A POSSIBLE SMALL IMPACT CRATER IN THE DAMARA OROGEN OF NAMIBIA. I. López[1], [1]Area de Geología. Universidad Rey Juan Carlos. C/Tulipán s/n. 28933. Móstoles. Madrid. Spain (ivan.lopez@urjc.es).

Introduction: Impact cratering is an important geological process for the surface evolution of the terrestrial planets. The terrestrial impact crater record is largely incomplete; there are 176 impact craters censed on Earth [1] with an underrepresentation of small impact craters based on expected magnitude-frequency relation (only 17 craters are ≤ 300 meter). The reason for this underrepresentation of small craters include: a) destruction of small impactors on their encounter with Earth's atmosphere, and b) crater erosion and/or easy burial by post-impact sediments. Besides these factors affecting the modification of small craters some of these structures located in remote areas remain simply unnoticed. In recent years the use of high resolution satellite imagery and other remote sensing data has led to the discovery of new impact structures on remote areas that is helping to complete the impact record on Earth [2-4]. In this work I report the discovery in high resolution satellite images provided by Google™ Earth of a small circular depression in the Damara Orogen of Namibia (Fig. 1), in the vicinity of the Huab River (coordinates lat: 20.84ºS; long: 13.72ºE); on the basis of morphology, characteristics and its geological setting I propose that this feature could represents a new small simple impact crater that has not yet being described.

An impact crater in the Damara Orogen?: The observed small circular structure occurs on exposed siliciclastic rocks of late Proterozoic age. These sedimentary rocks (sandstones, classic turbidites, conglomerates and mudrocks) are part of the Brak River Formation [5], a highly deformed siliciclastic sequence of materials that belong to the Damara Neoproterozoic-Early-Paleozoic Orogen (Fig. 1a).

The structure is approximately 80 meters in diameter and is composed of a circular rim surrounding a bowl-shaped depression that disrupts and postdates the western dipping beds of the Brak River Formation (Fig. 1b and 1c). Images of high resolution that help to study the circular structure are available for two different dates of the same year with different illumination conditions (Fig. 1b and 1c). In the two images the circular rim that delimitates the structure is very clear in the western and eastern sections and more irregular in the north-northeastern (Fig. 1b and 1c). Surrounding the structure, but specially clear to the north and south of the structure in the image taken in May (Fig. 1c), we observe some materials arranged near the structure rim that display a different texture than the underlying rocks (Fig 1b and 1c). The interior is also filled with material that displays a different texture (i.e. color and albedo) compared with the surrounding materials.

In yet absence of field data, a multiple working hypothesis approach is applied through which processes that could have produced this type of circular feature with negative relief are considered: sinkholes, volcanic activity (i.e. caldera formation) and impact crater formation.

The formation of sinkholes is typically associated with the presence of carbonate rocks and/or salt deposits. The described circular structure is located on top of siliciclastic materials of the Brak River Formation [5]. These lithologies are not prone to chemical dissolution and collapse processes as those that result in the formation of sinkholes. In addition, sinkholes typically cluster in groups forming a karst landscape, and do not occur as isolated features. In this case, the circular structure appears to be singular and isolated, with no other circular depressions visible in the surrounding area. The location of the structure, on top of a deformed sequence of materials that stand above surrounding materials and completely disconnected of the water table (e.g. Huab River located to the north) also suggest that the feature is not karstic in origin.

Volcanic activity and caldera collapse can produce circular structures with a negative topography. Although features of magmatic origin are present in the area surrounding the circular structure, these are intrusive and extrusive rocks of the Etendeka province, a cretaceous volcanic sequence related to the break-up of Pangea [6]. The Etendeka igneous province is well exposed in the area; eroded basaltic flows and intrusive complexes and structures (e.g. dykes and sills) postdate the deformed materials of the Damara Orogen. There are no individual volcanic edifices or calderas related to the emplacement of these cretaceous materials present in the vicinity of the studied structure, and there is no younger volcanic activity on the area that can produce volcanic features that can be better preserved than those related to the Etendeka province [7]. The area surrounding the structure lacks effusive volcanic materials like volcanic flows or explosive deposits that could be related to it, so the volcanic origin is neither considered for the origin of the structure.

A third process that can produce a circular structure of negative relief, the impact meteorite, is considered. The morphology of the structure, rim surrounded bowl-shaped depression is consistent with described small impact structures referred to as simple craters [8-9]. Simple craters are the smallest impact structures

and present depth-to-diameter ratios of about 1:5 [9] and a smooth bowl shape with a rised rim but without a central uplift. They are formed when a small meteorite impacts on the surface at a great velocity. As result of the impact the crater is excavated, the target rock is fractured and layer of ejecta material is arranged around the crater and falls and partially fills the crater [9].

As noted above the morphology of the structure is similar to other small simple craters described on the Earth and other terrestrial planets. Materials located in the northeast and southeast parts of the structure that postdate the target rocks display a different color and texture on the images (Fig. 1b and 1c). These materials can be interpreted as ejecta material related to the impact (i.e. fragmented materials projected outside the impact crater). We can observe that these materials are not symmetrically distributed around the crater. In the impact hypothesis this asymmetric distribution could be explained as result of a moderately oblique impact although could also be the result of differential erosion of the dispersed material. Material located inside the crater also display different color and texture than the surrounding rocks. This material can be interpreted as ejecta material that is redeposited inside (i.e. fallback ejecta) and debris slumped from the walls and rim. Alternatively this material could be sediment that is collected and fills the interior of the circular depression. According to morphological evidence and disregard of alternative models for the generation of small circular depressions based in the characteristics of the feature and its geological setting, it is proposed that the structure found in the Damara Orogen of Namibia could be a small impact crater in a good preservation state. Further field studies in this remote area will be necessary to verify its true nature, determine characteristics and age, study shock metamorphism in the target rocks and to look for possible fragments of the meteorite.

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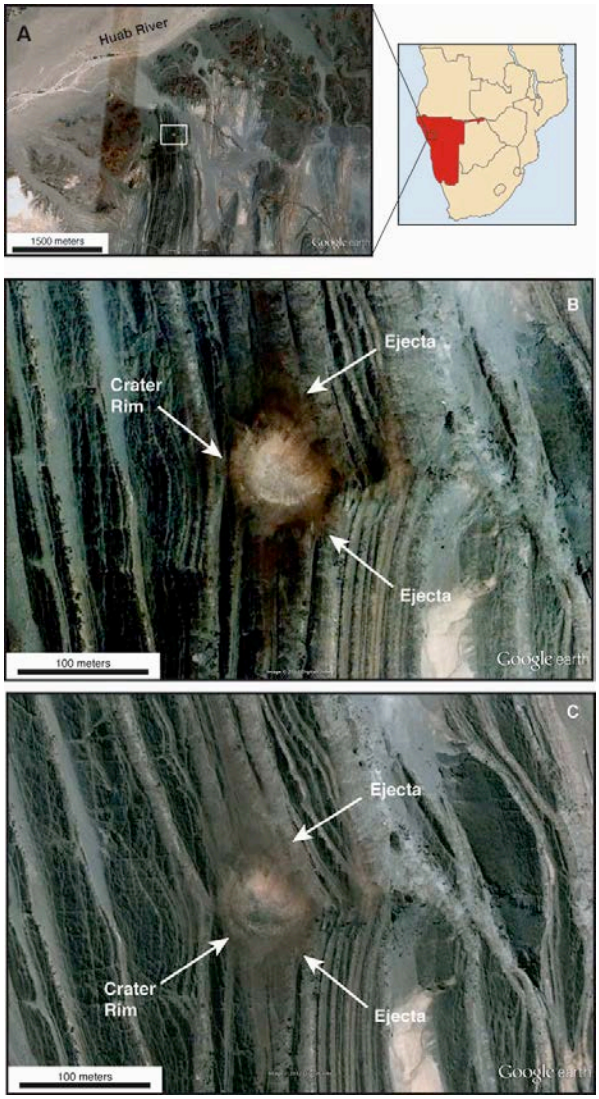

Figure. 1. a) Location of the proposed impact structure in the Damara Orogen, near Huab River (Namibia). The white box indicates the location of Figure 1b an1c. b) Detail image of the studied structure with location of the rim and the interpreted ejecta deposits (Image acquired 5/5/2003). c) Detail image of the studied structure with location of the rim and the interpreted ejecta deposits (Image acquired 11/27/2003). (© 2012 Google; © 2012 DigitalGlobe).