3D PHOTOGRAMMETRY REVEALS TRACE FOSSIL-LIKE FEATURES ON HAROLDSWICK – A MUDSTONE ROCK AT VERA RUBIN RIDGE, GALE CRATER MARS. Barry E. DiGregorio, Buckingham Centre for Astrobiology, University of Buckingham, Buckingham MK18 1EG, United Kingdom. USA address: 16 North Hartland Street, Middleport, New York 14105 (barry.dig@verizon.net)

On Earth, trace fossils (ichnofossils), are the trails, tracks and burrows left behind by ancient marine metazoans that are formally identified on the basis of their 3D morphology. On sol 1922 and 1923, of the Mars Science Laboratory (MSL) mission in Gale Crater, its microscope imager (MAHLI) returned to Earth over 84 images of a mudstone rock named *Haroldswick*. This rock had a number of dark-toned tube-like structures called "sticks" or crystals" by the MSL team (1). *Haroldswick* is part of a rock fragment group found near upper edge of *Vera Rubin Ridge*, once the site or shoreline of an ancient fresh water lake in Gale Crater 3.5 billion years ago (2).



Figure 1. Original MSL MAHLI image at http://mars.jpl.nasa.gov/msl-raw-images/msss/01923/mhli/1923MH0007280000703219R00_DXXX.jpg



Figure 2. Blue circles show possible burrow apertures. Other tube like features are visible in the upper left of image and lower right.

Although NASA has previously used photogrammetry and 3D printing to reconstruct a Martian meteorite imaged by the MER rover Opportunity (3), to date, they have not used this on *Harorldswick* and other rock fragments surrounding it.

Because these unique features appear to be the first of their kind ever observed on Mars, we decided to use a commercially available 3D photogrammetry-based imaging software program (4) to look at the features from various angles. Upon close inspection we identified over 20 key features that match established criteria used to identify terrestrial trace fossils (5).These features include burrows made up of galleries, tunnels, shafts, and chambers. An elongated and twisted metallic burrow-like feature only 10mm in length on *Haroldswick* clearly shows a shiny metallic aperture. A number of tube-like structures appear to meander in and out of their host rock just as terrestrial trace fossil burrows do.



Figure 3. Two or three tube-like burrows merging from rock.



Figure 4. Bent or twisted burrow with a metallic aperture.



Figure 5. A group of tubes. Note small aperture in tube at the top of image.



Figure 6. Tube detail showing it emerging from Haroldswick. Note smaller object appearing to burrow into larger tube.

Our work here shows the importance of using 3D photogrammetric analyses to reveal the full extent of delicate morphological textures and features found on rocks that may be of astrobiological significance. It is possible that the features we observed here may be evidence for metazoans that once existed in the ancient sediments of Gale Lake 3.5 billion years ago.

References:

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