SPACE EYEFUL: A VIRTUAL MICROSCOPE FOR EXTRATERRESTRIAL SAMPLES. M. Anand[1,2], V. K. Pearson[1], A. G. Tindle[1], S. P. Kelley[1], C. Koeberl[3], C. L. Smith[2], and P. C. Whalley[4], [1]CEPSAR, Open University, Milton Keynes, MK7 6AA, UK (m.anand@open.ac.uk) [2]Department of Mineralogy, The Natural History Museum, London, SW7 5BD, UK. [3]Natural History Museum, Burgring 7, A-1010 Vienna, Austria. [4]Knowledge Media Institute, Open University, Milton Keynes, MK7 6AA, UK

Introduction: In this contribution we describe recent progress we have made in producing a new "virtual microscope for extraterrestrial samples" which has been developed for public engagement and outreach purposes in the field of planetary sciences [1-3]. The tool allows the delivery of traditional petrological microscope images and hand specimens of rare and unique extraterrestrial samples and has the potential to reach a global audience through online delivery.

Planetary and space sciences have an unrivalled ability to capture the imagination of the public; young and old alike. NASA recognised the value of public interaction with 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 the origin and evolution of the Solar System, merely by observing 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 seen by members of the public, even within the museum environment. Through the Europlanet outreach scheme, we piloted 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. This initiative has now matured with several other virtual microscope projects [4] gaining significant momentum and funding from a number of external funding bodies in recent times. A new website hosting this and other Open University Virtual Microscope projects is now available at www.virtualmicroscope.co.uk. The delivery of this material in a web environment has the potential to transcend national boundaries and allow scientists, researchers and educators to forge international collaborations. This presents a tremendous opportunity for public engagement initiatives using this site on a global scale.

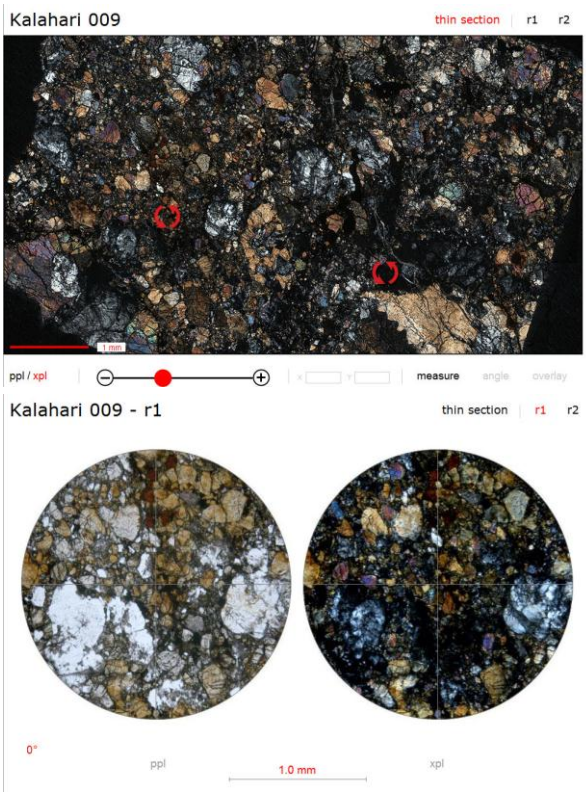

Figure 1: A screenshot of the web-based virtual microscope of lunar meteorite Kalahari 009 – recording the oldest (4350 Ma) volcanism on the Moon! **Top** – whole thin-section view between crossed polars (XPL). Buttons at the bottom allow users to switch from plane polarized light (PPL) to a view between XPL, vary magnification, pan around the sample, zoom in an out of an area of interest, and measure the size of grains. **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!

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 (Fig. 1 top), or compiled into rotation movies (Fig. 1 bottom). These resources are then integrated into proprietary software to produce a web-based library which users can then access each slide 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 cross-polars to reflected light), 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.

Present Status: Currently, the Europlanet project comprises 26 extraterrestrial samples and these can be accessed at:

http://www.virtualmicroscope.co.uk./projects/europlanet.

The library includes four lunar samples (two Apollo basalts and two lunar meteorites), five Martian meteorites, and 17 other non-chondritic and chondritic meteorites representing nearly the entire spectrum of extra-terrestrial sample types present in the worldwide collection. The variety represented in our 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. Each sample is also accompanied by brief background information including its location of find/collection along with web links to relevant articles and news items, providing an enriched experience to the user.

Future Developments: We plan to continue adding more samples to our virtual microscope library as and when samples become available. More supplementary material will be added to keep the website fresh and up to date. It is expected that the virtual microscope library 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.

One of the main objectives of this project is to stimulate the public's interest in planetary and space sciences through a range of multi-media platforms including hand-held devices (e.g. iPod, iPad). 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 be of international relevance, especially with the emergence of new space-faring nations.

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