Agoudal shatter cones (High-Atlas, Morocco) - Constraints on erosion of an associated impact crater.

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The first site with impact deformation discovered in Morocco, at Agoudal (High Atlas Mountains) has been the subject of different interpretations since its discovery in 2013 [1, 2, 3]. While some researchers assume that the formation of the shatter cones is related to the fall of the iron meteorites found in the vicinity [e.g., 1], our group prefers the interpretation that the two are not genetically linked, i.e., that the shatter cones are the remnants of an old, deeply eroded impact.

From a theoretical point of view, the formation of shatter cones in small impact structures is not impossible [4,5,6] and despite the fact that small craters are rarely associated with shatter cones, the size-limit for a possible eroded impact structure at Agoudal is still not provided. The current estimates of erosion rates in this region allow to remove tens of meters per million years - enough to completely obliterate any crater extending to several km into the basement within a few tens of millions of years. In comparison with the calculated age of the Agoudal meteorite of 105±40 ky [7, 8], this would make a putative impact crater much older. High erosion or incision rates (> mm/year) needed to erase a large crater in 100 000 years would not be consistent with the widespread preservation of reasonably freshly preserved iron meteorite fragments. Alternatively, if low (< 1mm/yr) regional denudation rates apply to the shatter cone site, the Agoudal impact structure would have been too large to have been eroded in a mere 100 000 years.

These considerations mitigate against a coeval impact and meteorite fall. Also, a fall onto a previously formed impact crater appears intuitively surprising. However, such coincidental events have been reported elsewhere and are not impossible from a statistical point of view.

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