

Investigating Ore Deposits on Mars

(Based on Investigating Ore Deposits from curricula materials created by the American Geological Institute. Used with permission.)

Introduction



How can we explore the mineral deposits on the surface of Mars with minimal impact to the environment?

Human beings on Earth rely on products made from metals we find and mine. Aluminum, copper, gold, iron, lead, silver, tin, and zinc are just a few of the metals we use. Rocks that contain these minerals are called **ore deposits**. As we begin our exploration of the surface of Mars, we will need an understanding of Mars's geology. We have some information already from satellite imaging and information sent back from robotic explorations. Geoscientists use this information to identify the best geologic areas on Mars for further exploration.

Geophysical exploration allows scientists to gather information about underground deposits without drilling holes. Geophysical surveys measure changes beneath the ground. Two types of geological surveys are *magnetic* and *gravity*.

Magnetic surveys show changes caused by certain magnetic metallic ores. **Gravity surveys** reveal density changes in the subsurface caused by high concentrations of metal.

Task

Your assignment as a NASA geoscientist is to work with your teammates to conduct a geophysical survey on an ancient flood plain to determine what metals are available on the surface of Mars. NASA has stipulated that you must limit the impact of your activities on the environment. Your mission is to gather information only. In order to complete your mission, you will participate in a training simulation using models of Mars. The site NASA has chosen is the same site that the Mars Pathfinder mission explored via the robotics of Sojourner. Now we are sending humans to verify whether or not this area has resources that could be useful in a long duration stay on Mars.



Materials

- ❖ Large empty pizza box (unused)
- ❖ Magnetic stud finder
- ❖ Selection of small objects:
 - ❖ Block of wood (8 x 5 x 1 cm)
 - ❖ Small magnet
 - ❖ Steel paper clips
 - ❖ Rectangular piece of Styrofoam (8 x 5 x 1 cm)
 - ❖ Brass door key
 - ❖ Plastic objects (such as a comb, buttons, ball point pen)
 - ❖ Sharpened pencil
 - ❖ Coins
- ❖ Plexiglas™ sheet (about the same size as the pizza box lid)
- ❖ Centimeter squared graph paper (to cover the pizza box lid)
- ❖ Metric ruler
- ❖ Calculator
- ❖ Duct tape or masking tape
- ❖ Non-toxic markers (thin line)

Procedure

1. In this simulation, the lid of a pizza box will serve as a model of Mars's surface. The inside of the box will represent rocks beneath the surface. The valuable ore deposit you are seeking is **MAGNETIC** material. A magnetic stud finder will simulate the geophysical equipment you will use.
2. To use a magnetic stud finder, slide it over the surface, and if it detects any material that is attracted to the magnets, the top of the finder moves.

To test the stud finder and see how the model works, first tape the objects randomly onto the Plexiglas™ sheet. Next, turn the Plexiglas™ sheet upside down and place it over a bowl. Run the stud finder over the Plexiglas™ sheet to see how it reacts to the different objects and the materials they are made from.
3. Now you are ready to construct your exploration model. Choose one person in

the group to prepare the model for everyone else to "explore". On the underside of the pizza box lid, secretly secure the objects with duct tape. Arrange them in a pattern, thinking carefully about where to place the magnet and other metal objects. Then close the box.

- The team is now ready to use the ore exploration model. Somewhere, below the surface, are the metal "deposits" you want. Your geophysical equipment will tell you where they are. But there is a catch! NASA has a strict budget for this project. Using your equipment on Mars is expensive. Before you begin your search, your team needs to do some planning to figure out how to keep your costs as low as possible.



Here are your budget and cost factors:

BUDGET: \$400,000 for the entire search
COSTS: \$1,000 for every centimeter you move the stud finder

Hint: Think about where you are going to start, and the movements you will make with your equipment. You can sketch your path onto the graph paper, count the centimeters you have used up, and see how this fits with your budget. Estimating costs is one thing that geoscientists must do when exploring for metals.

- Now you are ready to begin. As you move your equipment, use a fine marker to record its path over the surface and another marker to record anything you find. Keep searching and try to locate all the objects, and see if you can deduce what each one might be.
- Carefully lift the pizza box lid. Look at the objects. Compare where they are located under the lid with your graph paper. Have you successfully detected the ore deposits? If not, where did you go wrong in your search?
- Add the total length of your exploration path in centimeters and multiply the sum by 1,000 to determine the cost of your exploration.
 - ❖ Did you stay within your budget?
 - ❖ How could you have reduced the cost by searching in a more efficient way?
 - ❖ If you did this again, how might you change your search method?

Presentation



NASA will want to know:

- >What you found.
- >The size of the objects you located. (Devise two methods to estimate the surface area of a particular "discovered" metal deposit. Assume that 1 centimeter on graph paper = 0.5 kilometers on the ground. Or, 1 square centimeter = 0.25 square kilometers. Compare the results of both methods.)
- >How many objects did you find?
- >How big was the largest object? the smallest object?
- >What would have been the least costly way to search? How can you explain that?
- >Were there any objects you could not find with your equipment? Why might be the reasons for that?
- >If you used this model again, how might you improve the way you explored and why?
- >What are some of the limitations of this model as compared to the actual surface of Mars? In other words, how does this model differ from the real world?
- >What do you think are the major difficulties in finding underground ore deposits?
- >What knowledge and skills do you think exploration scientists need to be successful in their work?

Your presentation should address as many of the above- mentioned issues as possible. Some issues may require more research on your part. The following web sites may prove helpful:

www.agiweb.org
www.earthsciweek.org
www.smenet.org/
www.mii.org
www.nma.org/
www.usgs.gov

In addition, your presentation must include visuals and graphics.

Remember the original question?

How can we explore the mineral deposits on the surface of Mars with minimal impact to the environment?

You must convince NASA that you can do this effectively and stay in budget. Good luck!

