

Moon Zoo – Examples of Interesting Lunar Morphology

A. C. Cook (1), and J. Wilkinson (2)

(1) Institute of Mathematics and Physics, Aberystwyth University (atc@aber.ac.uk), UK, (2) Zooniverse, c/o Astrophysics Department, University of Oxford, UK (jules@astroshed.net)

Abstract

We present our experiences of inviting citizen scientists to identify unusual and potentially new forms of morphological features on the lunar surface through the use of posts to a discussion forum. Lessons learnt and suggestions for improvements will be addressed.

1. Introduction

At the inception of the Moon Zoo^{1,2} programme, users were encouraged to highlight interesting morphological features on the Moon for further study. This was achieved through a rectangular region of interest marker on the crater measuring tool, and also through the posting of interesting images, to a discussion forum. It is the latter that we describe here. Initially we wish to identify areas that appeared geologically young, as indicated by their smoothness and lack of craters. But we were also curious to look for evidence that might indicate past outgassing in the hope of identifying possible sites that could explain some Transient Lunar Phenomenon³. Users were encouraged to look for anything that they regarded as unusual that might indicate recent change, or did not fit in with the normal appearance of features on the lunar surface.

2. Method

To assist Moon Zoo² users a preliminary training set of images were issued as a PDF file, and a blog was posted on the subject of Transient Lunar Phenomena. Advanced users were on hand on the forum to give opinions on all the candidate images being submitted. A MoonZoo “Image of the Week” was also updated regularly to highlight findings.

Classes for features were divided into: 1) Black Stuff, 2) Boulder Repellent, 3) Hollows, 4) Landslides, 5) Skylights, and 6) Swirls. Initially Hollows formed two classes: Ina like features, resembling the geologically young Ina formation⁴, and Notched Cavities, as can be found on the floor of Hyginus crater, but the examples presented by Moon Zoo users were so diverse that the term “Hollows” will be used instead in this abstract.

3. Results

3.1 The Black Stuff

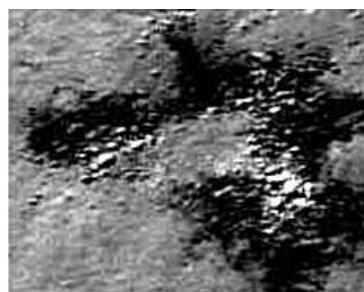


Figure 1: “Black Stuff” posted by Cook and Wilkinson 2010 Jul 06, located at 1.38° W, 49.54° N, solar altitude 37°.

This morphology was defined originally to be exposed dark material, often associated with slopes, and slightly branching in appearance. It often contained dark boulders (See figure 1). However the definition broadened to include general “dark material” and possible “dark volcanic glass”.

3.2 Boulder Repellent



Figure 2: “Boulder Repellent”, found by Cook 2010 Apr, located at 57.5° W, 7.9° N, solar altitude 56°.

This was a nick name for boulder filled craters with a small flat featureless interior. We were puzzled initially as to how the floor had remained featureless whilst the vast majority of the crater area was coated in boulders. However later it was pointed out that this was probably just an instance of impact melt.

3.3 Hollows

Several different examples of hollows were found, though none quite like Ina in morphology. Most appeared to be associated with where lava has not spread, or where material has been removed.

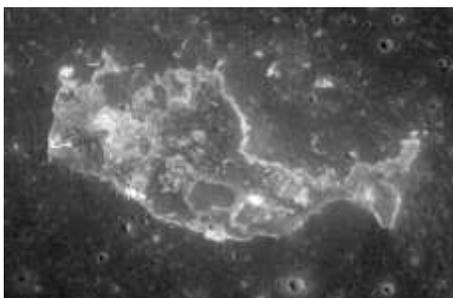


Figure 3: A Whale shaped hollow found by found by Tom128 on 2010 Dec 09, located at 21.51° E, 9.26° N, solar altitude 76°.

3.4 Skylight

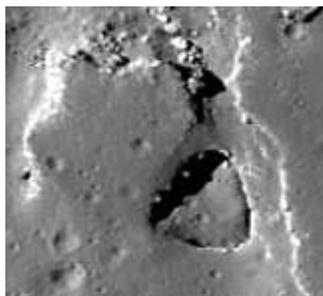


Figure 4: A suggested skylight posted to the forum by "Caro" on 2010 May 21, located at 47.55° W, 24.05° N, solar altitude 14°.

This refers to a collapsed roof of a lava tube when shadow is visible, even under high Sun angle.

3.5 Swirls

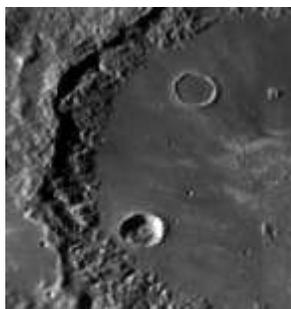


Figure 5: Possible swirl in Leibnitz crater, posted to the forum by "kodemunkey" on 2012 Jan 09.

This is an area of high albedo that has a swirl like appearance and an associated local magnetic field. They can appear similar to rays and this has caused some misinterpretation issues.

4. Discussion

This forum project has created a lot of interest with many hundreds of postings. However it was found to be quite time consuming to extract the latitude and longitude limits of the discovered interesting morphological features, from the forum discussion page. Sometimes participants would include the centre longitude and latitude, but most often would have only an image subsection and the LRO image file name. Occasionally they would include the solar altitude at the image centre. Therefore a catalogue is under construction for all the features found and weighted according to how reliable the descriptions are. Recommendations will be made to the users to utilize the machine readable keywords for feature discoveries in future that can be embedded in their postings.

Other problems found have included misinterpreting shadows for low albedo areas, and vice versa. Boulder shadows and low albedo spots have been mistaken for Skylights. Also there is sometimes confusion involved in interpreting images at only one set of illumination, in particular small phase angle images where topographic relief is drowned out by high contrast ray material. However the feedback of expert forum members, to new novices has been extraordinarily helpful, as well as the input from participating planetary geologists to help set the record straight over some interpretations. A new introductory guide is under construction to help new forum members get started on interpretation.

We hope that the eventual completed catalogue will be a useful resource to all lunar and planetary scientists.

Acknowledgements

We would like to thank the incredible efforts of the participating forum members of Moon Zoo and also the moderators: Geoff Roynon and Thomas Jennings. The Moon Zoo team mentioned in the authors list includes: Steven Bamford, Ian Crawford, Peter Grindrod, Katherine Joy, Chris Lintott, Arfon Smith, Doris Daou, Brian Day, Brad Bailey, and others.

References

- [1] Joy, K. *et al.* *Astron. & Geophys.*, 52, 2.10-2.12. [2] <http://www.moonzoo.org/> (accessed 29/05/2012). [3] Crotts, A.P.S. *Astrophys.J.*, 705, 687-705, 2008. [4] Schultz, P.H. *et al.*, *Nature*, 444, 184-186, 20006.