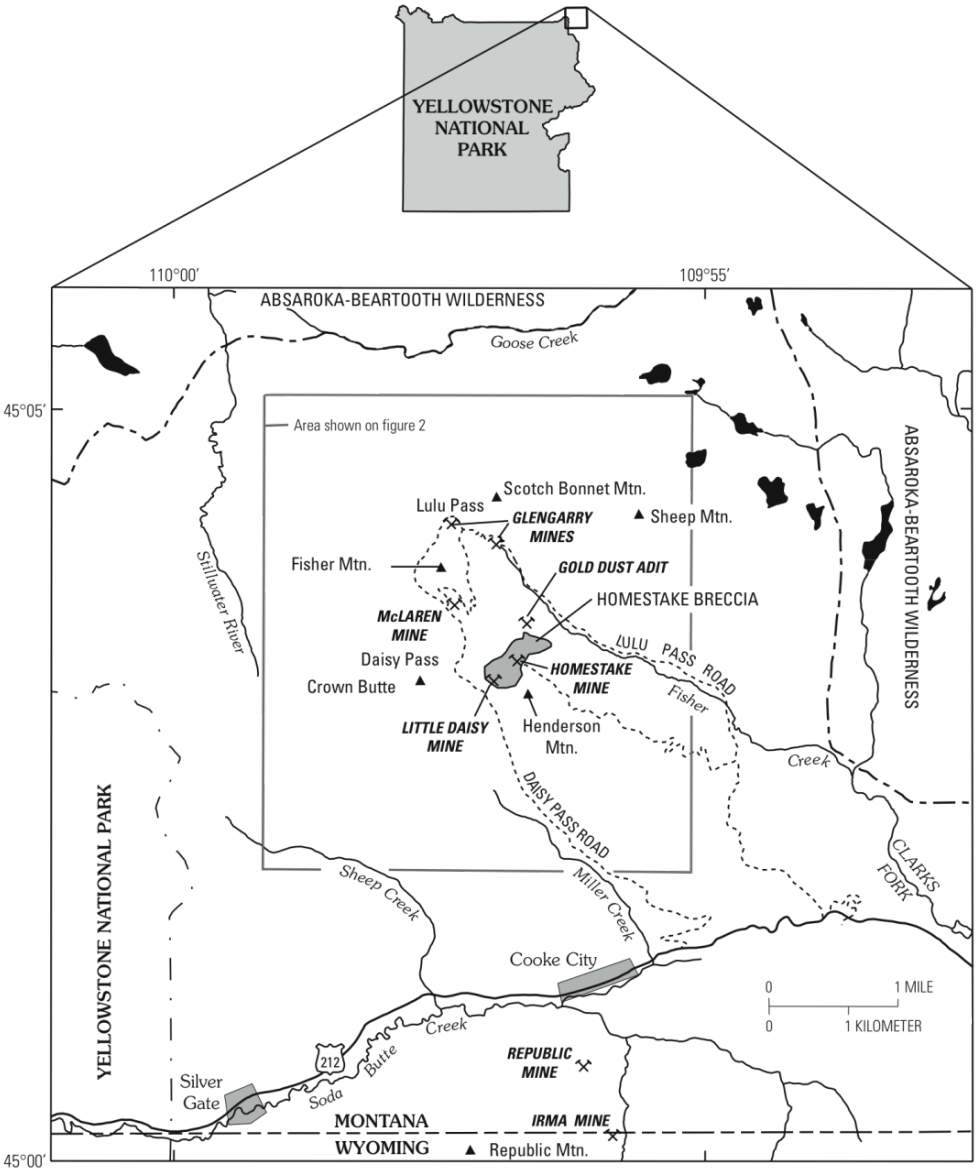
Igneous Processes, Hydrothermal Fluids, and Gold! A tale of two deposits

In this activity, you will analyze a geologic map of the Homestake Mine near Yellowstone National Park, and weigh the pros and cons of developing a gold-silver-copper mine at that location. You will also compare the potential environmental impacts of sulfide mining activities near Lake Superior with those near Yellowstone National Park. **Please read the document titled "Student Reading on Yellowstone National Park and Lake Superior" before completing this activity.**

An introduction to the gold-silver-copper deposits near Yellowstone National Park



Map modified from USGS Special paper 1717, Chapter M: "The Life Cycle of Gold Deposits Near the Northeast Corner of Yellowstone National Park—Geology, Mining History, and Fate," by Bradley S. Van Gosen

(http://pubs.usgs.gov/pp/1717/downloads/pdf/p1717M.pdf).

The generalized map on the previous page shows the location of the Homestake Mine, Montana, near Yellowstone National Park. The region around the Homestake Mine hosts identified resources of at least 2.3 million ounces of gold, 8.9 million ounces of silver, and 130 million pounds of copper (USGS Special paper, 1717). The mineral deposits were deposited by hydrothermal fluids during volcanic activities in that region about 40–50 million years ago.

Reading and interpreting geologic map

Handout 1 is a geologic map showing different types of bedrock with different types of shading. *Bedrock* is unbroken, solid rock, which may in some places be covered by soil, dirt, and broken rock pieces. The map also shows the locations of metal sulfide (such as copper sulfide) and gold deposits. Answer the following questions using the map:

1. Use the legends at the bottom of the map to find the locations where metallic sulfide and gold deposits have been identified. Which mountain is closest to the deposits?

2. The hydrothermal fluids carrying the metallic minerals came from igneous rocks, but did they deposit those minerals within igneous rocks? From the map, identify the rock type (igneous or sedimentary) where most of the ore minerals are deposited. Why do you think the ore deposits formed within that rock type?

3. Now look at the high-angle faults shown in the map. Faults often provide pathways for fluids bearing metallic minerals. Do you think those faults played any role in the way the metallic minerals were deposited? Explain your answer.

4. Based on this geologic map and your answer to the question above, would you recommend that a mining company should explore the area around Scotch Bonnet Mountain for potential gold, silver, and copper reserves? Why or why not?

   Base your answer on whether the rocks that might house those deposits and/or faults that might carry the mineral-bearing fluids are present near Scotch Bonnet Mountain. Also see where the known deposits are located with respect to Scotch Bonnet Mountain, and whether it makes sense to look for more such deposits near Scotch Bonnet.

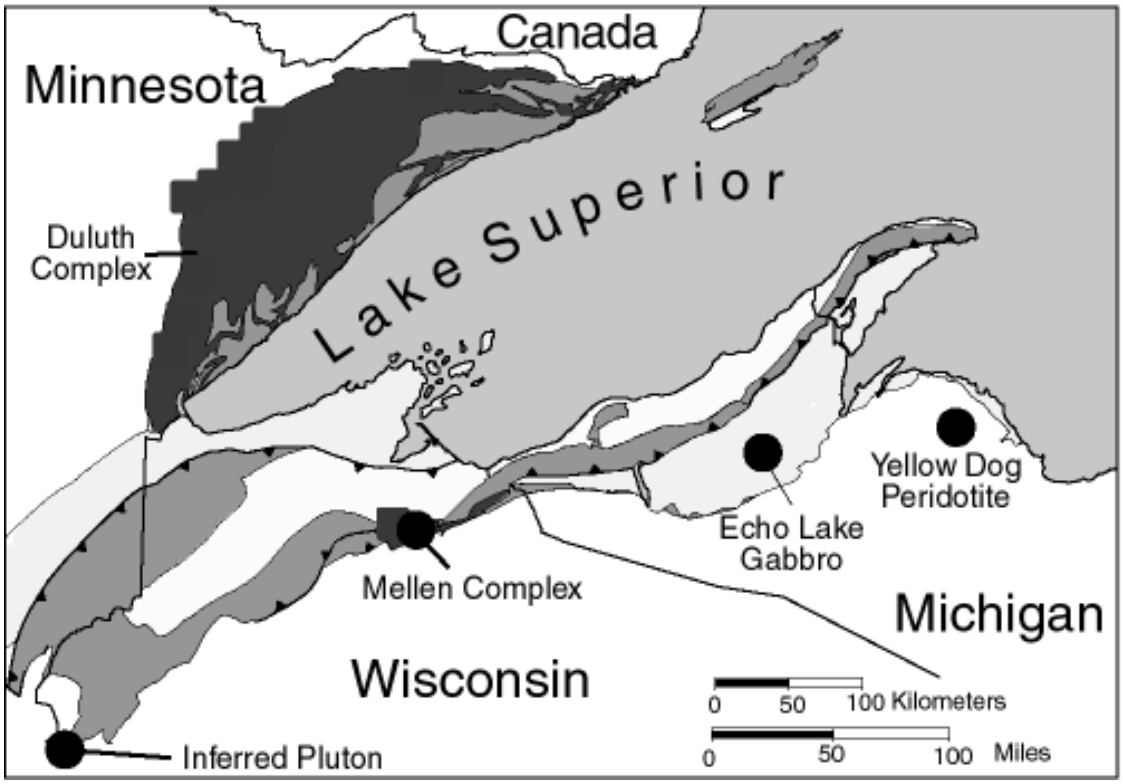
5. The area around Homestake Mine, Montana, is currently under a “no-mining” rule until 2017. After that, there is a high probability that this region will see active mining.

   There is a high likelihood of earthquakes in this region due to the igneous activity under Yellowstone National Park, and while most of the earthquakes are small, there have been some large earthquakes (such as a magnitude 7.3 in 1959) in the region. What type(s) of environmental concern(s) arising specifically from earthquake risk should be addressed before a mine is established in this region? Explain your answer.

Comparison with Lake Superior deposits (refer to the background reading for these questions as needed)

6. Some of the world's largest sulfide deposits are around the Lake Superior region, which happens to contain almost 10% of world's entire supply of freshwater. Yellow Dog Peridotite, and Echo Lake Gabbro in Michigan, as well as the Mellen Complex in Wisconsin are potential locations for sulfide mines (see the map below for locations with respect to Lake Superior).

   Assume that mining has to happen either near Yellowstone National Park or near Lake Superior. What factors (for example, land disturbance from mining as well as from infrastructure development, potential for pollution, increased job creation/economic development, etc.) would influence whether you decide to mine in Yellowstone or Lake Superior? Or would you prefer *not* to mine any more metallic sulfides in either location, but have an alternate proposal to meet the rising demand for those metals? Discuss the issue in your group, and write a one-minute position paper (Position 1: support mining near Yellowstone; Position 2: support mining near Lake Superior; or, Position 3: a viable alternative to mining for meeting demands) based on your discussion.



Map modified after USGS publication "Potential for New Nickel-Copper Sulfide Deposits in the Lake Superior Region" http://pubs.usgs.gov/info/mwni_cu/.