THE AGOUDAL IMPACT CRATER, MOROCCO: A QUATERNARY STRUCTURE

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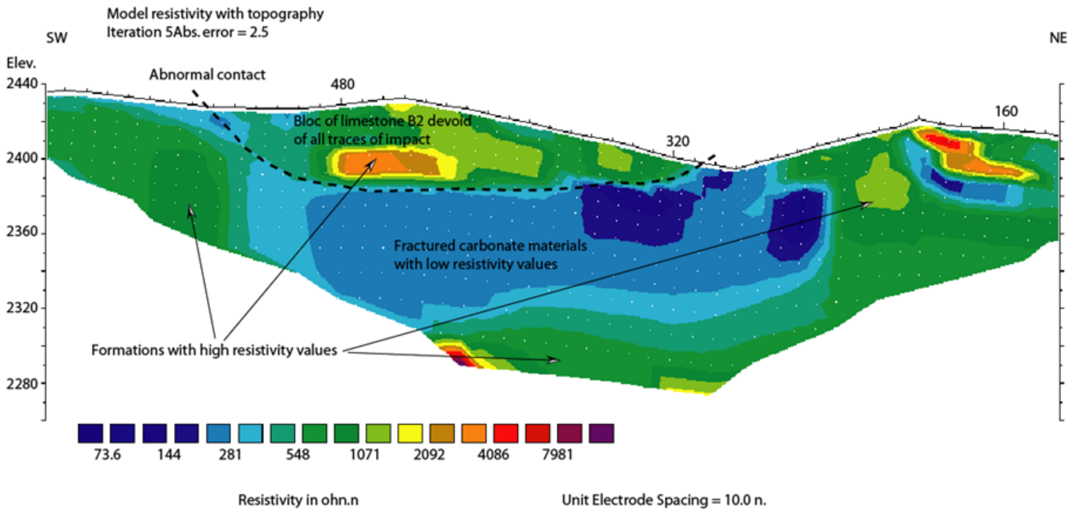
Introduction: The Agoudal impact crater is located at about 20 km South of Imilchil (Central High Atlas, Morocco) and about 25 km SE from Isli and Tislit lakes at 31°59'12.7"N; 5°30'57.3"W. The crater has been recognized by Sadilenko et al., 2013[1] due to the presence of shatter cones and breccias in ravines that cut the sedimentary formations of this locality. Chennaoui et al.(2014) [2] stated that the lack of a well preserved impact structure testifies the great age of the impact (post mid Jurassic) and that, the freshness of the meteorites found shows that there is not genetic relationship between the meteorite strewnfield and the shatter cone occurrence. Based on these results, Reimold and Koeberl (2014) [3] concluded that the meteorite falls occurred over an already impact-affected terrane. In the present study, we will clarify the morphology of the crater in this locality; his quaternary age and that the absence of an evident impact structure can be explained in a complex geological framework.

Geological data: In the area of the Agoudal impact structue, sedimentary rocks are of marine origin, attributed to the Bajocian [4]. The crater is bounded by rivers, representing the geomorphologic evolution of a related fault system. Our investigation on the field showed that the position of the crater corresponds to the flank of a syncline with a slope of about 25° to the North. Its shape cannot be defined because of a lack of a visible rim or structural features, which would distinguish it from the surrounding facies. Moreover, the whole northern part of the synclinal flank, where the crater is located, is washed out by the Tamegzarout valley. However, shatter cones have been found in Jurassic limestone samples embedded in quaternary deposits and in scree, predominantly in the flanks of the dry rivers which cut the syncline flank. These ravines delimit a block of limestone layers. With the exception of NE and N of this block, the only places where the shatter cones occur in the bedrock, this area is completely devoid of impact signatures. Impact breccia dikes cutting through limestone have been also observed in these places.

2D- electrical resistivity tomography data: Resistivity data were collected in the central uplift of the impact structure by using a six current electrode dipole-dipole configuration [5]. The profile shows a large conductive anomaly with low resistivity values centered in the profile (250 Ω.m) with thicknesses up to 70 m in the center of the investigated area. This anomaly is lenticular in shape, 300 m long, characterized by suddenly variation of resistivity to its limits (140 to 1000 Ω.m). In depth, the model shows a continuous interface characterized by a relatively strong vertical change in resistivity; the interface crater/ host rocks, which is modeled to be at 120 m depth, is interpreted as the boundary between the fractured rocks and the buried limestone layers. Upwards, this lens shape is capped by high resistivity limestone block formation (about 220 m long and 40 m thick). The formation of this lenticular structure showing a large conductive anomaly can match the impact area of the crater, formed by breccias and much fractured carbonate materials.



2D- electrical resistivity tomography model

The high-resistivity zone over the conduction anomaly corresponds to the block of limestone B2 collapsed after the meteorite fall. However, this block almost completely makes indistinct the impact crater. The profile also shows that the fall of the meteorite probably occurred in the NE part of the crater where the highly fractured rocks have the lowest resistivity values (100 Ω.m).

Discussion and conclusions: The mapping of the crater area shows that, aside from the NE and N part of the limestone block B2, collapsed as a result of a landslide following the fall of the cosmic body, all the shatter cones are in scree at the level of the ravines. The tomographic profiles have shown the presence of an impact crater, 300 m in diameter, almost completely covered by this block of limestone rocks, 220 m long and 40 m deep. In addition, the obliquity of the impact probably produced a crater initially rimless. This would have facilitated the sliding of the limestone block B2 in the crater. Furthermore, the northern part of the synclinal flank, where the crater is located, is washed out by Tamegzarout valley; this makes difficult to determine the exact form of the crater which should, theoretically, be slightly stretched in the NE-SW direction. Its supposed original form is now roughly bounded by rivers that are actually faults propagating to the East, West and South. Finally, the freshness of the meteorites found show that the age of the crater is relatively recent [6], Quaternary in age. The absence of an evident impact structure can be explained by complex geological framework, the recent tectonics and by the crater structure itself, initially rimless due to an oblique fall of the meteoroid.

References: [1]Sadilenko, D.A. et al. (2013) 76th An. Met. Soc. Meet. #5215. [2]Chennaoui H. A. et al. (2014) 45th Lun. Planet. Sc. Conference # 2053. [3]Reimold, W.U. and Koeberl, Ch.(2014) A review J. Af. Earth Sc. 93, 57–175. [4]Milhi, A. (1997) Notes et Mêm. Serv. Géol. Rabat, Maroc, N° 377. [5]Tong, C.H. et al. (2010) Geology 38, 91–94. [6]Jull, A.J.T. (2001) In: Peucker-Ehrenbrink, B., Schmitz, B. (Eds.). Plenum Publ., NY, 241-266.