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Virtual Microscope for Extra-Terrestrial Samples

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Abstract

In this contribution we describe a new tool "virtual microscope for extraterrestrial samples" which has been developed for public engagement and outreach purposes in the field of Planetary Sciences. The tool allows the delivery of traditional petrological microscope images and hand specimens of rare and unique extra-terrestrial samples in a virtual environment and has the potential to reach a global audience.

1. Introduction

Few can dispute that space has the ability to capture the imagination of the public, and children in particular. NASA recognised the value of the public being able to reach out and touch space rocks when they disseminated portions of the Apollo samples to schools and education establishments in the 1970s. Since then, many schemes have operated on national levels (e.g., UK Science and Technology Facilities Council's (STFC's) meteorite and lunar sample loan scheme) that allow the public to view and touch extraterrestrial samples.

Although hand specimens can have a wow factor, many are not aesthetically pleasing; thin sections, conversely, provide eye-catching and attractive imagery suitable for an online audience. Thin sections are the standard fare of planetary geologists, and provide information about origin and evolution of the Solar System, merely through observation of shape, colour and other optical properties of minerals.

Many world museums and academic institutions retain collections of extraterrestrial samples, either on display or as research materials, but these have limited geographical reach because of financial, political or scientific constraints. The Open University in the UK, and the Natural History Museums in London and Vienna have some of the largest collections of extraterrestrial samples in Europe, with many of these already curated as thin sections. Rarely are thin sections viewed by members of the public, even within the museum environment. Through the Europlanet outreach scheme, we are piloting the digitisation and web-delivery of a number of thin sections from these collections to help us inform and engage the public with Planetary Sciences. The delivery of this material in a virtual environment has the potential to transcend national boundaries.

2. Methodology

The method involves collecting up to 1000 high-resolution images of each thin-section using two polarizing microscopes. The images are then either stitched together to create large area mosaics, or compiled into rotation movies. These resources are then integrated into proprietary software to produce a web-based virtual microscope library which users can then examine in a very similar way to a real microscope. Users can pan around the images, change magnification (by zooming in and out), change lighting conditions (from plane polarised light to between cross-polars), and study changing mineral characteristics (pleochroism and birefringence) as the section is rotated (Fig. 1). It is also possible to make measurements of individual crystals or perform modal analysis using a superimposed grid.

3. Current status

We have created a small database for extra-terrestrial samples which can be accessed at http://www.open.ac.uk/planetarygeology/p12_1.shtml. This includes three lunar samples (two Apollo basalts and a lunar meteorite), one Martian meteorite, and two chondritic meteorites. The variety of rock types represented in our current collection allows users to learn about the main mineralogical differences between rocks from different planetary bodies and in the case of meteorites, various shock-induced features can also be easily identified. The mineralogical makeup and the state of preservation (i.e., lack of weathering and shock features in pristine Apollo lunar basalts compared to the highly brecciated and metamorphosed sample of a Martian meteorite) illustrate some of the important planetary processes these samples have been subjected to.

4. Future developments

We plan to build upon this preliminary dataset by creating a virtual microscope library for a range of planetary samples including unique and rare meteorites, to which we will add images of rock hand specimens and brief background information about each imaged sample. It is expected that the virtual microscope database will provide resources that will also appeal to the academic and research community, thus ensuring its widest possible use for educational, research and outreach purposes.

5. Summary

One of the main objectives of this project is to stimulate the public's interest in planetary and astronomical sciences through a range of multi-media platforms such as PCs, laptops, and other hand-held devices. The use of current technologies in delivering this project will also engage and excite a young audience interested in science and engineering subjects. Because the internet will be the main medium of dissemination for the virtual microscope, the impact of this project will transcend national boundaries and will be of international relevance, especially with the emergence of new space-faring nations.

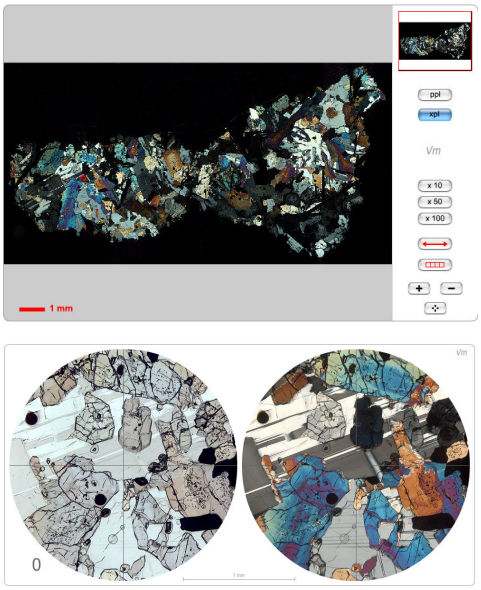

Figure 1: A screenshot of the web-based virtual microscope of lunar basalt 12064 collected by Apollo 12 astronauts. **Top** – view of a whole thin-section between crossed polars (XPL). Buttons on the right allow users to switch from plane polarized light (PPL) to a view between XPL, vary magnification, pan around the sample, zoom in an out of an area of interest, and overlay a grid or scale. **Bottom** – the two circular areas are rotation movies in PPL (left) and XPL (right). The user can rotate these two views simultaneously - something not possible with a real microscope.

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