

DESCRIPTION, ORIGIN AND EVOLUTION OF A BASIN IN SIRENUM TERRAE, MARS, INCLUDING ATLANTIS CHAOS: A PRELIMINARY STUDY. M. A. de Pablo and M. Druet. Seminar on Planetary Sciences. Facultad de Ciencias Geológicas. Universidad Complutense de Madrid. 28040 Madrid. Spain. depablo@geo.ucm.es.

INTRODUCTION

Atlantis is the name proposed in this preliminary study for the basin where (at 35°S, 177°W) the chaotic terrain Atlantis Chaos is located. We propose that this basin harbored a lake during one of the 'humid Mars' epochs [1, 2]. The main evidences for this hypothesis are the circular morphology, the bordering fracture and ridge systems, the volcanic constructs, and a variety of erosive and sedimentary landforms associated. Cross-cutting relationship of these features permits the partial reconstruction of the history of this basin, which could be one of the few such basins not clearly housed in an impact crater.

METHODOLOGY

The preliminary study of the Atlantis basin has been carried out through the analysis of the images and the topographic data of the Viking orbiters with the software PDSWIN 2.0. We have used photomosaics with 0.231 km/pixel resolution, as well as individual images with 0.025 km/pixel resolution. The topographic data have been treated with the programs Bryce3D and Surfer 6.0 in order to elaborate digital terrain models, maps and topographic profiles.

LOCATION

Atlantis is a sedimentary basin centered at 35°S, 177°W in Sirenum Terrae, between the fracture systems of Sirenum Fossae and Memnonia Fossae, SW of the Tharsis dome and South of Gusev crater, close to another topographic low where Gorgonium Chaos is located.

DESCRIPTION

Atlantis basin is a low area with a closed circular morphology shaped by tectonic ridges, volcanic constructs and impact craters (Fig.1a). The general slope is northward. What appear to be tectonic structures form a part of the West edge of the basin. These ridges could be the result of compression with a E-W σ_1 , perhaps as an outcome of the Tharsis uplift [3], since they show a planform concentric to the dome. That uplift could also be the cause of the two large radial fracture systems that cross the region (Sirenum Fossae, at the South, and Memnonia Fossae, at the North) [3]. In addition to these tectonic structures, there are two fracture groups with WSW-ENE and NW-SE directions (Fig. 1b), the last one perhaps related to the fissural volcano existing in the Eastern edge of the basin.

The volcanic activity of the area is reflected in the presence of two volcanic constructs. The first one, fissural in character, closes the basin by its NE edge. The second one, an ancient massive volcanic building, is located at the SSW. These two constructs have already been portrayed in some thematic maps [4].

The center of Atlantis is occupied by a chaotic terrain that gives its name to the basin. The chaos is extensively eroded, and partially covered by detritic sediments which cover the whole basin area, as well as an impact crater located in it. These epiclastic layers are probably related with the run-off areas that cover most of the North, South and East edges of the basin. Two series of sediments can be recognized through its albedo. The lighter series is partially covered by modern sediments of lesser albedo.

The topographic data reveal that the basin rim is lower at the North, South, and Southwest, where the run-off areas are located.

ORIGIN

The three-dimensional models elaborated (Fig. 1c) have permitted us to confirm that the morphology of Atlantis basin is circular, what would possibly imply that the basin is originally an impact crater. Numerous smaller impacts, fluvial erosion, volcanic processes, tectonic stresses, and sedimentation have erased the typical impact features.

However, in this preliminary study, it has not been possible to discard that this basin and its circular morphology had its origin in volcanic processes, tectonic and other impacts.

EVOLUTION

Independently of the doubts on the origin of this basin, an evolution of the area can be outlined.

In the first place, and through tectonics or impact processes, magma reached the surface of Atlantis, building the volcanic construct on the SW of the basin. The regional rise of the temperature induced the fusion of the permafrost, that in turn provoked the formation of a chaotic terrain (Atlantis Chaos) inside the basin.

The run-off areas in the basin resulted from water coming from the South, as the topographic data indicate (Fig. 1d). This resulted in the sedimentary filling of the basin. The run-off surface of the Northern rim would indicate a water evacuation when the basin was thoroughly full.

The dessication of the basin can be related to a global climatic change [1], or to the interaction between compressive tectonic stresses (which caused some of the ridges) and volcanism (forming or reactivating the fissural volcanic construct of the NE rim). After the humid interval, meteoritic impacts and eolian sedimentation have been the only events modelling Atlantis.

CONCLUSIONS

Possible origins of Atlantis (proposed name) basin have been discussed, and a hypothesis on its evolution has been put forward. However, this basin presents many features that should be studied in detail -especially those that could indicate the existence of a lake at some epochs of its history- in order to know more completely its evolution. We plan to perform this research on the basis of the analysis of MGS data.

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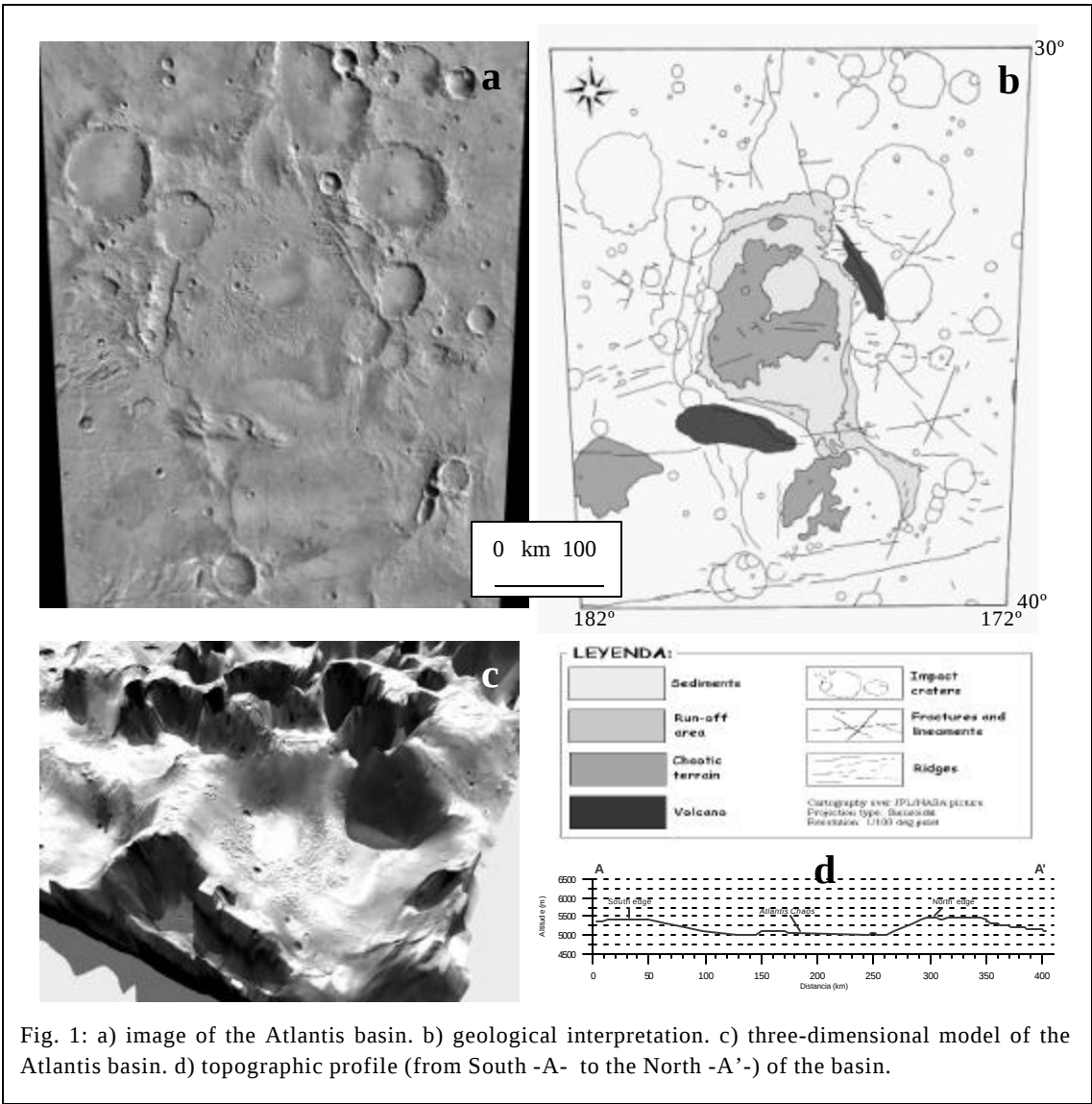


Fig. 1: a) image of the Atlantis basin. b) geological interpretation. c) three-dimensional model of the Atlantis basin. d) topographic profile (from South -A- to the North -A'-) of the basin.