SHALLOW MARINE IMPACT CRATERS ON MARS. G. de Villiers[1], D.T. King, Jr.[1], and L.J. Marzen[1]. [1]Department of Geology and Geography, Auburn University, Auburn, AL, 36849 USA [devilli@auburn.edu].

Introduction: Data gathered by sensors on artificial satellites orbiting Mars can be used to study the general topography and morphology of impact craters on selected parts of the planet's surface. The main objective of this study is to locate, map, and describe impact structures on a part of Mars that has been described by some as a shallow continental shelf area. Good evidence of shallow-marine impact craters on Mars will aid in understanding the geological and morphological evolution of the planet and its former oceans.

Study Area Background: The focus of this study is on the identification of possible shallow-marine impact craters in the region of Arabia Terra - a large, relatively flat area on the geologic boundary between the northern lowlands and the southern highlands. The average elevation of Arabia is around 1-2 km below mean surface level.

Using Viking data, [1] and many others have interpreted the dichotomy as the remnant of a shoreline of an ocean or lake. According to [2], the current high-resolution MOLA data of the northern lowlands of Mars affirms the hypothesis that this boundary between the northern lowlands and the southern highlands represents an ancient shoreline of what was once a very large body of water. Assuming that a large sea once covered the northern lowlands, water would have covered all areas north of the dichotomy, thus creating a shallow-water, continental shelf environment of varying width all along the dichotomy.

In 2003, [3] evaluated geologic relations along the crustal dichotomy on Mars. Although the morphologic evidence for a large standing body of water is equivocal in some places along the crustal dichotomy, the occurrence of the ~100 m thick sedimentary layer (the Vastitas Borealis Formation or VBF) on the northern plains indicates that a large ocean once existed in that area. The VBF is also discussed by [4] who concluded that a large body of water once existed in the northern lowlands based on the presence of the VBF within and under the majority of the impact craters located there. According to [4], an ancient ocean with an average depth of ~430 m existed in the northern lowlands during Late Hesperian.

If Earth is any indication, a continental shelf is an ideal setting for the preservation of shallow-marine impact craters developed in the seafloor [5]. Therefore Arabia Terra, which was once part of such a submarine setting, makes a suitable study area.

Instruments: This study employs datasets gathered by four different instruments. They are (1) the Mars Orbiter Laser Altimeter (MOLA) and (2) the Mars Orbital Camera (MOC), which are onboard the Mars Global Surveyor (MGS) spacecraft, (3) the Thermal Emission Imaging System (THEMIS) onboard the Mars Odyssey spacecraft, and (4) the High Resolution Stereo Camera (HRSC) onboard the Mars Express spacecraft. The resolutions of these datasets are substantially better than that of the 1976 Viking 1 and 2 images, which have been used in the past for morphological studies on Mars.

Shallow-marine impact craters: As reported by [6], the Martian surface could have up to 1,400 marine impact craters, based on the length of time that oceans existed on the planet and the size of the possible ocean(s). Their study was based on the minimum and maximum ages of duration for two large bodies of water in the northern lowlands, in combination with the cratering rates for Mars during that span of time. Most of these marine craters ought to occur in shallow-shelf environments due to the unlikelihood of the formation and preservation of sea-floor marine craters in deep oceanic environments.

We have developed a list of some geomorphological criteria that are key to identifying suspect Martian marine impact craters. Some important characteristics that are associated with shallow-marine impact craters are resurge gullies, collapsed rims, and features of fluidized (water-saturated) mass movement. These features should all be visible on high-resolution images and could therefore be used as key characteristics in the identification of shallow-marine impact craters. Further distinctive attributes of shallow-marine impact craters include the overall crater shape and cross-sectional profile, the volume of the crater depression, and the extent, shape and thickness of ejecta deposits.

Conclusion: It is possible to gain insight into the morphology of crater forms within Arabia Terra with the use of different imagery datasets. The study of shallow-marine impact craters on Mars is still in an early stage, thus the results of this study could be useful in the general classification and characterization of these craters.

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