - USGS I-1803_D_plate_crop_rr.tif
 - USGS I-1803_E_sheet_2_crop_rr.tif
 - USGS_I-1803-F_clip.tif
 - USGS I-1803_G_sheet_3S_rr.tif
 - USGS I-1803_G_sheet_3T_rr.tif
 - USGS OFR 78-972 Mt Rare II Rdless Areas W Map_rr.tif
 - USGS OFR 84-637 Mt Rare II Rdless Areas Plate 1_rr.tif
 - RGB
 - Red: Band_1
 - Green: Band_2
 - Blue: Band_3
- USGS OFR-2007-1011
 - of2007-1101-16_Fig_4_rr.tif
 - of2007-1101-18_Fig_6_rr.tif
 - of2007-1101-20_Fig_8_rr.tif
- USBOM MLA 9-94
 - MLA_9_94_East_Pioneer_Study_Area_Pg_12_rr.tif
 - MLA_9_94_West_Pioneer_Study_Area_Pg_31_rr.tif
- USGS Map 1585-A
 - USGS_MF_1585-A_Fig3_rr.tif
 - USGS_MF_1585-A_Fig4_rr.tif
 - USGS_Map_1585-A_Fig5_PS_rr.tif
 - USGS_MF_1585-A_Fig6_PS_rr.tif
 - USGS_MF_1585-A_Fig7_rr.tif

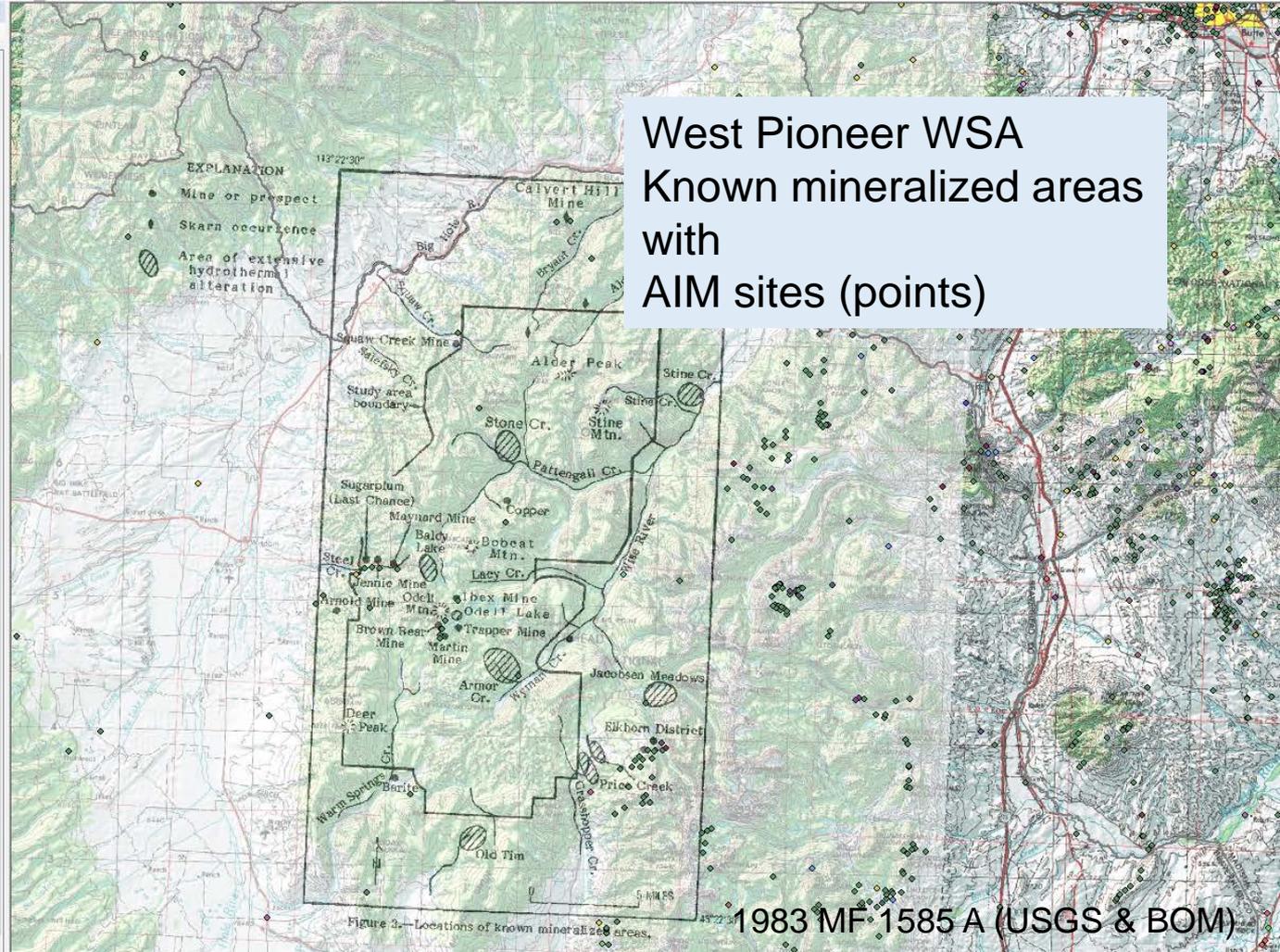
- Topography - scale changes as zoom in


Table Of Contents

- 100k geology (map service)
- 1" x 2" Geology tiffs
- 500k geology MBMG 62
- Montana Mining Districts
- BLM Wilderness & WSAs Boundaries
- USFS Wilderness, WSAs, Roadless Areas Boundaries
- USGS MRDS Hardrock Commodities Only
- Mineral Potential Maps of Large Tracts of Public Lands
- Mineral Potential Maps of Multiple USFS Roadless Areas
- All Roadless & Wilderness Study Area Individual Mineral Potential Maps**
- Mineral Potential Maps of Individual USBLM WSAs
- Mineral Potential Maps of Individual USFS Roadless Areas
- Mineral Potential Maps of Individual USFS WSAs INSERT!!!!
- USFS WSAs & Roadless
 - Flint Creek Range WSA
 - Elkhorn WSA
 - USFS Roadless
 - Big Snowies WSA (USFS)
 - Blue Joint WSA (USFS)
 - Hyalite-Porcupine-Buffalo_Horn_WSA (USFS)
 - Middle Fork of the Judith River (USFS)
 - Sapphires WSA (USFS)
 - Ten Lakes WSA (USFS)
 - West Pioneer WSA (USFS)
 - USGS Prof Paper 1300
 - USGS_Prof_Paper_1300_East_Pioneers_WSA.tif
 - USGS_Prof_Paper_1300_West_Pioneer_Wilderness_Study_Area
 - page_690_rr.tif
 - page_758_rr.tif
 - USGS OFR-96-683-A
 - USGS I-1803_D_plate_crop_rr.tif
 - USGS I-1803_E_sheet_2_crop_rr.tif
 - USGS I-1803-F_clip.tif
 - USGS I-1803_G_sheet_3S_rr.tif
 - USGS I-1803_G_sheet_3T_rr.tif
 - USGS OFR 78-972 Mt Rare II Rdless Areas W Map_rr.tif
 - USGS OFR 84-637 Mt Rare II Rdless Areas Plate 1_rr.tif
 - USGS OFR-2007-1011
 - USBOM MLA 9-94
 - MLA_9_94_East_Pioneer_Study_Area_Pg_12_rr.tif
 - MLA_9_94_West_Pioneer_Study_Area_Pg_31_rr.tif
 - USGS Map 1585-A
 - USGS_MF_1585-A_Fig3_rr.tif
 - USGS_MF_1585-A_Fig4_rr.tif
 - USGS_Map_1585-A_Fig5_PS_rr.tif
 - USGS_MF_1585-A_Fig6_PS_rr.tif
 - USGS_MF_1585-A_Fig7_rr.tif
- Topography - scale changes as zoom in

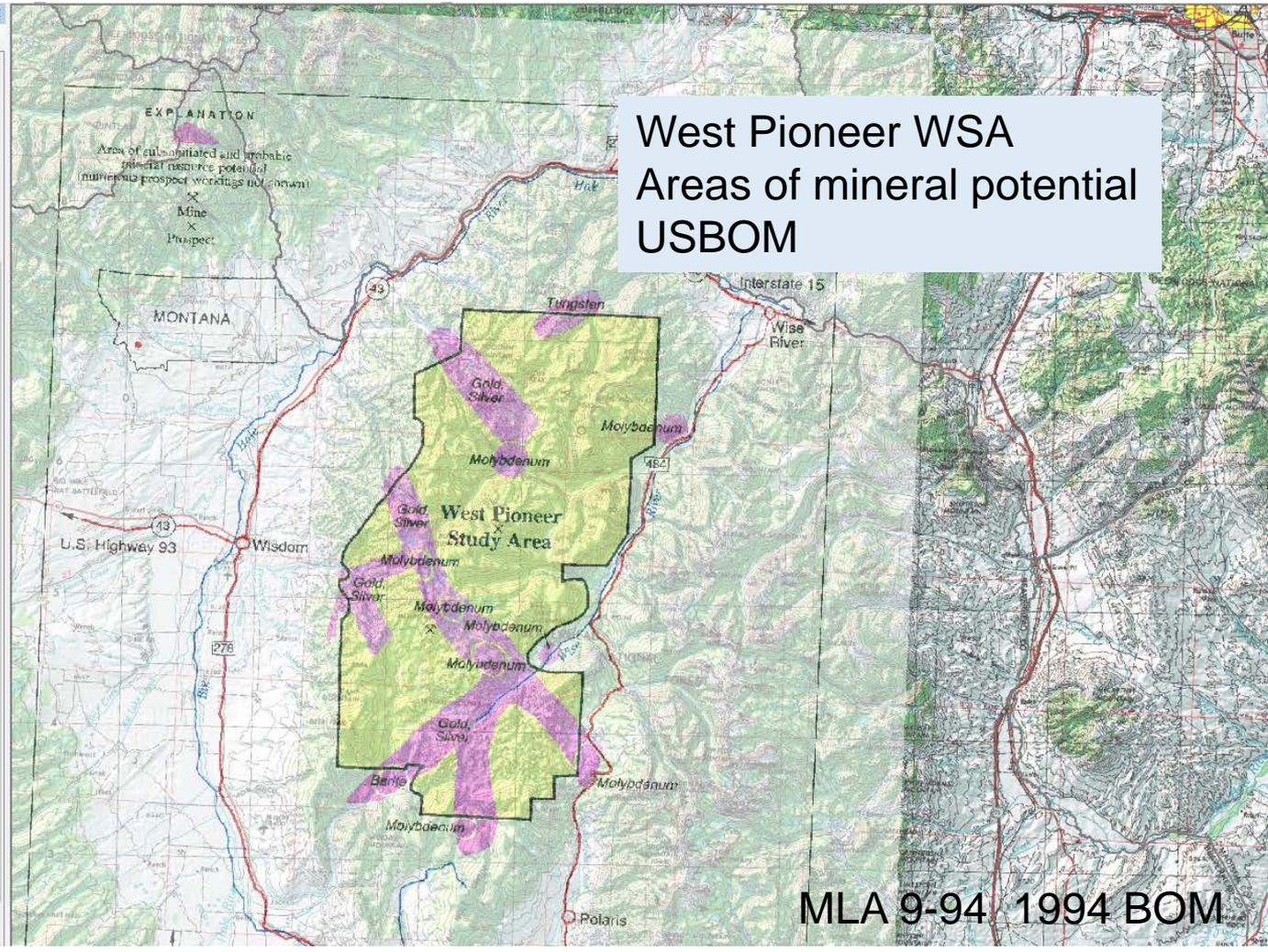
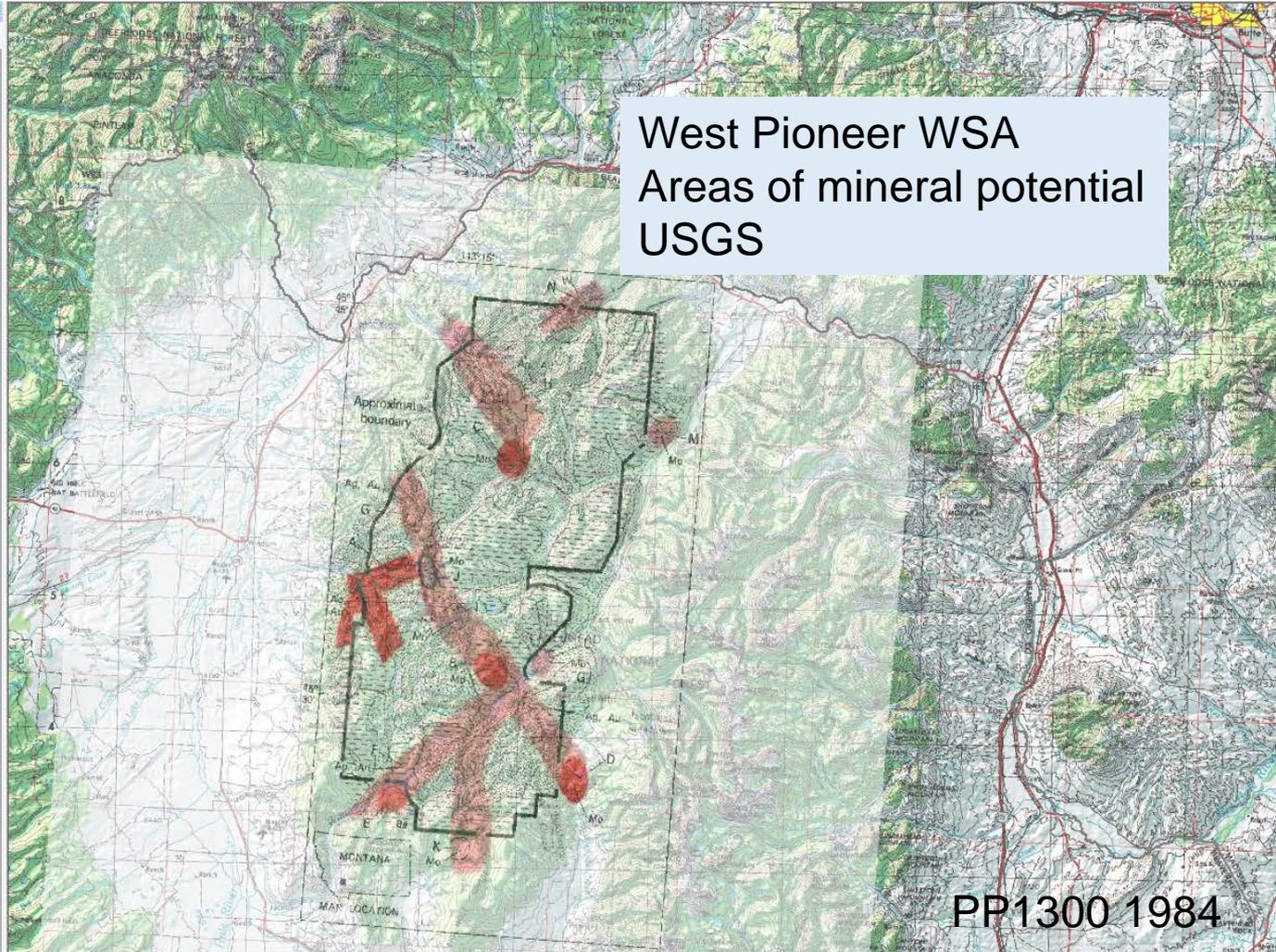


Table Of Contents

- 100k geology (map service)
- 1" x 2" Geology tiffs
- 500k geology MBMG 62
- Montana Mining Districts
- BLM Wilderness & WSAs Boundaries
- USFS Wilderness, WSAs, Roadless Areas Boundaries
- USGS MRDS Hardrock Commodities Only
- Mineral Potential Maps of Large Tracts of Public Lands
- Mineral Potential Maps of Multiple USFS Roadless Areas
- All Roadless & Wilderness Study Area Individual Mineral Potential Maps
 - Mineral Potential Maps of Individual USBLM WSAs
 - Mineral Potential Maps of Individual USFS Roadless Areas
 - Mineral Potential Maps of Individual USFS WSAs INSERT!!!!
- USFS WSAs & Roadless
 - Flint Creek Range WSA
 - Elkhorn WSA
 - USFS Roadless
 - Big Snowies WSA (USFS)
 - Blue Joint WSA (USFS)
 - Hyalite-Porcupine-Buffalo_Horn_WSA (USFS)
 - Middle Fork of the Judith River (USFS)
 - Sapphires WSA (USFS)
 - Ten Lakes WSA (USFS)
 - West Pioneer WSA (USFS)
 - USGS Prof Paper 1300
 - USGS_Prof_Paper_1300_East_Pioneers_WSA.tif
 - USGS_Prof_Paper_1300_West_Pioneer_Wilderness_Study_Area.tif
 - page_690_rr.tif
 - page_758_rr.tif
 - USGS OFR-96-683-A
 - USGS I-1803_D_plate_crop_rr.tif
 - USGS I-1803_E_sheet_2_crop_rr.tif
 - USGS I-1803-F_clip.tif
 - USGS I-1803_G_sheet_3S_rr.tif
 - USGS I-1803_G_sheet_3T_rr.tif
 - USGS OFR 78-972 Mt Rare II Rdless Areas W Map_rr.tif
 - USGS OFR 84-637 Mt Rare II Rdless Areas Plate 1_rr.tif
 - RGB
 - Red: Band_1
 - Green: Band_2
 - Blue: Band_3
- USGS OFR-2007-1011
 - of2007-1101-16_Fig_4_rr.tif
 - of2007-1101-18_Fig_6_rr.tif
 - of2007-1101-20_Fig_8_rr.tif
- USBOM MLA 9-94
 - MLA_9_94_East_Pioneer_Study_Area_Pg_12_rr.tif
 - MLA_9_94_West_Pioneer_Study_Area_Pg_31_rr.tif



West Pioneer WSA
Areas of mineral potential
USGS

PP1300 1984

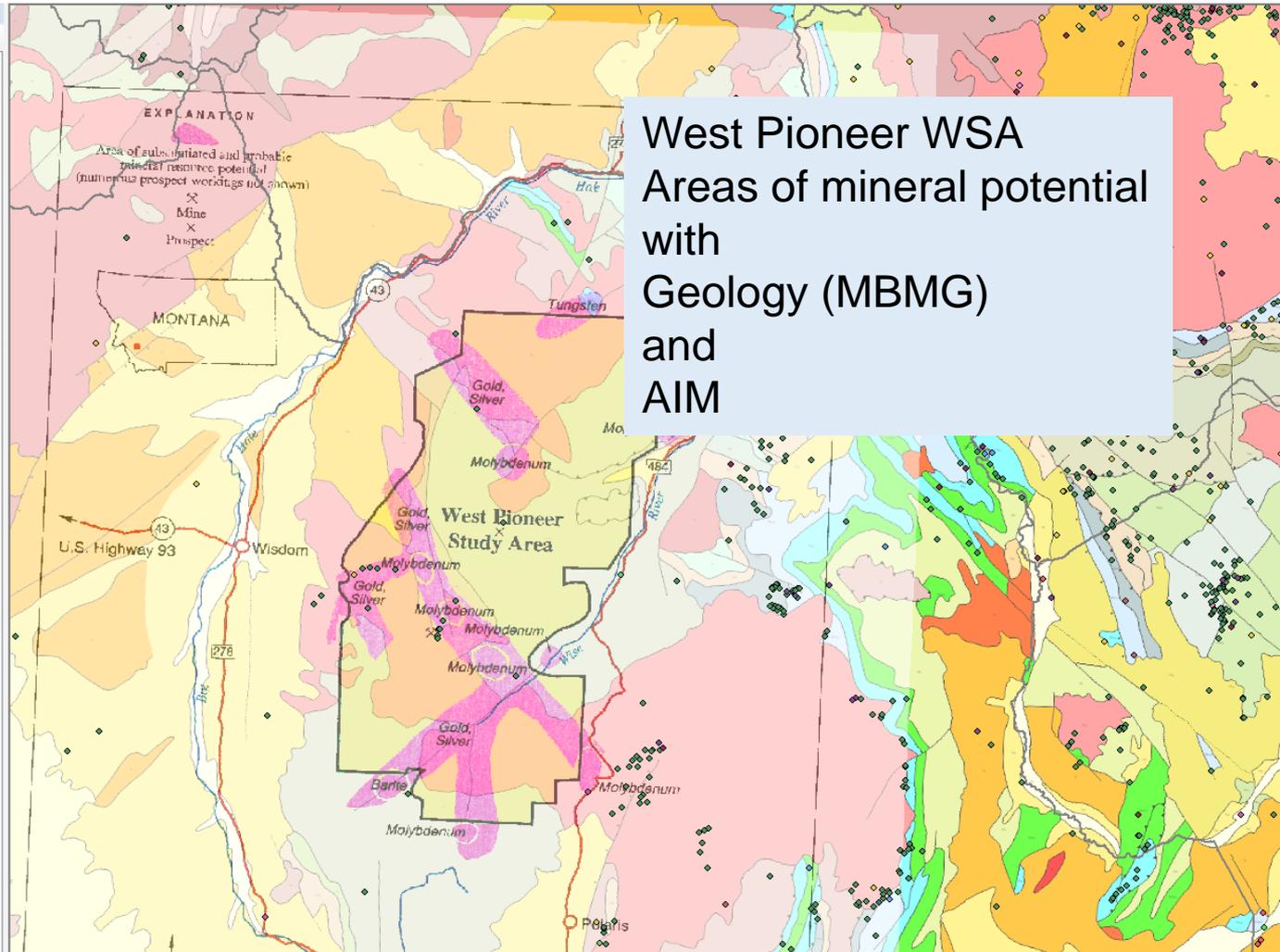
Table Of Contents

- All Roadless & Wilderness Study Area Individual Mineral Potential Maps
 - Mineral Potential Maps of Individual USBLM WSAs
 - Mineral Potential Maps of Individual USFS Roadless Areas
 - Mineral Potential Maps of Individual USFS WSAs INSERT!!!!
 - USFS WSAs & Roadless
 - Flint Creek Range WSA
 - Elkhorn WSA
 - USFS Roadless
 - Big Snowies WSA (USFS)
 - Blue Joint WSA (USFS)
 - Hyalite-Porcupine-Buffalo_Horn_WSA (USFS)
 - Middle Fork of the Judith River (USFS)
 - Sapphires WSA (USFS)
 - Ten Lakes WSA (USFS)
 - West Pioneer WSA (USFS)
 - USGS Prof Paper 1300
 - USGS_Prof_Paper_1300_East_Pioneers_WSA.tif
 - USGS_Prof_Paper_1300_West_Pioneer_Wilderness_Study_Area.tif
 - page_690_rr.tif
 - page_758_rr.tif
 - USGS OFR-96-683-A
 - USGS I-1803_D_plate_crop_rr.tif
 - USGS I-1803_E_sheet_2_crop_rr.tif
 - USGS I-1803-F_clip.tif
 - USGS I-1803_G_sheet_3S_rr.tif
 - USGS I-1803_G_sheet_3T_rr.tif
 - USGS OFR 78-972 Mt Rare II Rdless Areas W Map_rr.tif
 - USGS OFR 84-637 Mt Rare II Rdless Areas Plate 1_rr.tif

RGB

- USGS OFR-2007-1011
 - of2007-1101-16_Fig_4_rr.tif
 - of2007-1101-18_Fig_6_rr.tif
 - of2007-1101-20_Fig_8_rr.tif
- USBOM MLA 9-94
 - MLA_9_94_East_Pioneer_Study_Area_Pg_12_rr.tif
 - MLA_9_94_West_Pioneer_Study_Area_Pg_31_rr.tif
- USGS Map 1585-A
 - USGS_MF_1585-A_Fig3_rr.tif
 - USGS_MF_1585-A_Fig4_rr.tif
 - USGS_Map_1585-A_Fig5_PS_rr.tif
 - USGS_MF_1585-A_Fig6_PS_rr.tif
 - USGS_MF_1585-A_Fig7_rr.tif

- Topography - scale changes as zoom in
- 500k geology MBMG 62



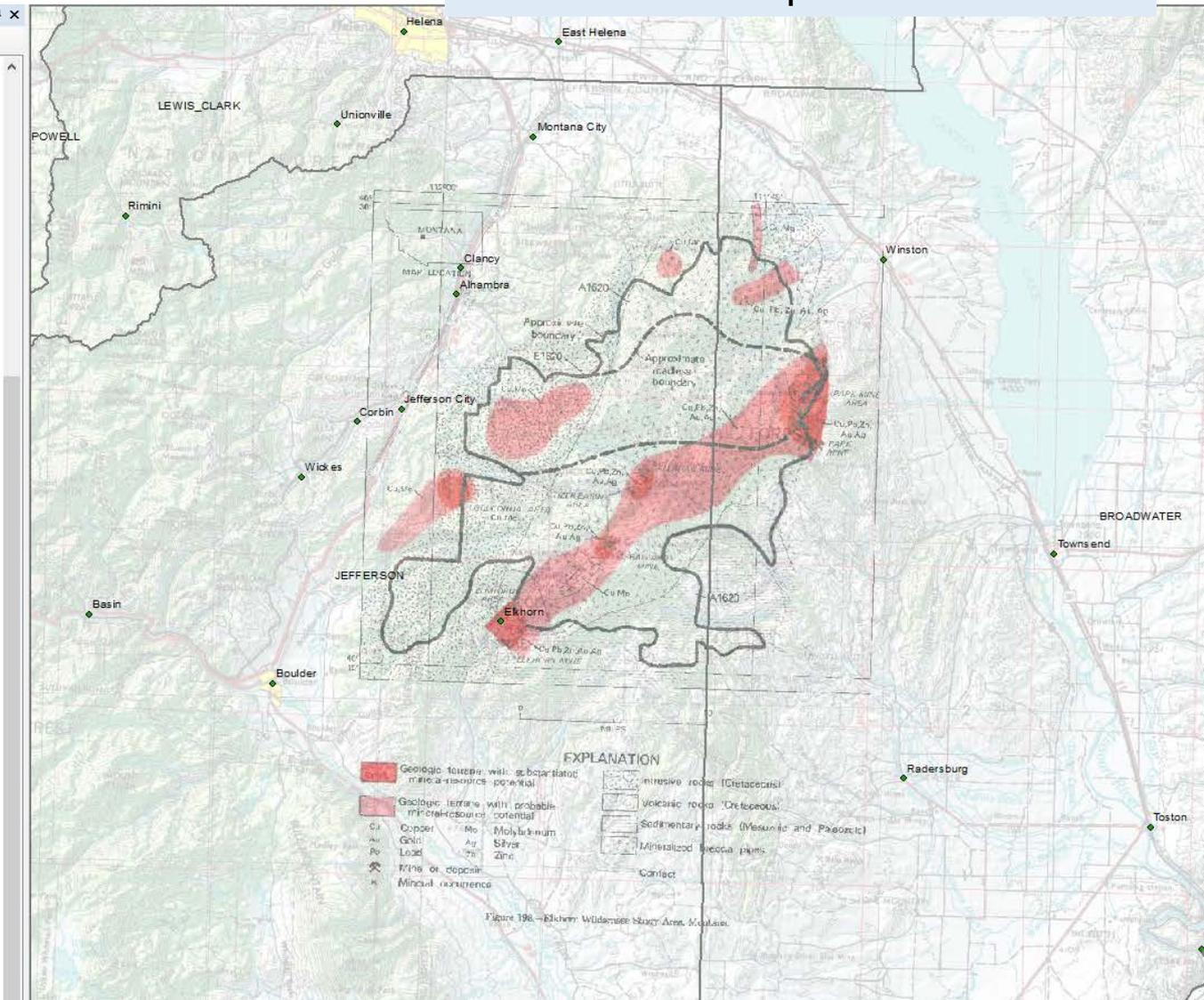
West Pioneer WSA
 Areas of mineral potential
 with
 Geology (MBMG)
 and
 AIM

Elkhorn WSA

Areas of mineral potential USGS

Table Of Contents

- USFS Wilderness Study Areas outline (USFS WSAs)
- USFS Wilderness Study Areas - filled polygons (USFS WSAs)
- USFS Roadless Areas outline
- USFS Roadless Areas - filled polygons
- USGS MRDS Hardrock Commodities Only
- Mineral Potential Maps of Large Tracts of Public Lands
- Mineral Potential Maps of Multiple USFS Roadless Areas
- All Roadless & Wilderness Study Area Individual Mineral Potential Maps
- Mineral Potential Maps of Individual USBLM WSAs
 - Antelope Creek WSA (BLM)
 - Axolotl Lakes WSA (BLM)
 - Beaver Meadows WSA (BLM)
 - Bell/Limekiln Canyons WSA (BLM)
 - Big Horn Tack On WSA (BLM)
 - Black Sage WSA (BLM)
 - Blacktail Mountains WSA (BLM)
 - Burnt Timber Canyon WSA (BLM)
 - Centennial Mountains WSA (BLM)
 - Cow Creek WSA (BLM)
 - Dog Creek South WSA (BLM)
 - East Fork of Blacktail Deer Creek WSA (BLM)
 - Elkhorn WSA
 - Ervin Ridge WSA (BLM)
 - Farlin Creek WSA (BLM)
 - Henneberry Ridge WSA (BLM)
 - Hidden Pasture Creek WSA (BLM)
 - Hoodoo Mountain WSA (BLM)
 - Humbug Spires WSA (BLM)
 - North Fork Sun River WSA (BLM)
 - Pryor Mountain WSA (BLM)
 - Quigg West WSA (BLM)
 - Ruby Mountains WSA (BLM)
 - Sheep Creek WSA (BLM)
 - Sleeping Giant WSA (BLM)
 - Square Butte WSA (BLM)
 - Stafford WSA (BLM)
 - Twin Coulee WSA (BLM)
 - Wales Creek WSA (BLM)
 - Woodhawk WSA (BLM)
 - Yellowstone Island WSA (BLM)
- Mineral Potential Maps of Individual USFS Roadless Areas
- Mineral Potential Maps of Individual USFS WSAs INSERT!!!!!!
- USFS WSAs & Roadless
- 500k geology MBMG 62

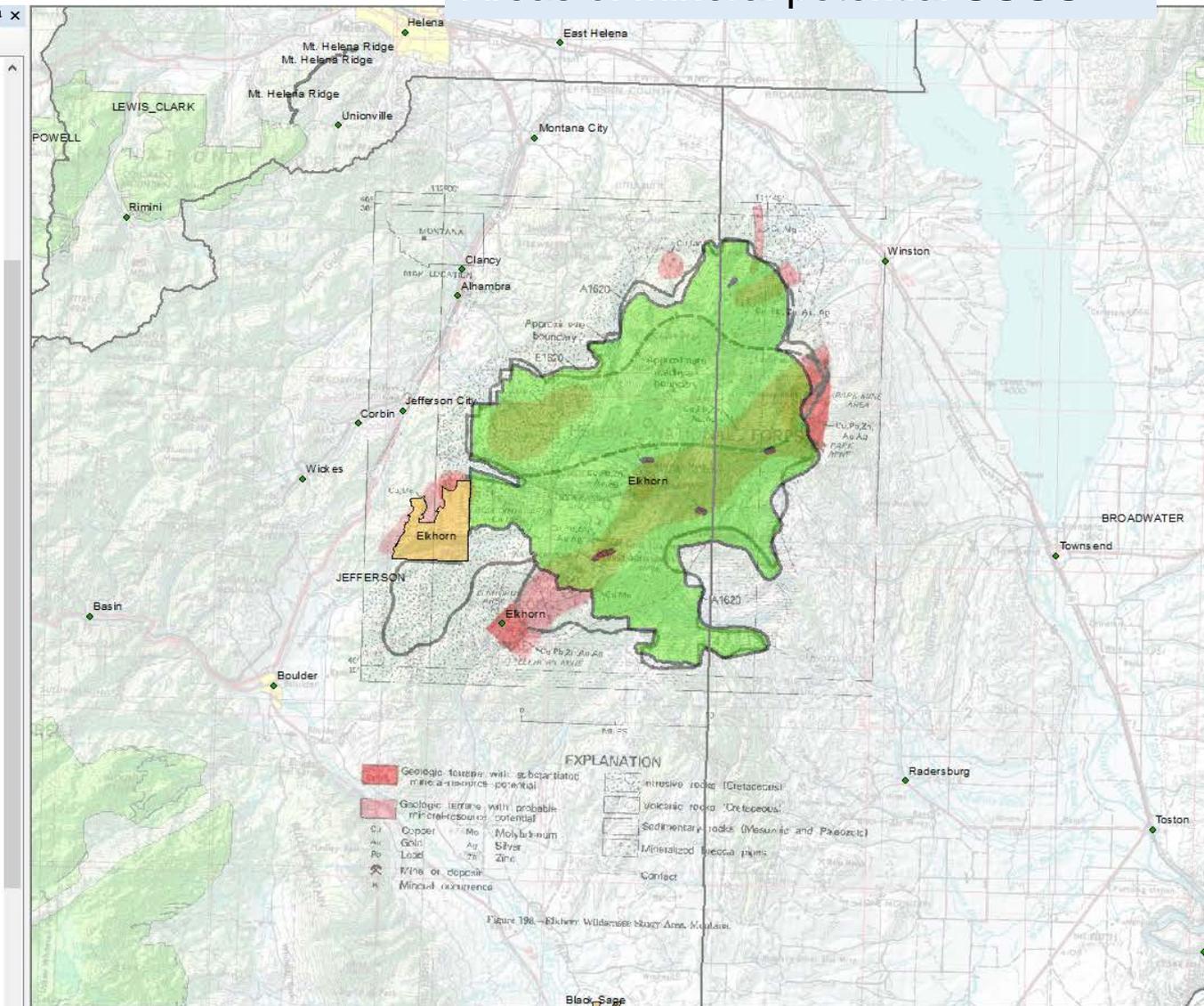


Elkhorn WSA

Areas of mineral potential USGS

Table Of Contents

- 100k geology (map service)
- 1" x 2" Geology tiffs
- Montana Mining Districts
- Topography - scale changes as zoom in
- BLM Wilderness & WSAs Boundaries
- USFS Wilderness, WSAs, Roadless Areas Boundaries
 - MT Wilderness Areas outline (USFS)
 - MT Wilderness Areas- filled polygons (USFS)
 - USFS Wilderness Study Areas outline (USFS WSAs)
 - USFS Wilderness Study Areas - filled polygons (USFS WSAs)
- USFS Roadless Areas outline
- USFS Roadless Areas - filled polygons
- USGS MRDS Hardrock Commodities Only
- Mineral Potential Maps of Large Tracts of Public Lands
- Mineral Potential Maps of Multiple USFS Roadless Areas
- All Roadless & Wilderness Study Area Individual Mineral Potential Maps
 - Mineral Potential Maps of Individual USBLM WSAs
 - Antelope Creek WSA (BLM)
 - Axolotl Lakes WSA (BLM)
 - Beaver Meadows WSA (BLM)
 - Bell/Limekiln Canyons WSA (BLM)
 - Big Horn Tack On WSA (BLM)
 - Black Sage WSA (BLM)
 - Blacktail Mountains WSA (BLM)
 - Burnt Timber Canyon WSA (BLM)
 - Centennial Mountains WSA (BLM)
 - Cow Creek WSA (BLM)
 - Dog Creek South WSA (BLM)
 - East Fork of Blacktail Deer Creek WSA (BLM)
 - Elkhorn WSA
 - Ervin Ridge WSA (BLM)
 - Farlin Creek WSA (BLM)
 - Henneberry Ridge WSA (BLM)
 - Hidden Pasture Creek WSA (BLM)
 - Hoodoo Mountain WSA (BLM)
 - Humbug Spires WSA (BLM)
 - North Fork Sun River WSA (BLM)
 - Pryor Mountain WSA (BLM)
 - Quigg West WSA (BLM)
 - Ruby Mountains WSA (BLM)
 - Sheep Creek WSA (BLM)
 - Sleeping Giant WSA (BLM)
 - Square Butte WSA (BLM)
 - Stafford WSA (BLM)

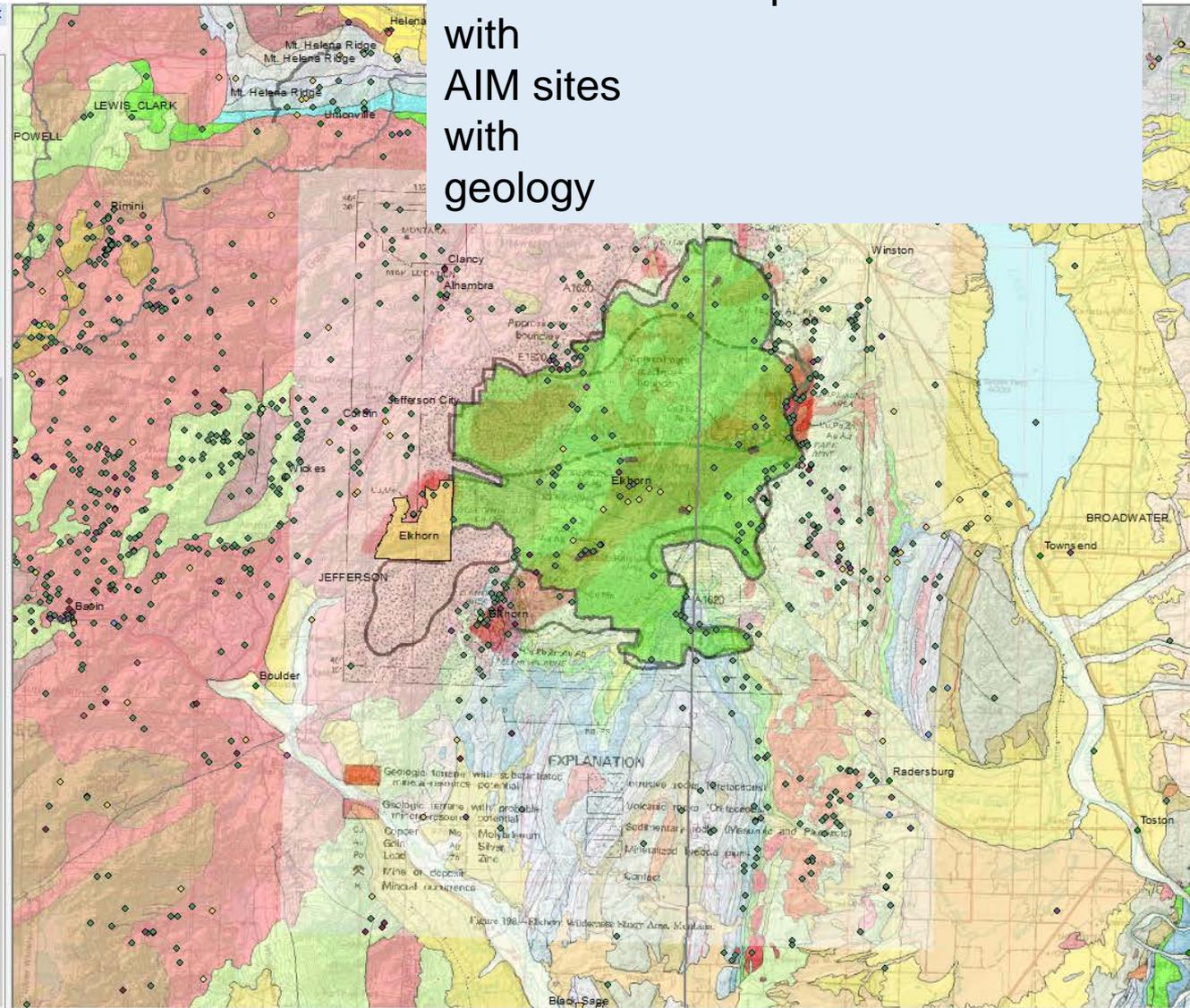


Elkhorn WSA

Areas of mineral potential USGS with AIM sites with geology

Table of Contents

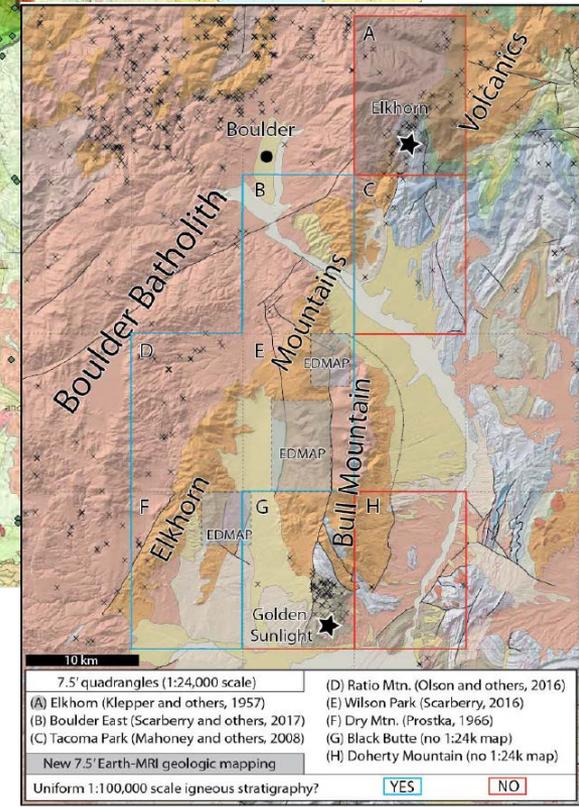
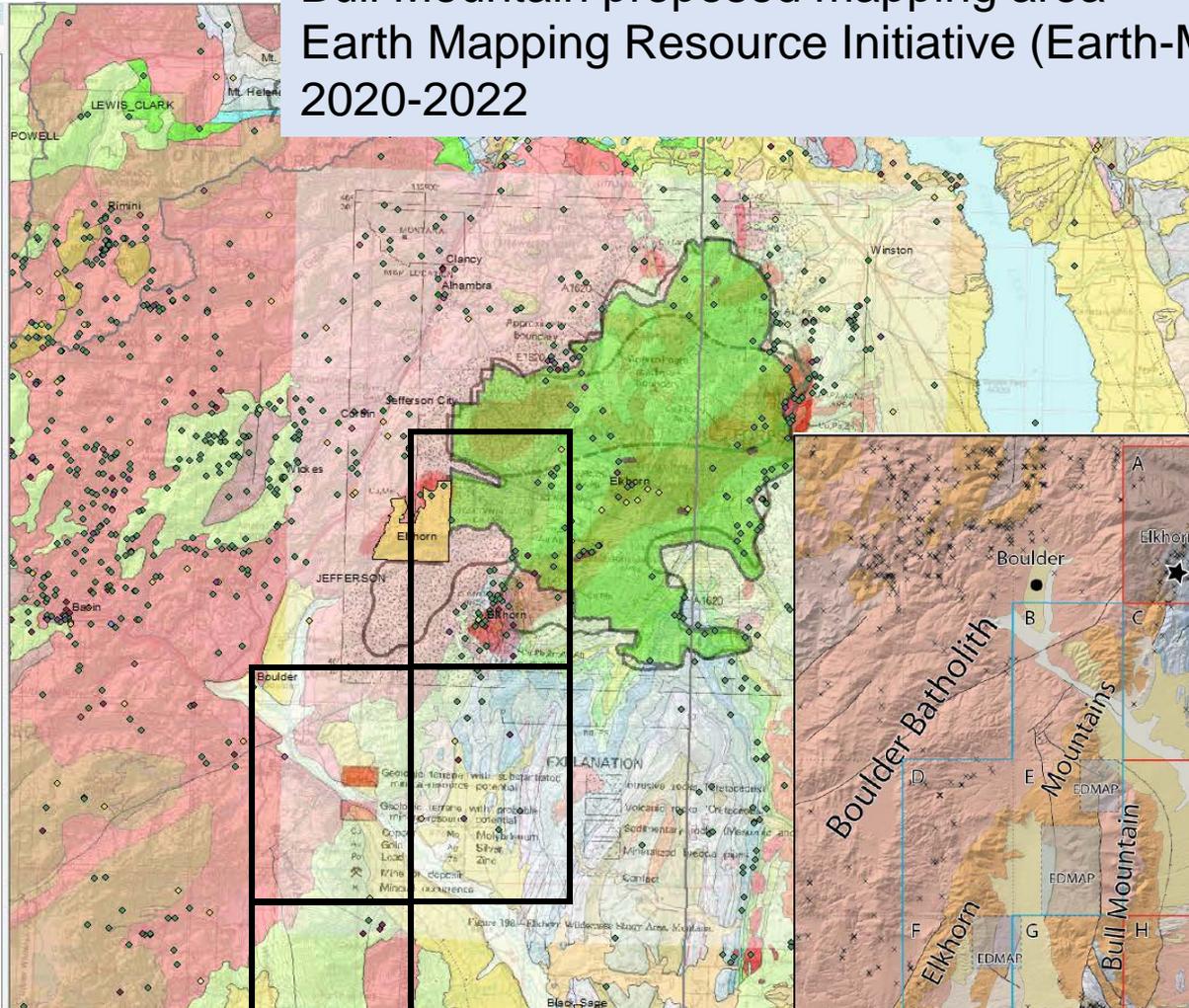
- USFS Wilderness Study Areas outline (USFS WSAs)
- USFS Wilderness Study Areas - filled polygons (USFS WSAs)
- USFS Roadless Areas outline
- USFS Roadless Areas - filled polygons
- USGS MRDS Hardrock Commodities Only
- Mineral Potential Maps of Large Tracts of Public Lands
- Mineral Potential Maps of Multiple USFS Roadless Areas
- All Roadless & Wilderness Study Area Individual Mineral Potential Maps
- Mineral Potential Maps of Individual USBLM WSAs
 - Antelope Creek WSA (BLM)
 - Axolotl Lakes WSA (BLM)
 - Beaver Meadows WSA (BLM)
 - Bell/Limekiln Canyons WSA (BLM)
 - Big Horn Tack On WSA (BLM)
 - Black Sage WSA (BLM)
 - Blacktail Mountains WSA (BLM)
 - Burnt Timber Canyon WSA (BLM)
 - Centennial Mountains WSA (BLM)
 - Cow Creek WSA (BLM)
 - Dog Creek South WSA (BLM)
 - East Fork of Blacktail Deer Creek WSA (BLM)
 - Elkhorn WSA
 - Ervin Ridge WSA (BLM)
 - Farlin Creek WSA (BLM)
 - Henneberry Ridge WSA (BLM)
 - Hidden Pasture Creek WSA (BLM)
 - Hoodoo Mountain WSA (BLM)
 - Humbug Spires WSA (BLM)
 - North Fork Sun River WSA (BLM)
 - Pryor Mountain WSA (BLM)
 - Quigg West WSA (BLM)
 - Ruby Mountains WSA (BLM)
 - Sheep Creek WSA (BLM)
 - Sleeping Giant WSA (BLM)
 - Square Butte WSA (BLM)
 - Stafford WSA (BLM)
 - Twin Coulee WSA (BLM)
 - Wales Creek WSA (BLM)
 - Woodhawk WSA (BLM)
 - Yellowstone Island WSA (BLM)
- Mineral Potential Maps of Individual USFS Roadless Areas
- Mineral Potential Maps of Individual USFS WSAs INSERT!!!!
- USFS WSAs & Roadless
- 500k geology MBMG 62



Bull Mountain proposed mapping area Earth Mapping Resource Initiative (Earth-MRI) 2020-2022

Table Of Contents

- USFS Wilderness Study Areas outline (USFS WSAs)
- USFS Wilderness Study Areas - filled polygons (USFS WSAs)
- USFS Roadless Areas outline
- USFS Roadless Areas - filled polygons
- USGS MRDS Hardrock Commodities Only
- Mineral Potential Maps of Large Tracts of Public Lands
- Mineral Potential Maps of Multiple USFS Roadless Areas
- All Roadless & Wilderness Study Area Individual Mineral Potential Maps
- Mineral Potential Maps of Individual USBLM WSAs
 - Antelope Creek WSA (BLM)
 - Axoloti Lakes WSA (BLM)
 - Beaver Meadows WSA (BLM)
 - Bell/Limekiln Canyons WSA (BLM)
 - Big Horn Tack On WSA (BLM)
 - Black Sage WSA (BLM)
 - Blacktail Mountains WSA (BLM)
 - Burnt Timber Canyon WSA (BLM)
 - Centennial Mountains WSA (BLM)
 - Cow Creek WSA (BLM)
 - Dog Creek South WSA (BLM)
 - East Fork of Blacktail Deer Creek WSA (BLM)
 - Elkhorn WSA
 - Ervin Ridge WSA (BLM)
 - Farlin Creek WSA (BLM)
 - Henneberry Ridge WSA (BLM)
 - Hidden Pasture Creek WSA (BLM)
 - Hoodoo Mountain WSA (BLM)
 - Humbug Spires WSA (BLM)
 - North Fork Sun River WSA (BLM)
 - Pryor Mountain WSA (BLM)
 - Quigg West WSA (BLM)
 - Ruby Mountains WSA (BLM)
 - Sheep Creek WSA (BLM)
 - Sleeping Giant WSA (BLM)
 - Square Butte WSA (BLM)
 - Stafford WSA (BLM)
 - Twin Coulee WSA (BLM)
 - Wales Creek WSA (BLM)
 - Woodhawk WSA (BLM)
 - Yellowstone Island WSA (BLM)
- Mineral Potential Maps of Individual USFS Roadless Areas
- Mineral Potential Maps of Individual USFS WSAs INSERT!!!!
- USFS WSAs & Roadless
- 500k geology MBMG 62





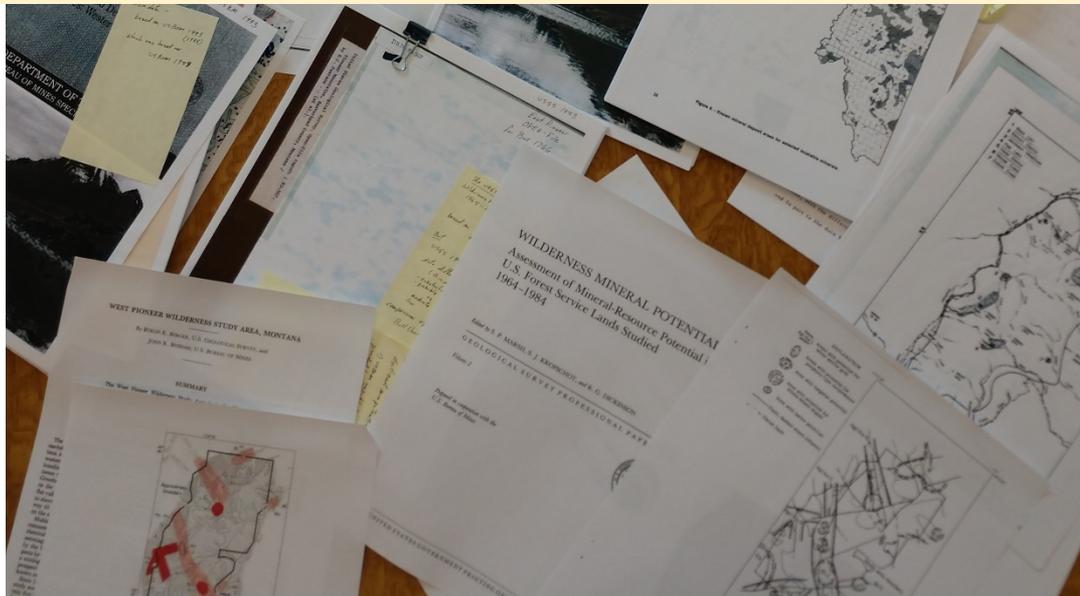
US Forest Service Wilderness Study Areas

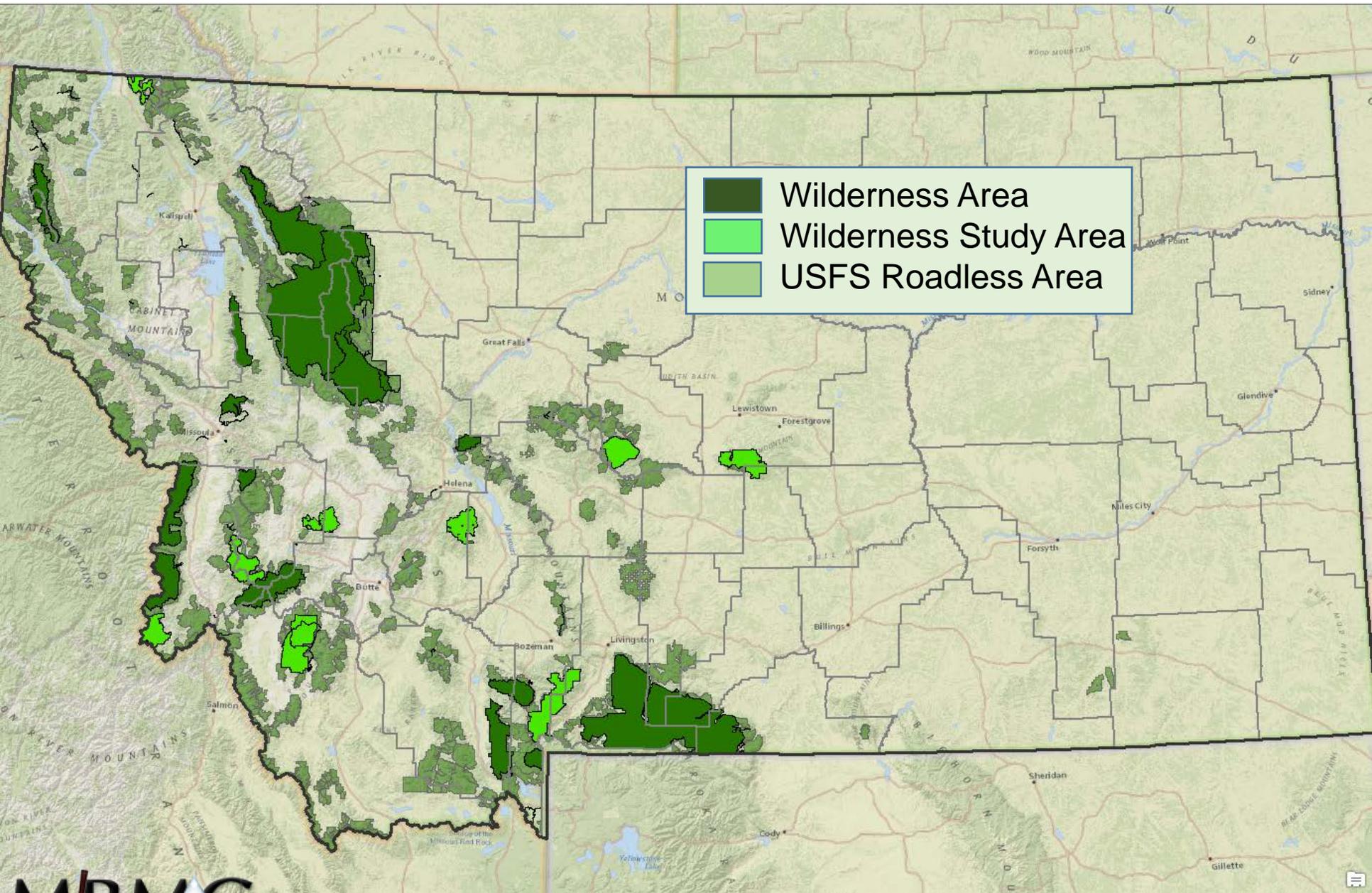
Mineral Potential - statewide (US Bureau of Mines)

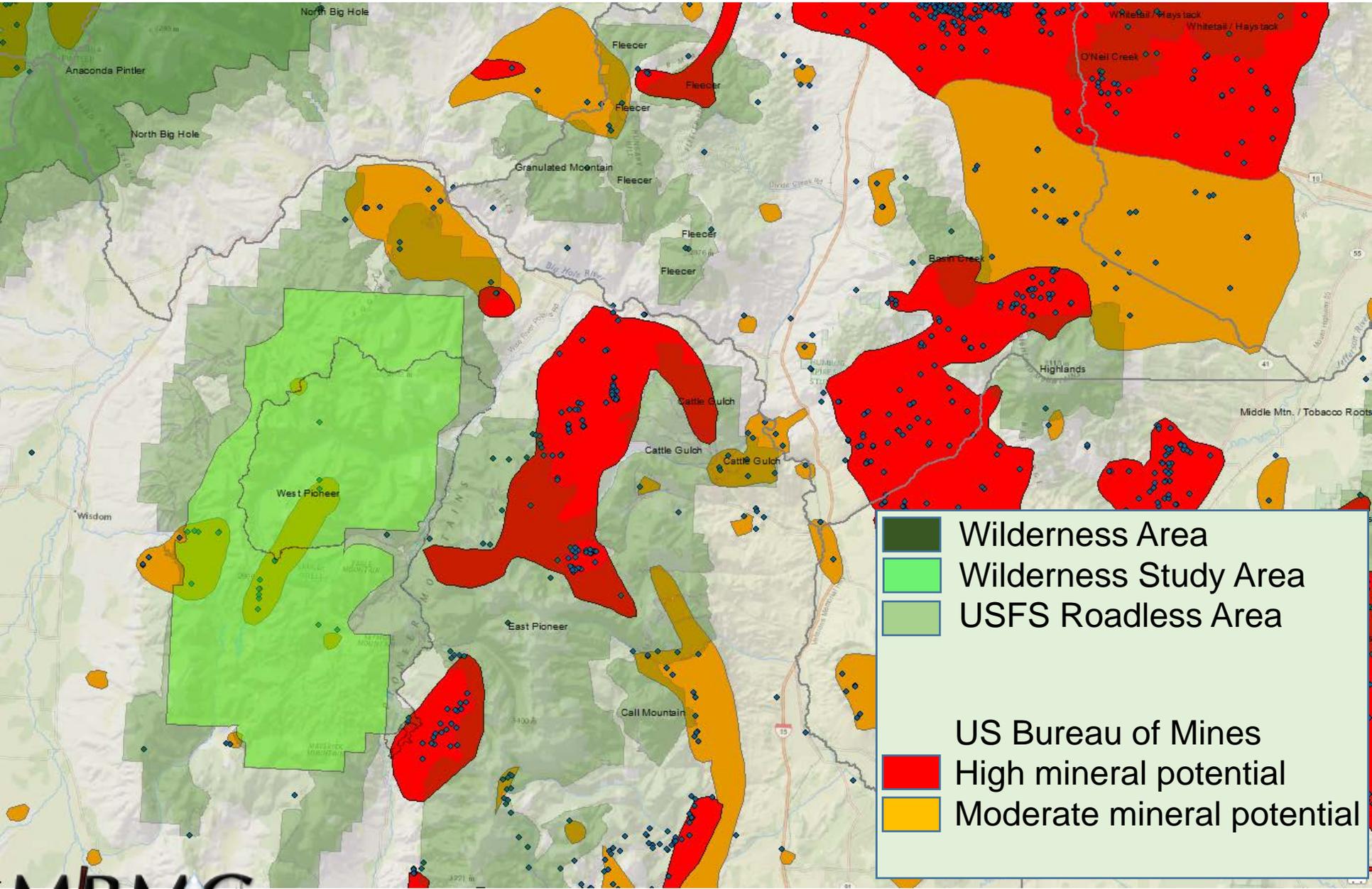
Mineral Potential - each WSA (USGS Professional Paper 1300)

Abandoned Inactive Mines - statewide (MBMG)

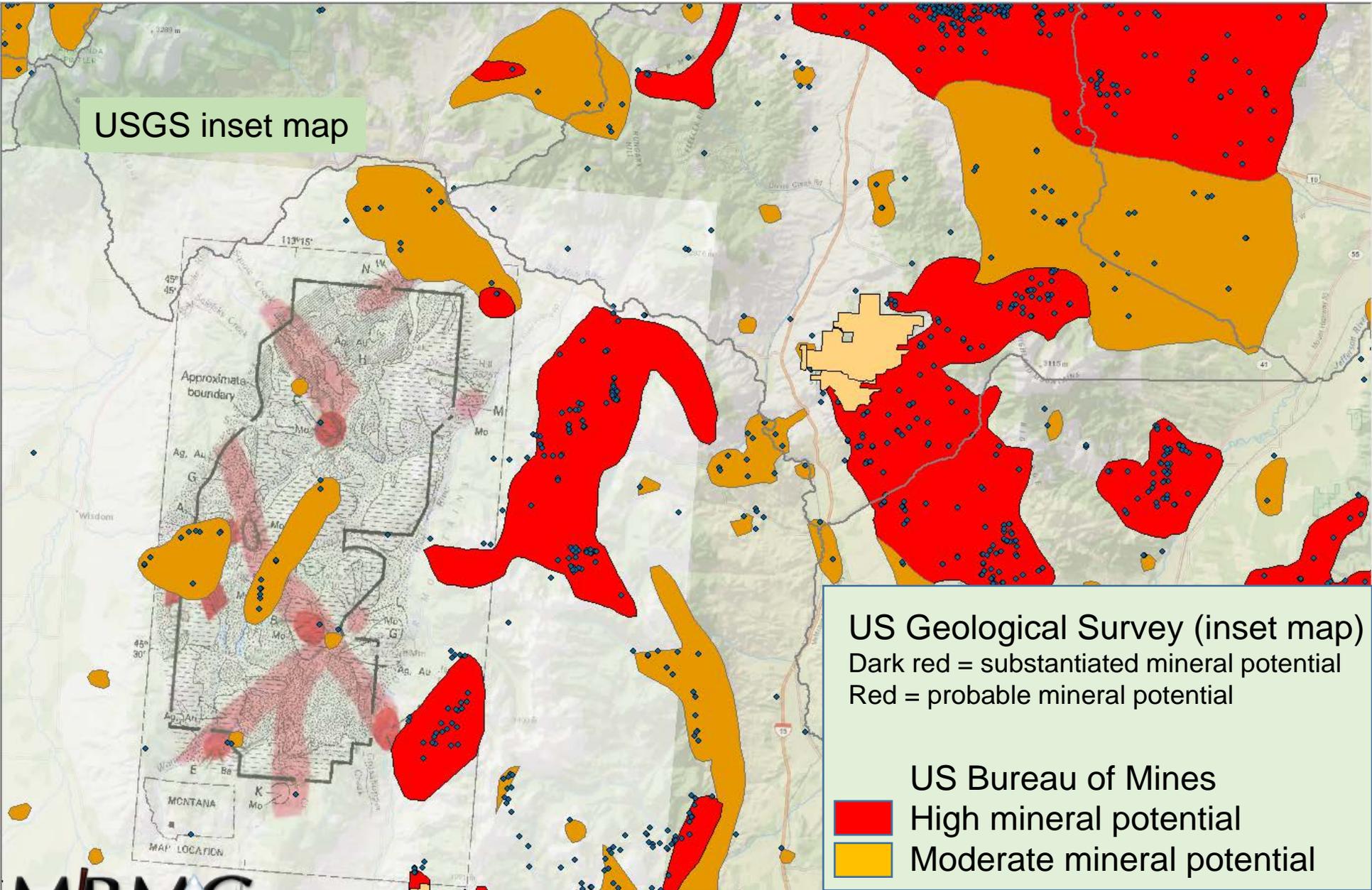
Geology - statewide (MBMG)



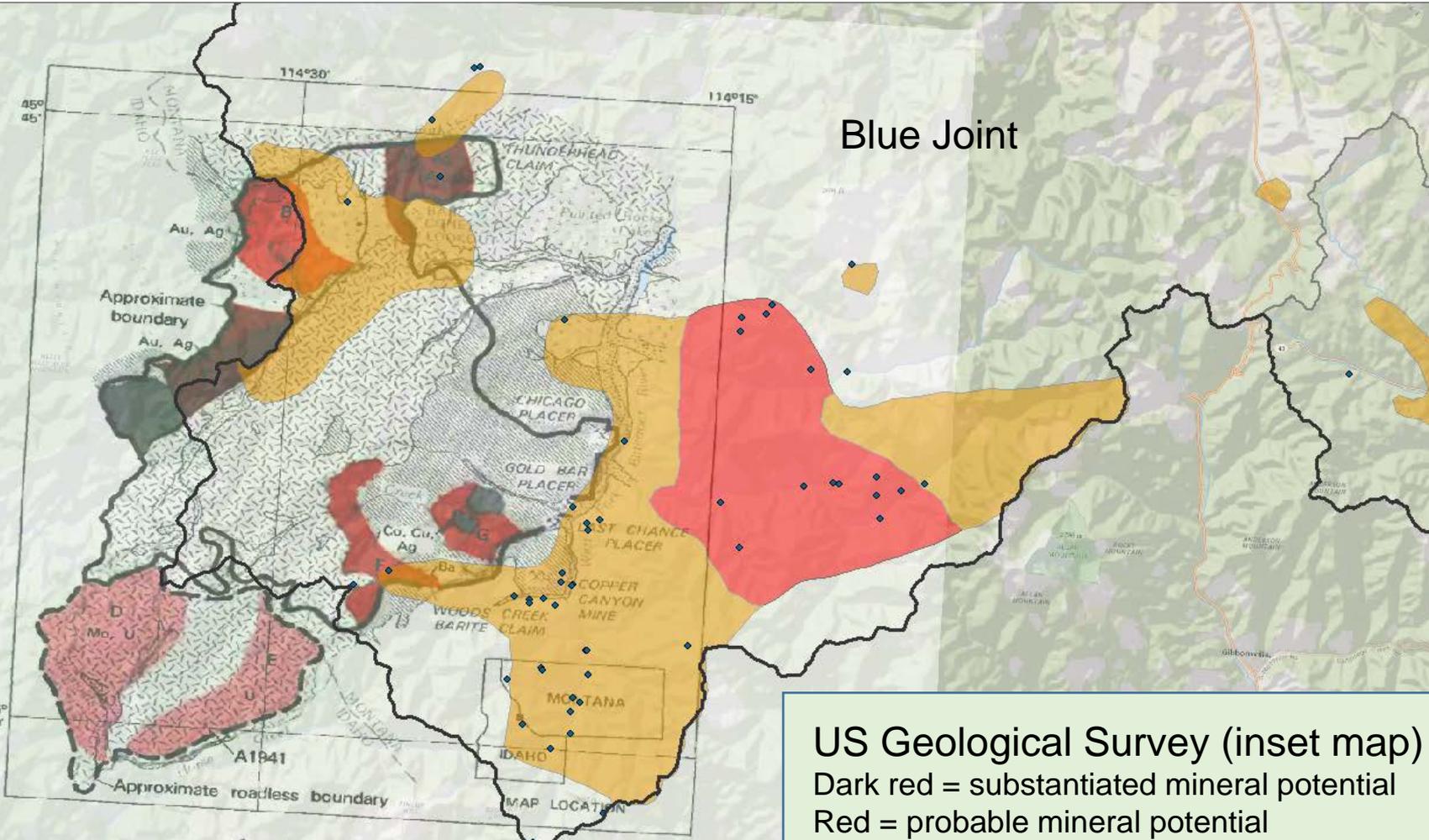




USGS inset map



Blue Joint



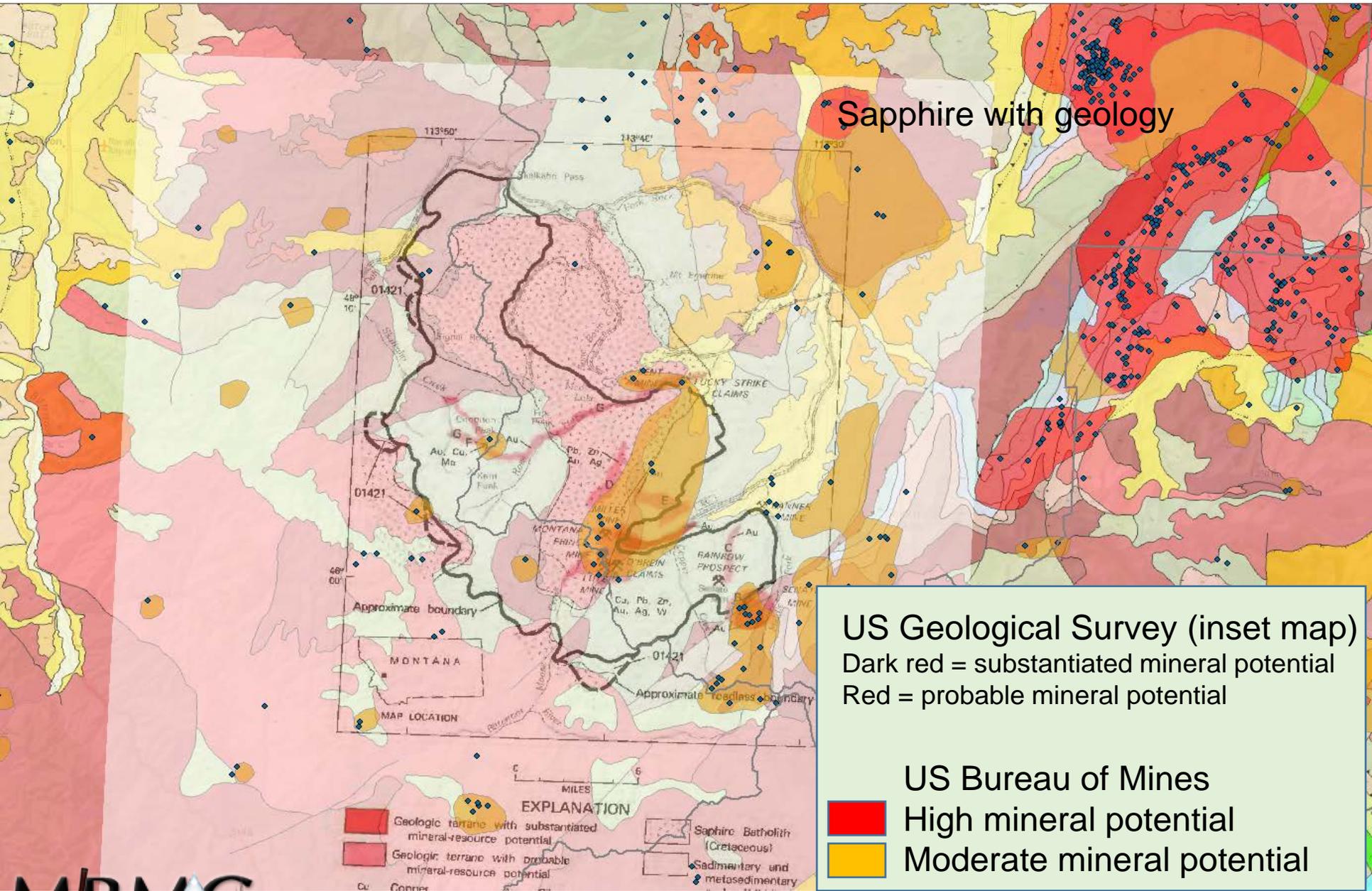
US Geological Survey (inset map)
 Dark red = substantiated mineral potential
 Red = probable mineral potential

US Bureau of Mines
 High mineral potential
 Moderate mineral potential

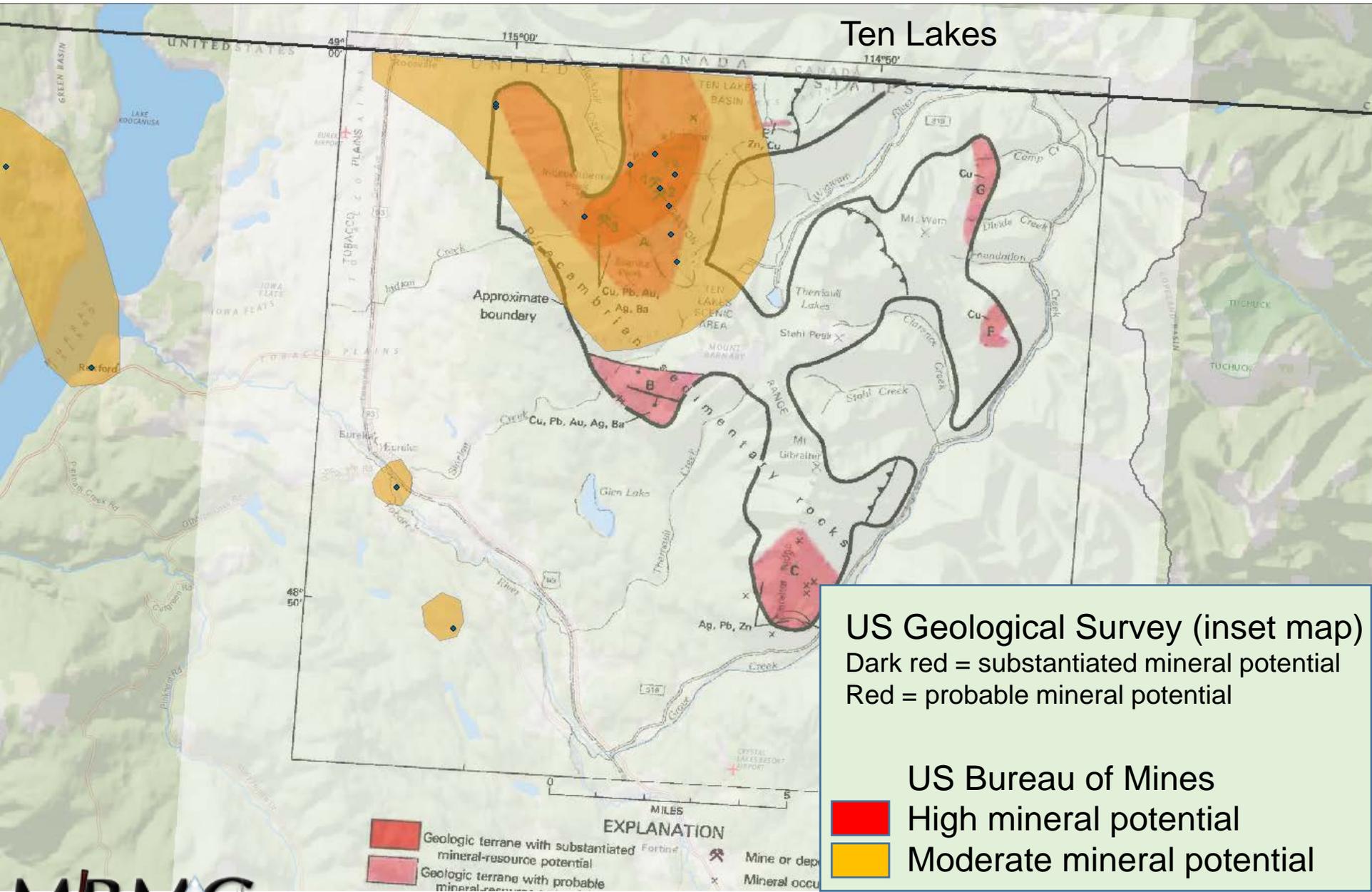


EXPLANATION

- Geologic terrane with substantiated mineral-resource potential and probable molybdenum resource potential
- Geologic terrane with substantiated mineral-resource potential
- Geologic terrane with probable mineral-resource potential
- Alluvium (Quaternary)
- Painted Rocks pluton (Tertiary)
- Volcanics (Tertiary)



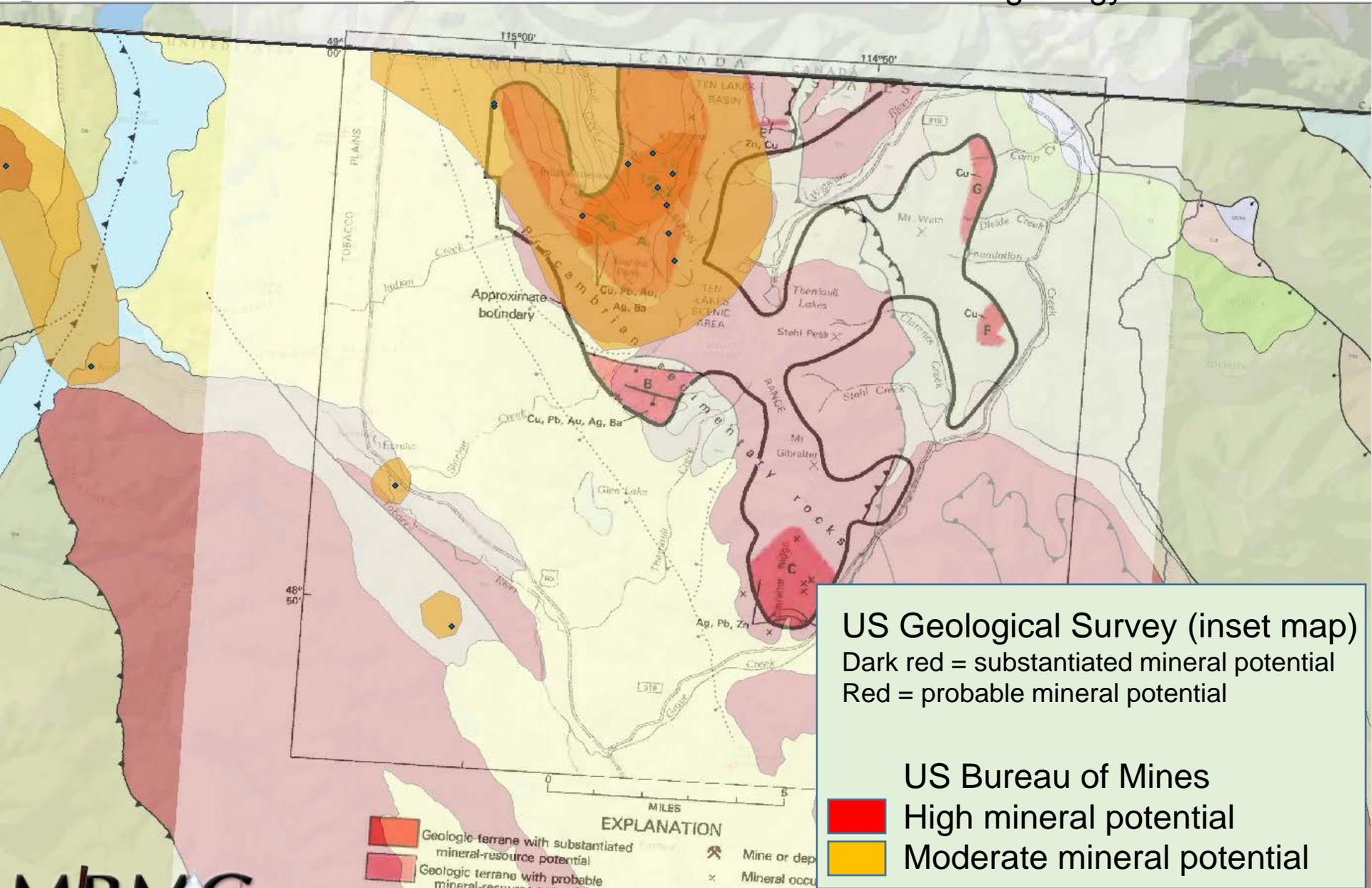
Ten Lakes



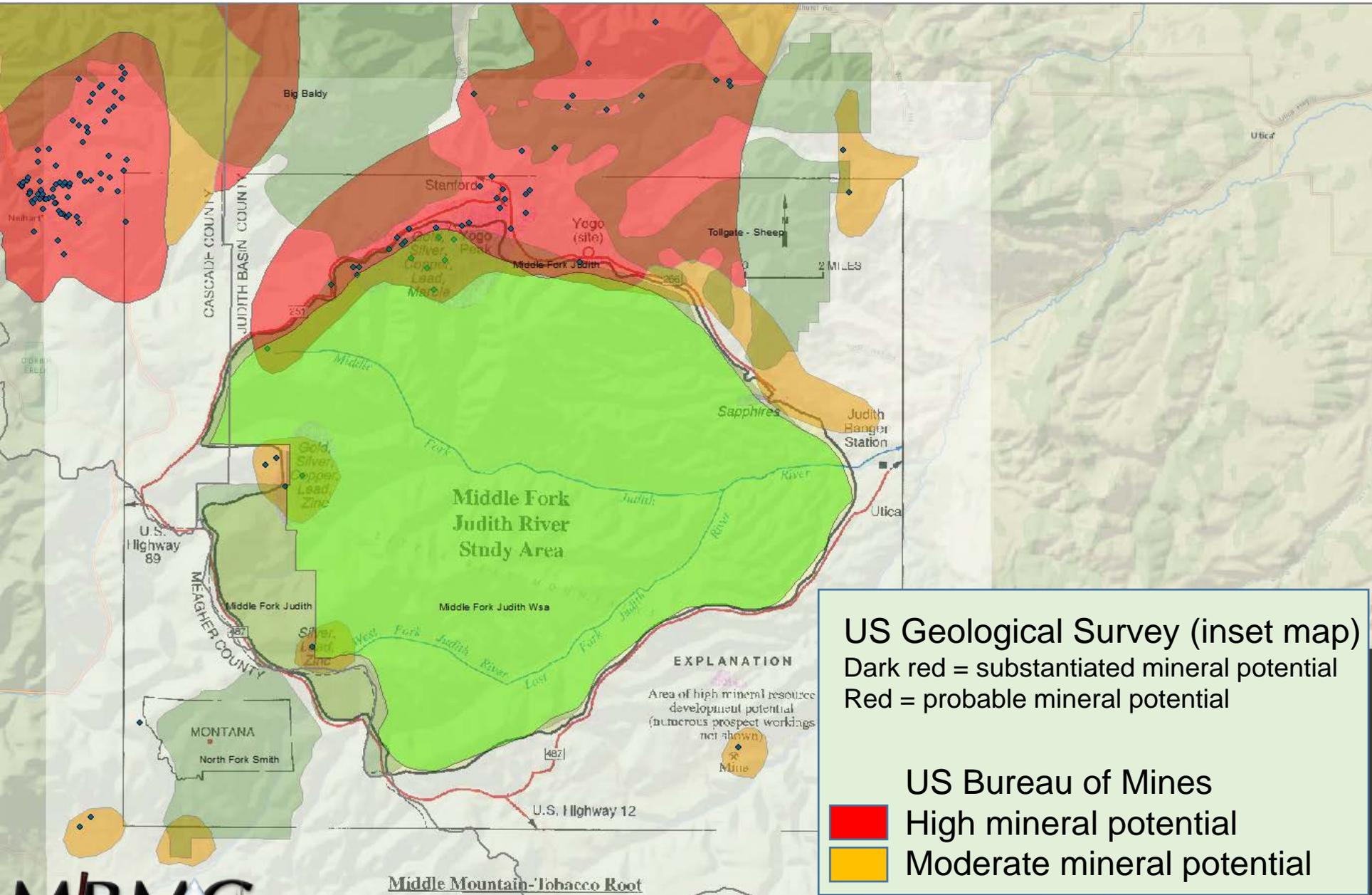
US Geological Survey (inset map)
 Dark red = substantiated mineral potential
 Red = probable mineral potential

US Bureau of Mines
 High mineral potential
 Moderate mineral potential

Ten Lakes with geology



Middle Fork Judith River



US Geological Survey (inset map)
 Dark red = substantiated mineral potential
 Red = probable mineral potential

US Bureau of Mines
 High mineral potential
 Moderate mineral potential

EXPLANATION

Area of high mineral resource development potential (numerous prospect workings not shown)

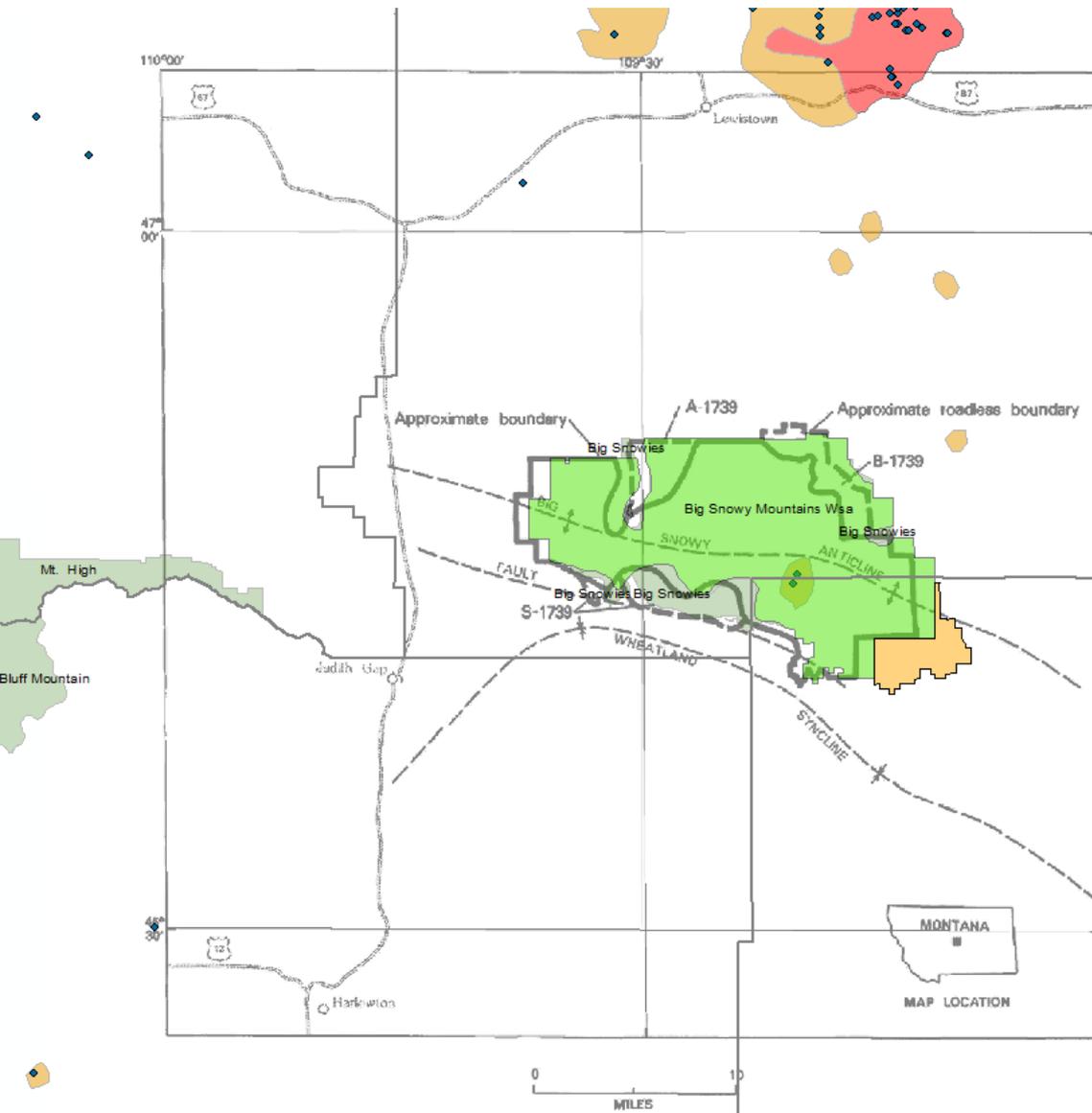


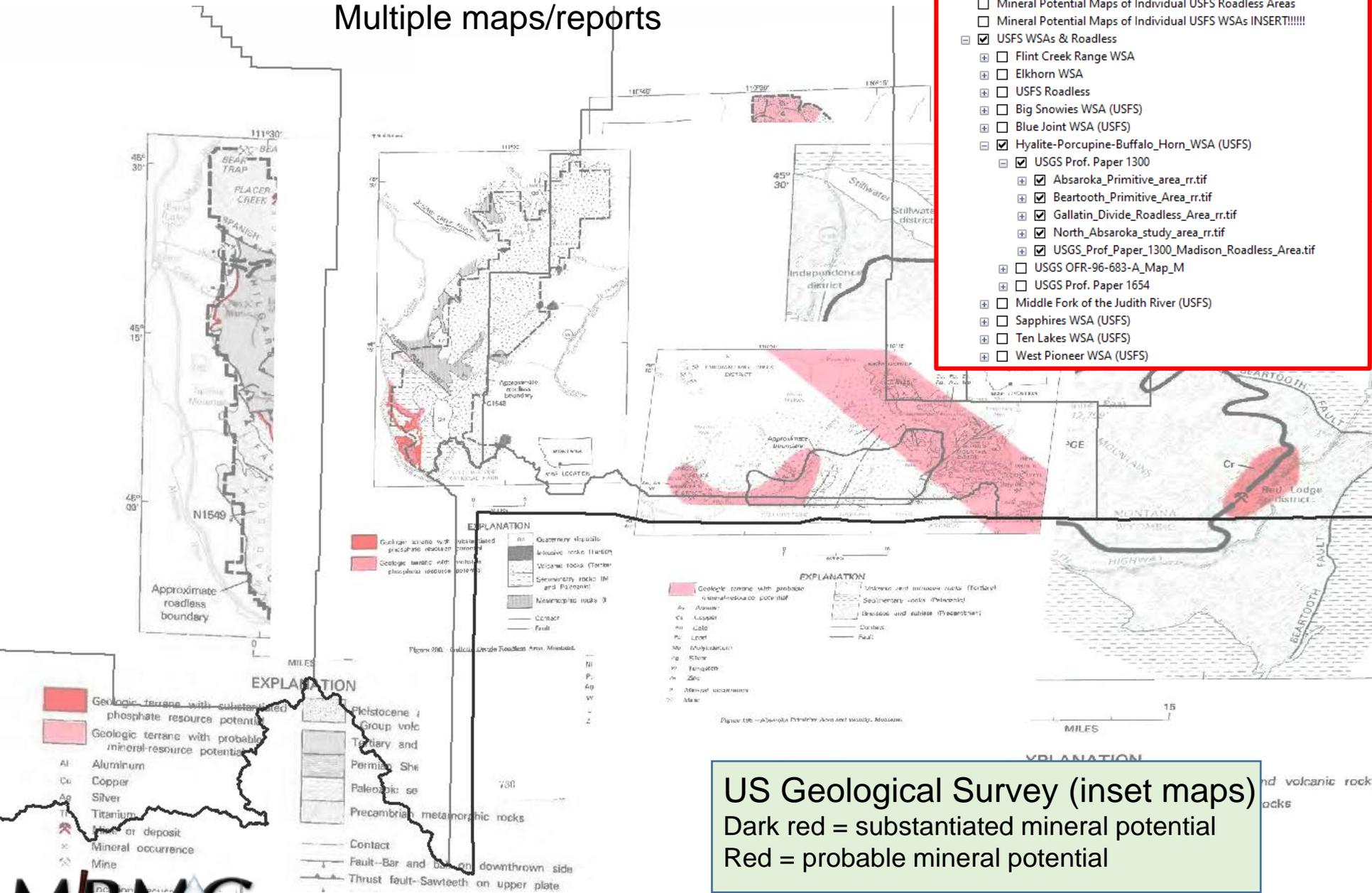
Figure 191.—Big Snowies Wilderness Study Area and contiguous roadless areas, Montana.

US Geological Survey (inset map)
 Dark red = substantiated mineral potential
 Red = probable mineral potential

US Bureau of Mines
 High mineral potential
 Moderate mineral potential

Hyalite-Porcupine-Buffalo Horn Multiple maps/reports

- All Roadless & Wilderness Study Area Individual Mineral Potential Maps
- Mineral Potential Maps of Individual USBLM WSAs
- Mineral Potential Maps of Individual USFS Roadless Areas
- Mineral Potential Maps of Individual USFS WSAs INSERT!!!!!!
- USFS WSAs & Roadless
 - Flint Creek Range WSA
 - Elkhorn WSA
 - USFS Roadless
 - Big Snowies WSA (USFS)
 - Blue Joint WSA (USFS)
 - Hyalite-Porcupine-Buffalo_Horn_WSA (USFS)
 - USGS Prof. Paper 1300
 - Absaroka_Primitive_area_rr.tif
 - Beartooth_Primitive_Area_rr.tif
 - Gallatin_Divide_Roadless_Area_rr.tif
 - North_Absaroka_study_area_rr.tif
 - USGS_Prof_Paper_1300_Madison_Roadless_Area.tif
 - USGS OFR-96-683-A_Map_M
 - USGS Prof. Paper 1654
 - Middle Fork of the Judith River (USFS)
 - Sapphires WSA (USFS)
 - Ten Lakes WSA (USFS)
 - West Pioneer WSA (USFS)



US Geological Survey (inset maps)
Dark red = substantiated mineral potential
Red = probable mineral potential