Suitable for UK KS3 or ages 11-15

Investigating the Effect of Temperature on Crystal Size

Student worksheet

Introduction

Rocks make up the majority of the world's crust. In studying the rock cycle, you will see that, far from being immobile and boring, rocks are constantly on the move and change in response to the conditions they find themselves in.

Some rock formation takes time as rocks are squeezed under great pressure and melted due to great heat, but some rock formation can be violent and rapid, as when a volcano erupts.

Igneous rocks are rocks that are associated with volcanoes and are made when molten rock (magma) cools and the minerals inside solidify into crystals.

You are going to conduct an experiment to investigate how the rate of cooling of magma affects the size of mineral crystals found in the igneous rock produced.

Experiment

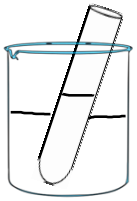
Before beginning the experiment, read through all of the instructions so that you are clear on what you need to do before starting. Pay particular attention to any **safety** information as you will be using Bunsen burners and heating liquids to high temperatures!

Equipment – each working group will require the following

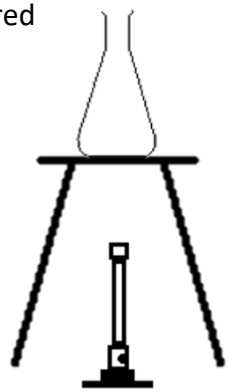
- 1 x Bunsen burner
- 1 x heatproof mat
- 1 x gauze
- 1 x 25cm^3 measuring cylinder
- scrap paper to place under and label their own groups evaporating dish
- 1 x filter paper
- 1 x filter funnel
- 1 x weighing boat
- 3 x petri dish or evaporating dish
- 1 x spatula
- 1 x conical flask (100cm^3)
- 1 x 250ml beaker
- 1 x large boiling tube
- 1 x thermometer
- Copper oxide powder
- Sulfuric acid

Procedure

1) Half fill a glass beaker with boiling water from a kettle.
   I. Take care when pouring hot water.
2) Use your measuring cylinder to measure out 45cm^3 of sulfuric acid and add to a boiling tube.
   I. Take care handling acid at all times as it is an irritant
3) Place your boiling tube containing sulfuric acid into your beaker of hot water so that it stands upright.
4) While the sulfuric acid heats in the water bath you have created, use a spatula and a weighing boat to weigh out 5.7g of copper oxide (a black powder).
5) Add one spatula of copper oxide to your hot acid and stir using a stirring rod until the copper oxide has dissolved and you are left with a clear blue solution.
6) Repeat step 5, adding one spatula of copper oxide power at a time until all of your copper oxide has been added or until no more will dissolve (you will see black powder at the bottom of your boiling tube no matter how hard you try to mix them).
7) Set up your filtering equipment as shown;
   I. place your filter funnel in the neck of your conical flask.
   II. Fold your filter paper in half twice and then open and rest inside your filter funnel.
8) Filter your copper sulfate solution by pouring your solution through your filtering equipment. This removes any undissolved black copper oxide as it will not be able to pass through the filter paper. Be patient, do not pour your solution too quickly or the level will rise above the filter paper and bypass it.



9) Once filtered, remove the filter funnel from the conical flask. Filter papers can be disposed of in the bin but check with your teacher for their instruction.
10) Place your conical flask containing your filtered copper sulfate solution onto gauze above a Bunsen burner as shown.
    I. Before turning on your gas, ensure that the air hole is closed (safety flame) and someone is close by to light it.
11) Heat your solution until just boiling and then allow to simmer for 2 mins before turning off your Bunsen burner.
    I. Do not allow your solution to reach a vigorous boil as it may spit. Do not boil your solution dry.
12) Allow the conical flask to cool for a short period of time and then remove it. Be careful as the conical flask may still be hot. Handle the neck of the flask only as this will be the coolest part. If still too hot, use a paper towel.
13) Pour equal volumes of your solution into three different evaporating dishes or petri dishes.
14) Place each petri/evaporating dish in places where they are exposed to different temperatures to cool. Use a thermometer to estimate cooling temperature. Make a note of these temperatures in the table given (*see experimental analysis*).
15) Leave overnight or until your next lesson, at which point you will be able to see and compare the crystals you have produced.



Experimental follow up

Your experiment aims to replicate aspects of igneous rock formation. Answer the following questions to explain how.

What crystallises to form igneous rock?

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In your experiment, what crystallises?

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What does the copper sulfate solution you produced represent in the volcano?

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Suggest why you think it was important to heat the sulfuric acid before dissolving in the copper oxide?

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Suggest why you heated the acid in a water bath, rather than using a direct heat source such as a Bunsen burner.

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What safety precautions did you take during the experiment and why?

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Which condition of cooling most closely replicates the formation of intrusive (rocks that cool underground) igneous rock?

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Which condition of cooling most closely replicates the formation of extrusive (rocks that cool on the surface) igneous rock?

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Write down your prediction for how the temperature of cooling will affect this size of crystals formed.

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Table of results

	Temp. 1 ____˚C	Temp. 2 ____˚C	Temp. 3 ____˚C
Largest crystal formed (mm)			

Write a conclusion for your experiment. Was your prediction above correct?

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Use your conclusion to explain why the largest crystals are found in intrusive igneous rock.

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