Prospecting by Chemistry

Part A – What's it all about?

Prospecting for minerals

You are going to take the part of a geochemist working for the British Geological Survey.

The British Geological Survey provides advice to the Government, industry and the public. It gathers information on all aspects of geology by doing scientific surveys. The team you work with is prospecting for minerals.

Prospecting means looking or exploring. In this unit your team will be prospecting for minerals containing iron.

A **mineral** is a chemical element or compound which occurs *naturally* in the Earth's crust. It has a definite chemical composition and is often found as crystals. For example, hematite (Fe_2O_3) is a mineral from which the metal iron is obtained. Rocks containing valuable amounts of minerals are called **ores**.

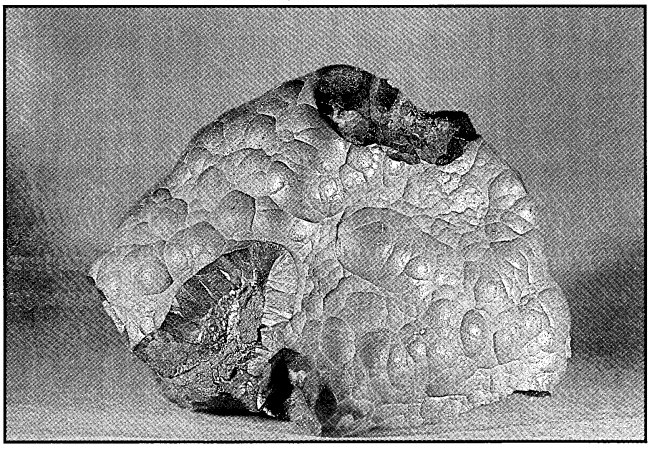


Figure 1 Hematite is a mineral containing iron

The prospector's problem

Minerals are usually found in very small amounts. Occasionally, you can find quantities large enough to be worth digging out of the ground.

Minerals are mined in many areas of Britain. The prospector's problem is to find *new* areas with deposits of minerals worth digging up.

Prospectors often look at areas where mining has been carried out in the past. They hope to find minerals which miners have missed before. Or minerals may have been left in the ground because they were too difficult to extract. As prices rise it may become worthwhile mining lower grade ores with less mineral content.

Part A introduces prospecting for minerals.

Part B is a practical investigation using a chemical test for iron.

Part C is a data-handling exercise.

Part D is a class discussion (optional).

A1 *Here are the names of some minerals:*

galena, gypsum, calcite, rock salt, sulphur and zinc blende.

These are their chemical names but not in the same order:

calcium carbonate, calcium sulphate, lead sulphide, sulphur, sodium chloride, zinc sulphide.

(a) Match the names to the minerals.
(b) Which mineral is an element?

A2 *What clues might a geologist look for when prospecting for minerals containing iron?*

The task – prospecting in the Iron Hills

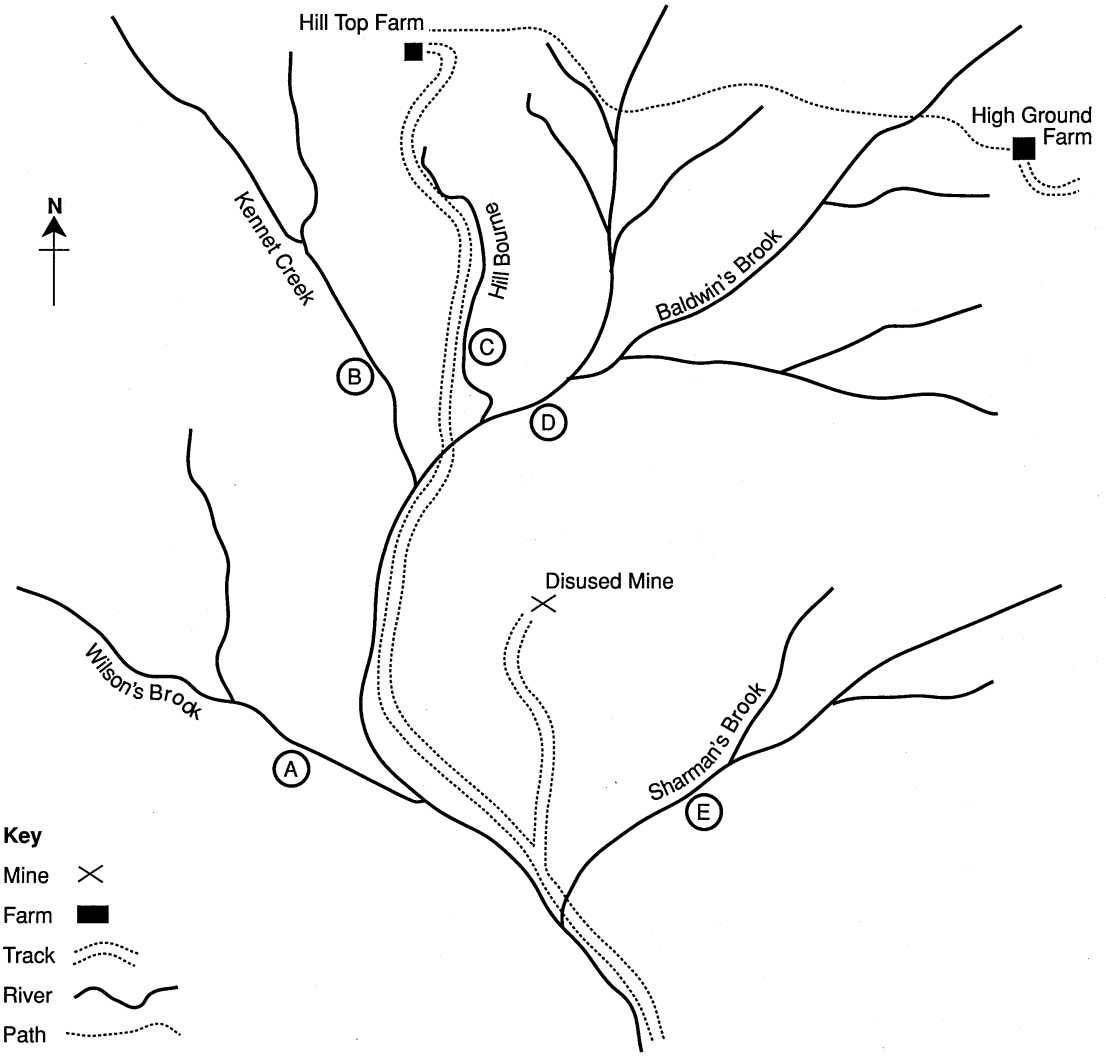
The team has been asked to investigate the *Iron Hills*. (See **Map 1**.) It is an area where iron ore was mined in the past. Mining stopped when no more could be found. Using new methods the team may be able to find sources of iron that were not discovered before.

A3 If you found grains of gold in a stream bed where would you look for more, up-stream or downstream?

A4 How might a study of water in the streams help to find iron in the Iron Hills?

The Iron Hills cover a large area. Much of it is woodland. There are few places where you can see bare rocks. Several streams flow through the area and streams can give clues about the rocks they pass over.

The team will investigate the streams first. Your task is to look for compounds of iron dissolved in the water. If the tests show large amounts of iron, you may advise the team to carry out further exploration of the area.



Map 1 The Iron Hills

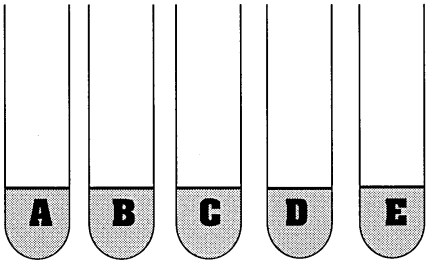
Part B – Testing water samples for iron

You have taken samples of water, **A, B, C, D** and **E** from five streams in the Iron Hills. The samples were taken at the points shown on **Map 1.**

You will need to find out if any of these samples has iron dissolved in it.

The test described on this page can detect iron in water. *Try it on sample A first.*

Repeat this test with the other water samples, B, C, D and E. Use a clean test tube each time.



B1 *Make a table of your results with headings:*
Water sample Colour Iron content
Use it to answer questions B2 to B6.

B2 *Which stream had the highest iron content?*

B3 *Did any stream contain no iron at all?*

B4 *Which stream contained iron in the smallest detectable quantity?*

B5 *Suggest why you were advised to rinse the pipette with distilled water.*

B6 *Explain why you had to use the same volumes of each water sample and iron-testing solution each time.*

Reporting your findings

You will need to report on your findings to your boss at the British Geological Survey.

You may do it on a **report form** or write a more detailed report on paper. You should include
(a) a summary of your investigation,
(b) the conclusions you have come to,
(c) what the next course of action should be.

Test for iron

Eye protection must be worn.

1 Add 5 cm^3 of the water sample to a test tube with a pipette or syringe.

2 Rinse this pipette with distilled water immediately after use.

3 Using a second pipette, add 5cm^3 of the iron-testing solution to the test tube in the same way.

4 Rinse the pipette.

5 If iron is present the colour will change. The colour you get depends on the iron content in the sample, as follows:

Colour	Iron content	
colourless	No iron	(N)
yellow	Low iron	(L)
orange	Moderate iron	(M)
orange/red	High iron	(H)

Part C – The follow-up

As a result of your exploration of the Iron Hills area another geologist did a follow-up investigation of Baldwin's Brook.

The geologist took water samples from the sites shown on **Map 2**. These were analysed for iron, and the results are shown in the table.

Table 1 Results of the follow-up survey

Sample number of	Iron content
1	L
2	N
3	N
4	N
5	N
6	N
7	M
8	H
9	H
10	L
11	L
12	M
13	M
14	H
15	H
16	N
17	H
18	H
19	N
20	N
21	M
22	M
23	H
24	H
25	N
26	H
27	N

Key to iron content

H	=	high
M	=	moderate
L	=	low
N	=	none

C1 *Plot the data from table 1 on a copy of Map 2 using colours. Decide how you are going to represent different iron contents.*

C2 *Carefully draw lines on the map to outline the areas of high iron content. Shade these areas lightly. Add a key to your map.*

C3 *Describe the pattern shown by the map.*
(a) How many areas are high *in iron content?*
(b) Roughly, what are the sizes and shapes of the areas of high iron content? Can they be related to the disused mine?
(c) Where are the areas of medium *iron content – upstream or downstream of the high iron content areas? Why does this happen?*

C4 *Suggest further investigations that could now be carried out in this area.*

Part D – Questions for discussion

D1 If deposits of iron ore are buried well below the surface, would you be able to detect them with the technique used in this unit? What other methods may be used for prospecting?

D2 Suggest the names of two other metals which you might look for using chemical tests on stream water.

D3 Imagine that a new deposit of iron ore is discovered around the town of Tunbridge Wells in Kent, south of London. The area is well-populated but most of the ore is under scenic countryside. The ore which is of good quality would be expensive to mine.

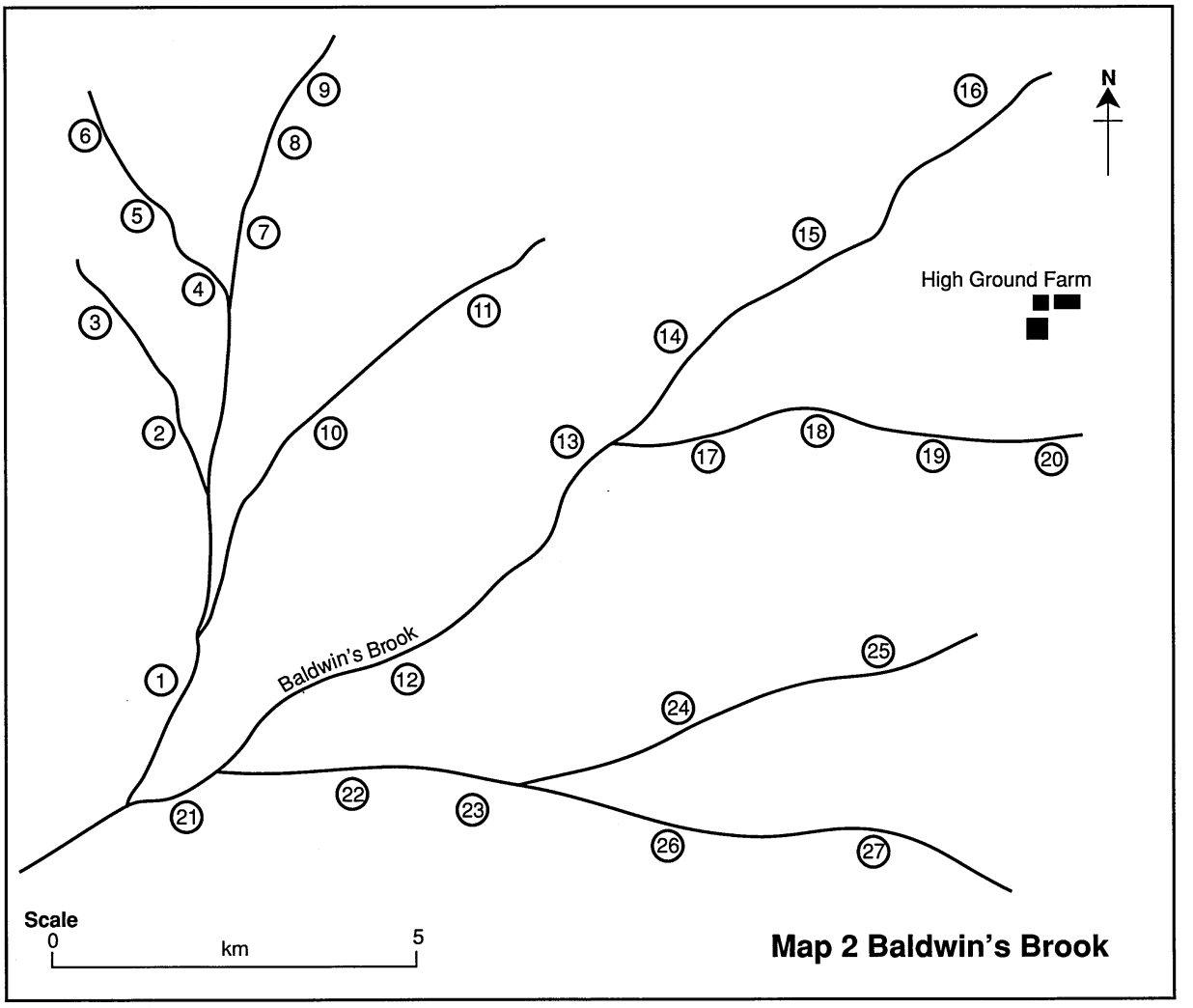
(a) Suggest what objections local people might raise against mining in their area.

(b) In what circumstances might mining go ahead?

Answers to the questions are given in the *Teachers' Notes.*

Part C

Follow-up study of Baldwin's Brook area



Signed .....

BRITISH GEOLOGICAL SURVEY

CHEMICAL ANALYSIS REPORT

From .....Senior Geochemist

Date .....

To: F E Isenberg, Head of Mineral Prospecting.

Summary of Investigation: **Iron Hills area**

Conclusions

Suggested Action

Signed .....