A Study of the King's Bowl Phreatic Explosion Crater as an Analog to Pits on Solar System Exploration Target Bodies

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Abstract

The phreatic explosion crater King's Bowl (KB), at Craters of the Moon, Idaho, can serve as an analog to pits with similar morphologies on the Moon, Mars, and Vesta. These pits are associated with the release of water and are of interest to the planetary science and astrobiology research communities. KB crater was formed 2,220 ± 100 B.P. when a magmatic dike encountered subsurface water. The resulting explosion created an 85 m long, 30 m wide and 30 m deep crater and ejected blocks distances in excess of 100 m. Here we describe fieldwork and observations performed by the NASA SSERVI FINESSE (Field Investigations to Enable Solar System Science) team. Our objective is to utilize the distribution of ejecta blocks at King's Bowl to better understand the formation energetics associated with such pits and to quantify the amount of water necessary to produce them on other planetary bodies. We focused on the western KB ejecta field, and ran a westerly line, a line N45oW, and a line S45oW. Along these transects, we photographed and recorded the location, size and mass (when <18 kg) of every block > 20 cm. We collected photographs normal to the surface, every 10 m, to determine block number density. Thirdly, we walked in a raster pattern through the field cataloging blocks >20 cm. Finally, we mapped the perimeter of the crater. Initial results suggest similarities between KB ejecta distributions and ejecta of impact craters on Earth, asteroids, Phobos, Deimos, and the Moon. These similarities are; the radial extent of the ejecta, the decrease in number density with distance, the aspect ratio of the blocks, proximity of the largest blocks to the rim, and the size of the largest blocks relative to the crater diameter. This implies a similar physics of formation on differing bodies whether derived through impact or phreatic explosion. Further studies at KB crater will provide insight to the formation of phreatic explosion pits on other planetary bodies, most especially the volume of water necessary to form them.