

GEOPHYSICAL ANALYSIS OF THE CRESTONE “CRATER”, GREAT SAND DUNES NATIONAL PARK, COLORADO. C. Cox¹, R. Isherwood¹, A. Reitz¹, R. Krahenbuhl¹, J. C. Andrews-Hanna¹ and A. Valdez², ¹Colorado School of Mines Department of Geophysics, 1500 Illinois St, Golden, CO 80401 (jcahanna@mines.edu) ²Great Sand Dunes National Park and Preserve, 11500 Highway 150, Mosca, CO 81146-9798, USA (andrew_valdez@nps.gov)

Introduction: In the northwest of Great Sand Dunes National Park, outside of Crestone, Colorado at 37°54'40.0"N, 105°39'10.9"W, exists a controversial crater-like feature of unknown origin (Figure 1). This small (100 m diameter) raised-rim depression, dubbed the Crestone Crater, is suspected to be of either impact or aeolian origin. The word “crater” will be used throughout this study, but this is meant in a descriptive sense independent of the formation mechanism. Previous studies supported an aeolian origin, possibly produced by a blowout [1], based on the surface expression of the crater and a single drill core that did not find meteoritic material.

Here we report on the results of geophysical surveys conducted by Colorado School of Mines undergraduate students (Cox, Isherwood, & Reitz). This project was motivated by the Second International Planetary Dunes Workshop in Alamosa, CO during a field trip that visited the Crestone Crater. The main objectives of the study were to determine the subsurface structure of the putative crater as revealed by geophysical property contrasts. The survey included gravity, magnetics, and DC-resistivity measurements over the crater.

The proposed aeolian and impact origins for the crater would be expected to result in different subsurface properties as revealed in the geophysical survey. In particular, an origin of the depression as an aeolian blowout would not be expected to result in any subsurface structure correlated with the topographic expression of the crater, since the low-energy removal of material would have had little effect at depth. In contrast, an impact origin would be expected to significantly modify the

properties of the subsurface from the passage of the shockwave and the excavation flow. The results of this preliminary survey lend some support to an impact origin, but are not conclusive.

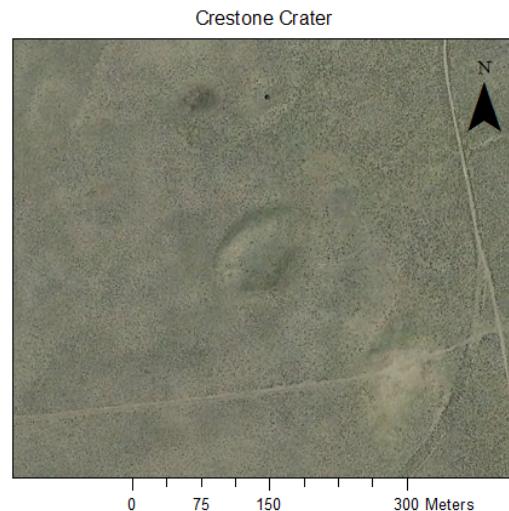


Figure 1. Aerial view of the Crestone crater.

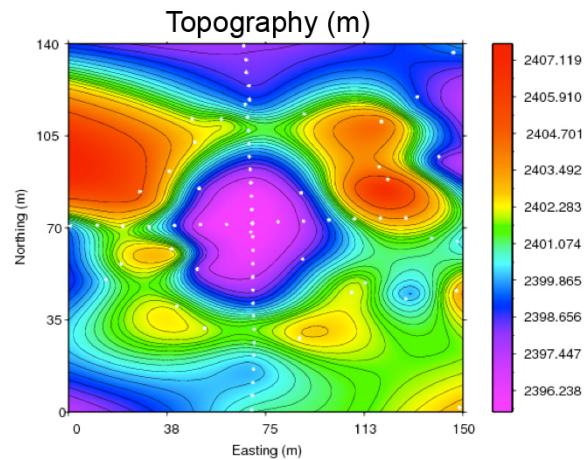


Figure 2. Interpolated topographic map of the Crestone crater (white dots represent data points).

Survey and results: The data was collected over two consecutive weekends early 2010. The survey consisted of topographic surveying of select points, two 1D gravity transects, a grid of 15 lines of magnetics measurements, and a grid of 9 lines of DC resistivity measurements. The DC resistivity and magnetics data were inverted to yield 3D maps of the subsurface resistivity and magnetic susceptibility. The gravity data was processed to yield the Bouguer anomaly using the measured surface topography.

The topography reveals an elliptical depression with a raised rim (Figure 2). Both the DC resistivity and magnetics survey reveal subsurface anomalies at depth that correlate with the surface expression of the crater (Figures 3 and 4). In the resistivity data inversion, a ring shape appears at depth that correlates with the raised topographic rim. Similarly, the Bouguer gravity anomaly reveals a relative gravity high at the center of the crater, anti-correlated with the topography (Figure 5). This is indicative of a positive density anomaly below the crater floor

Conclusions: This preliminary geophysical survey of the Crestone crater has revealed a unique geophysical signature in the subsurface that is correlated with the surface expression. This is contrary to the expectations for an aeolian origin, but may be consistent with the effects of an impact. However, the results of this study remain inconclusive, as no diagnostic evidence for an impact has been found in this or previous work. Future work should include surveys of aeolian features in the vicinity for comparison. A geomorphic comparison of the Crestone crater with small impact craters in aeolian environments on Mars would also help to shed light on its origin. If the feature is an impact crater, it is unique both due to its small size and its preservation in unconsolidated sediments. Understanding the preservation and modification of craters in aeolian environments on Earth may help to understand similar craters on Mars and to

draw inferences regarding the degree of recent aeolian activity there.

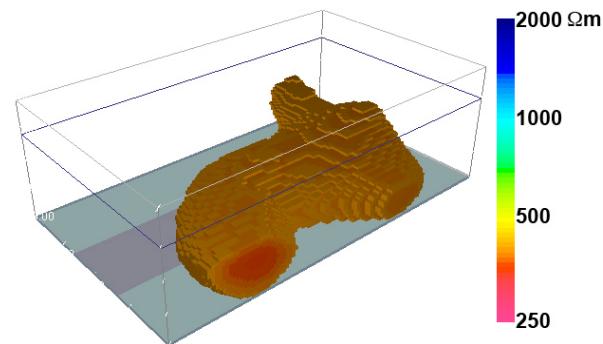


Figure 3. Results of the 3D DC resistivity inversion (note only half of crater was surveyed)

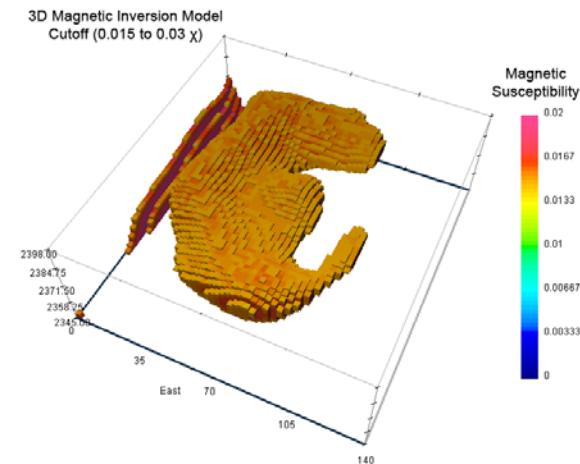


Figure 4. 3D magnetic susceptibility model from inversion of magnetics data.

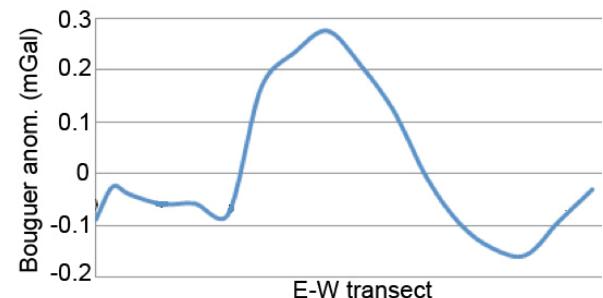


Figure 5. Bouguer gravity profile along the east-west survey line.

References: [1] Marvin, U. B. and T. C. Marvin A re-examination of the crater near Crestone, Colorado. Meteoritics, 3(1):1-10, 1966.