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## **The STFC Lunar Sample Collection Virtual Microscope**

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All samples in this collection have been kindly loaned to the STFC by NASA. The Virtual Microscope was created at the Open University.

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## **Introduction to the STFC Lunar Sample Collection Virtual Microscope**

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Valuable samples of moon rock and soil were brought back to Earth by NASA's Apollo astronauts. STFC is the only authorised source for the loan of this precious material to educational or scientific organisations within the United Kingdom. Four educational packages are available free of charge (including special security delivery/collection) for short term loans of lunar samples and meteorites.

The samples were collected during NASA's manned space missions to the Moon in the late 1960's and early 1970's. During these missions the Apollo astronauts brought back to earth 382 kilograms of lunar material. NASA decided to use a small proportion of the rock and soil to develop lunar and planetary sciences educational packages. The lunar samples are presented in encapsulated discs and the digitised thin sections are contained on this memory stick. They are of interest to everyone from a young child to a geology student. Each package also contains different examples of meteorites, put together by the Natural History Museum. Some sets have sectioned samples, and every set has chunk-sized pieces of meteorite that can be handled. Comprehensive support material is included with each loan. Hundreds of schools, colleges, universities, museums and astronomical societies throughout the UK have enjoyed the samples since the scheme began.

The virtual microscope for viewing the lunar sample collection thin sections is a viewer created by The Open University that allows you to study thin sections of lunar soils, breccias and rocks in an internet browser window. It has many of the capabilities of a petrological microscope including changing magnification, viewing in plane polarised light (PPL) and through crossed polars (XPL) and rotating the sample to view variations in pleochroism and birefringence colours.

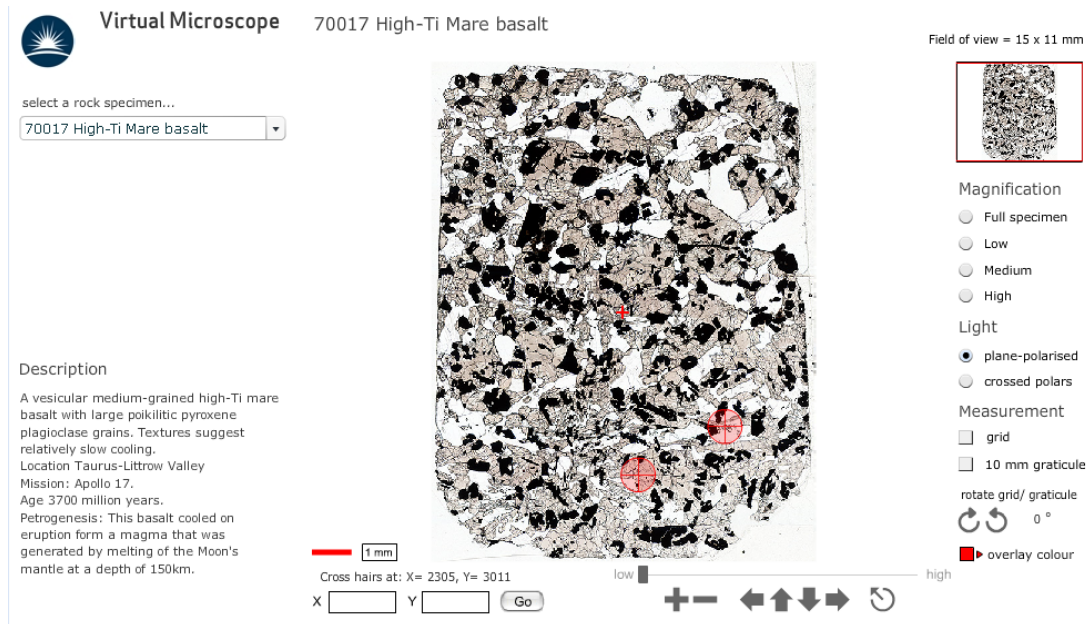
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## **Using the STFC Lunar Sample Collection Virtual Microscope**

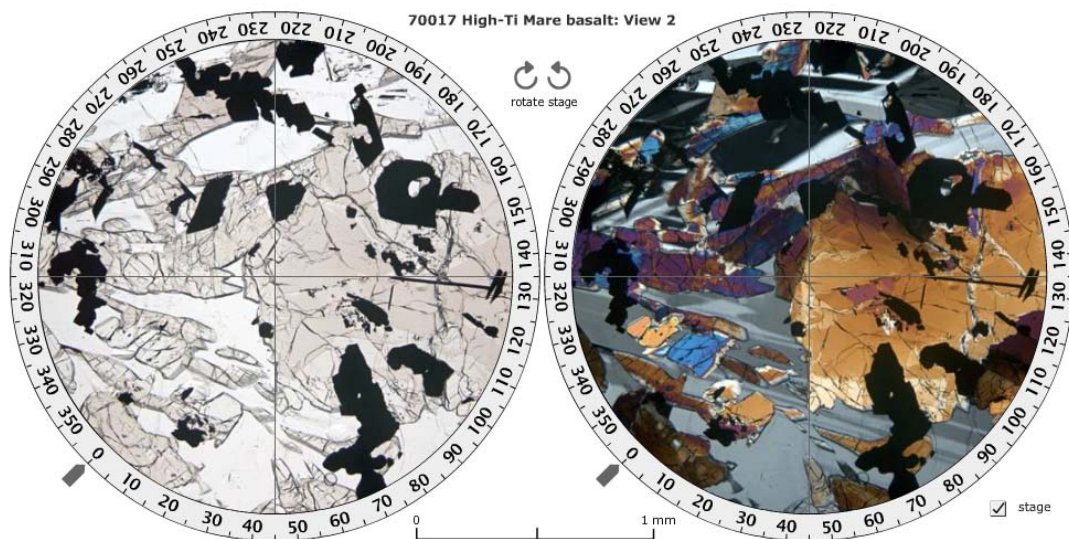
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Open the Virtual microscope by double clicking the box of slides on the opening page of the virtual microscope and you should see a screen similar to the one shown in Figures 1 and 2. We will use the thin section of sample 70017 to illustrate the Virtual Microscope, but this may not be the image that appears the first time you access the VM.

When you open the Virtual Microscope you may find that the security settings in your browser block the active content which is adobe flash and active X. This is a feature of browsers designed to protect you from internet threats so you will have to click 'allow blocked content'. This will not affect your browsing since it will only apply to the Virtual Microscope.

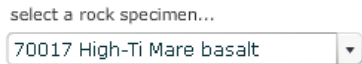


**Figure 3.4.1** A view of the main screen of the 70017 page in the Virtual Microscope.

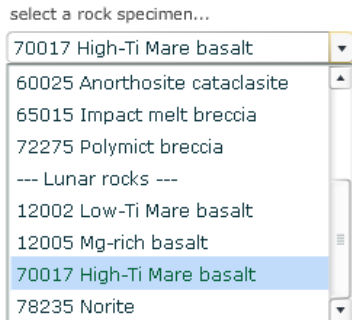


**Figure 3.4.2** A view of one of the rotatable views (View 2) for the 70017 page in the Virtual Microscope.

The screen is divided into a main viewing window and several functional areas that provide the ability to pan around the thin section, change magnification and light transmission conditions, and allow measurement (Figure 1). Two circles lower down the screen (Figure 2) display rotating images for viewing in plane-polarised light (left-hand circle), and between crossed polars (right-hand circle). These will only be displayed when you click on one of the circles on the full specimen view.

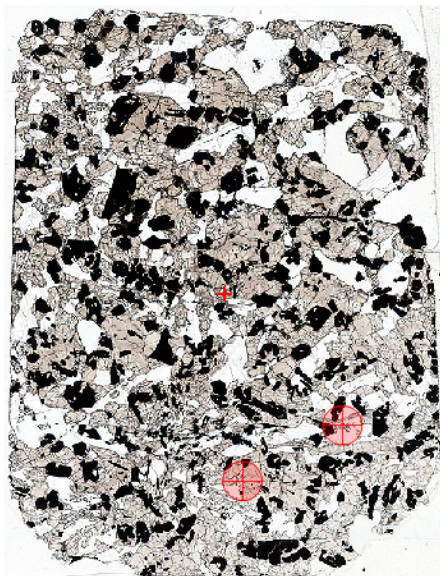



1 In the upper left-hand corner, the catalogue of specimens can be accessed via a drop-down menu. The menu allows you to access the collection of soil, breccia and rock specimen thin sections.



2 Clicking and scrolling down the upper menu allows you to select from the menu of grouped soil, breccia and rocks. Select '70017 High-Ti mare basalt' in the 'Lunar rocks' grouping for this demonstration.

70017 High-Ti Mare basalt



3  The main window shows the full thin section view when initially selected from the menu. In the middle of the field of view there is a small cross (traditionally called the 'cross hairs' because real hairs were used in early microscopes); this is used for locating features in the specimen (see point 5).

Note that a small number of coloured, semi-transparent circles with crosses are visible. These are 'hot spot icons' that, when clicked, display rotatable images in the circles below the main viewing window.

The image in the main window can be manipulated either by zooming in and out, or by panning around the specimen at selected magnifications. As the main image is zoomed or panned, the thumbnail image in the top right-hand corner shows the location of the main window as a red rectangle superimposed on the thumbnail image.

The dimensions of the field of view of the main window are given in millimetres at the top right above the thumbnail image.

The image can be moved in several different ways by:

- clicking and dragging the image itself
- using the arrows on the right below the viewing window (further explained in point 6)
- clicking and dragging the red rectangle on the thumbnail image in the top right-hand corner
- clicking and holding the arrow keys on the keyboard.

The image magnification can be varied in various ways:

- If you wish to zoom in to a specific point in the thin section, simply click on the required spot, which then becomes the new centre of the field of view at a higher magnification. Another click zooms in further.
- Zooming in and out can also be achieved using the computer keyboard. Press the 'A' key to zoom in, and the 'Z' key to zoom out.
- A set of screen controls on the right below the main viewing window contains all the zooming and panning functions. These are explained in point 6.
- Finally, there is a set of fixed magnifications, similar to a series of fixed objective lenses in a real polarising microscope, that can be used to standardise magnifications for some activities, see point 8.

A scale bar below the main view window on the left shows 1 millimetre.

4 Click on the upper-left hot spot icon of the image shown in point 3 (one of the coloured circles containing crosses) and the window will display two circular images known as 'rotating views' (Figure 2). At this point, two high-resolution movies are loaded into the browser. The circles may be blank while this is happening, but will display the word **LOADING** in the centre of the view:

- the view on the left is an area of the thin section displayed in plane-polarised light
- the view on the right is the same area of the thin section displayed as it appears between crossed polars.

The high-resolution movies may take several seconds to load, but take considerably longer over a slow internet link. The process of loading the images can be speeded up considerably by pre-loading the movies – see point 13 for instructions.

These rotating views are used to demonstrate several of the key optical properties of minerals in the thin sections: in plane-polarised light (PPL) and between crossed polars (XP). They can also be used to measure angles and can be viewed either with a 360° scale surrounding the view like a real microscope stage, or with a simple numerical indicator. You can choose between these two views by clicking on the 'Stage' tick box in the bottom right-hand corner of the view.

The images in these views (i.e. PPL or XP) can be rotated to view changing colours (pleochroism or interference colours) and extinction by clicking and dragging either


image using the mouse, or by clicking one of the circle arrows labelled 'rotate stage' located between the rotating views at the top.


Some of the main features in each rotating view are indicated by labels that can be switched on and off using the 'labels' tick box at the bottom right-hand corner of the screen.

Cross hairs at: X= 5278, Y= 4167

5 X  Y

The location of the cross hairs is constantly displayed below the viewing window as X and Y coordinates. The sample can be moved to a specific location by typing the X and Y coordinates into the boxes and clicking the 'Go' button or by pressing the return key on the keyboard. This useful feature allows locations of particular features to be specified and communicated between different users.


low  high

6 

Below the main viewing window on the right-hand side are a series of image manipulation controls. Click on the '+' to zoom in, and the '-' to zoom out. Click on the arrows to move the viewing window across the thin section in the direction indicated. The circle containing an arrow resets the window to the full thin section view. Above the controls, a magnification slide bar indicates the zoom level. The magnification slider can also be clicked (it will go black as the mouse passes over it) and dragged to the right and left to zoom in and out of the thin section.

We recommend that you try all the ways of moving the thin section and changing its magnification, to see which are best for you.

Field of view = 15 x 11 mm

7 

At the top right-hand side of the main window, a thumbnail image of the main window displays a red rectangle showing the location of the current field within the thin section as a whole.

Magnification

8 ☐ Full specimen  
☐ Low  
☐ Medium  
☐ High

Fixed magnifications are required for some tasks, and can also be used to switch quickly between magnifications and compare grain sizes *at the same magnification* in different thin sections.

Light

9 ☒ plane-polarised  
☐ crossed polars

Each thin section can be viewed in plane-polarised light and between crossed polars. Switch between the two views using the labelled buttons.





10 To the lower right of the thin section view are two tick boxes labelled 'grid' and '10 mm graticule'. Two curved arrows rotate the graticule and grid to measure features in any orientation.

When the '10 mm graticule' box is selected, a 10 mm graticule with 0.1 mm divisions is superimposed over the thin section view, allowing direct measurement of features anywhere in the thin section once the features are moved to the centre of the field of view.

When the 'grid' box is selected, a grid that does not change in size with magnification is superimposed on the thin section view. The grid can be used to define an area for study at a particular magnification, and is especially useful to estimate proportions of different minerals in a view.



11 The colour of the cross hairs and scale bar can be changed by clicking on the 'overlay colour' tick box.

#### Description

A vesicular medium-grained high-Ti mare basalt with large poikilitic pyroxene plagioclase grains. Textures suggest relatively slow cooling.  
Location Taurus-Littrow Valley  
Mission: Apollo 17.  
Age 3700 million years.  
Petrogenesis: This basalt cooled on eruption from a magma that was generated by melting of the Moon's mantle at a depth of 150km.

12 To the left of the thin section view, a description of the rock and its locality are given for each thin section. Minerals and features that appear in blue are hyperlinks to examples in the thin section, many of which are shown in the rotating views.

[return to top](#)

[preload files](#)

13 [credits](#) At the bottom left hand corner adjacent to the rotation views you'll find three links. The first quickly returns you to the top of the page where you'll see the main thin section image. The second link leads to a feature that is disabled in the memory stick virtual microscope. The Virtual Microscope is designed to be used over the web (and will shortly be freely available on an Open University website) and on some slower broadband links the rotating views load quite slowly, but they can be speeded considerably by pre-loading the movies. The final link leads to a page with details of all the folks involved in creating this virtual microscope.