

## METAMORPHIC AUREOLE

### *Purpose*

*To show how the temperature changes in the rocks adjacent to an intrusion as the intrusion cools.*

### *Activity*

*The sand represents the country rock and the hot water the intrusion.*

- 1 Place four thermometers in the sand as shown in the diagram. Each thermometer should be placed so that the bulb is about 5cm below the surface.*
- 2 Make up a chart like this but with at least 30 lines, to record the temperature shown by each thermometer.*

<i>time</i>	<i>temperature of water</i>	<i>temperature of sand</i>			
		<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>

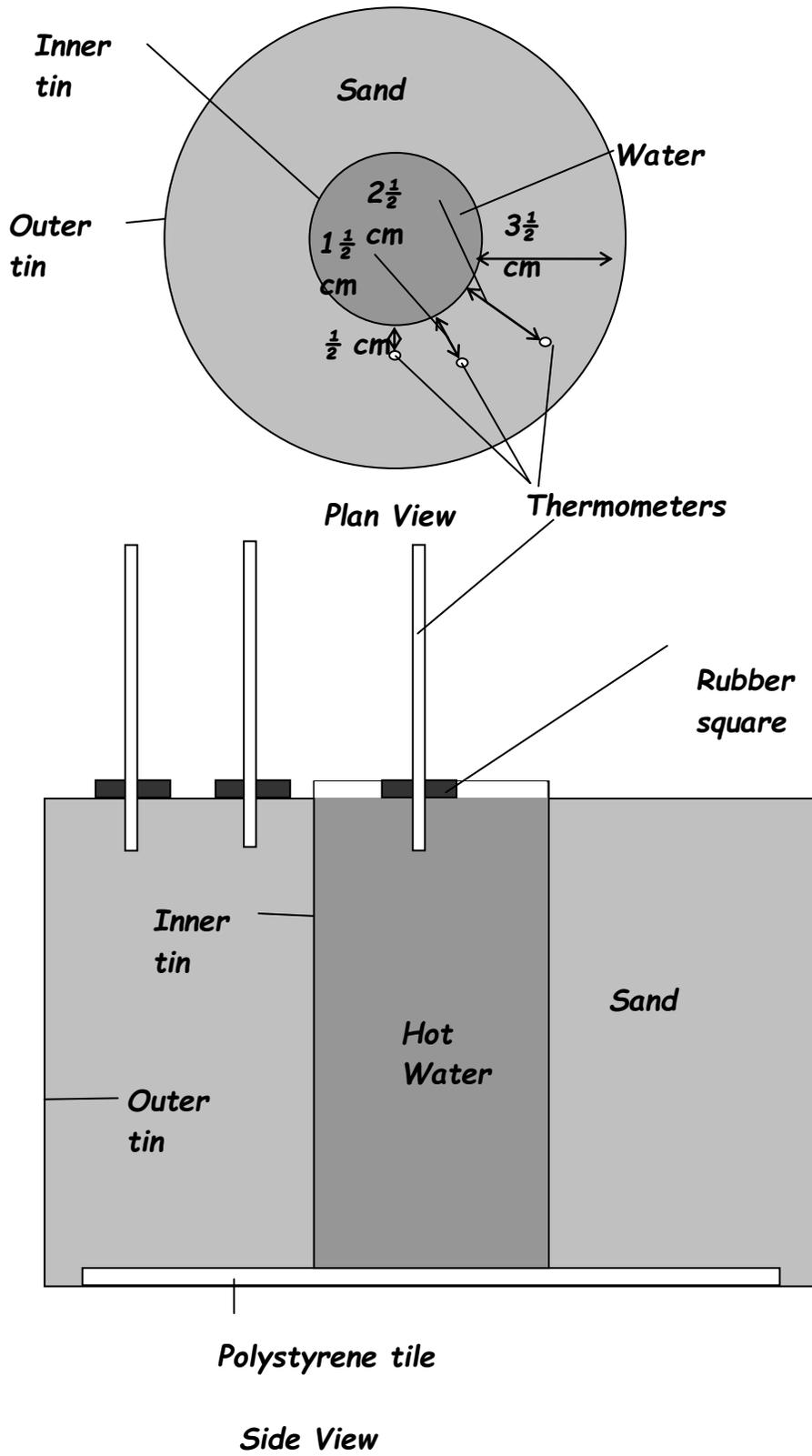
- 3 Record the temperature shown by all the thermometers before pouring in the water.*
- 4 Pour boiling water into the small tin and quickly put on the lid. Place the fifth thermometer in the hole in the tin lid so that the bulb is 5cm below the lid.*
- 5 Start your timer and start recording the temperature shown by each thermometer every two minutes until all thermometers show a decrease in temperature.*
- 6 Plot all the temperatures on a single piece of graph paper. Use the graph paper in landscape format and plot temperature on the vertical axis 1cm = 5 degrees and time 1cm = 4 minutes on the horizontal axis.*

- 7 Collect the data of tin diameter the inner tin, damp or dry sand, and time to maximum temperature for each thermometer from other students in a table like the one below.

<i>Time to maximum temperature</i>										
<i>name</i>	<i>Diam eter</i>	<i>dry or damp</i>	<i>Thermometer</i>							
			<i>1</i>		<i>2</i>		<i>3</i>		<i>4</i>	
			<i>Time</i>	<i>temp</i>	<i>time</i>	<i>temp</i>	<i>Time</i>	<i>temp</i>	<i>time</i>	<i>temp</i>

- 8 For tins with dry sand plot size of the inner tin against time to maximum temperature. For two tins of equal diameter but one with damp sand and one with dry sand plot the time to maximum temperature.
- 9 Answer the questions below.
- How does the temperature change with distance away from the intrusion?
  - How does the size of the intrusion affect the size of the metamorphic aureole?
  - How does the size of the intrusion affect the thermal gradient?
  - How does the temperature at any one place change with time?
  - Which will cool fastest a large or a small intrusion?
  - Does damp rock transmit heat energy more or less quickly than dry rock?

*Metamorphic aureole*



## **Teacher's Section**

### **Requirements**

**Round tins about 24cm diameter and 11 cm deep, Roses Chocolates tins are ideal. Alternatively a cake tin can be bought from a hardware store.**

**A variety of smaller tins about the same height but varying in diameter from 78 to 110 mm (see notes).**

**Sand**

**5 thermometers**

**Polystyrene tiles at least 25cm across**

**Timer**

**Kettles to boil enough water**

**Making the apparatus (About 1 hour for 5 tins)**

**Cut the tile to the size of the large tin and place it in the bottom. Place the smaller tin in the centre on top of the tile and fill the space between them with well compacted dry or damp sand. The thermometers should have small pieces of rubber or plastic collars on them to show what depth they should be inserted into the sand or water. Make a hole just large enough to take a thermometer in the centre of the lid of the smaller tin.**

### **Notes**

**To show the variation of temperature away from an intrusion and with time you need only one outer and one inner tin but having the results from a variety of sizes of inner tins allows students to answer more questions. These are the sizes of tins I have used but smaller ones might be better as they would reach maximum temperature more quickly**

### **Results**

**The sand farthest away takes longer to reach maximum temperature. The maximum temperature reached decreases away from the inner tin. The innermost thermometer shows a very rapid rise in temperature and a slow decline. Other thermometers show a gentler rise in temperature. The larger the inner tin the longer the cooling takes. Wet sand cools faster than dry sand.**

### **Time**

**Readings need to be taken until all the thermometers begin to show a decrease in temperature. All the thermometers in a damp 78mm tin will**

*cool with an hour. A 90mm diameter tin will take 100minutes but the change in temperature is very slow below 60°.*



*Tin for metamorphic aureole*