SHOCK DEFORMATION OF CALCITE, A POSSIBLE TOOL FOR RECONSTRUCTION OF THE SIZE OF DEEPLY ERODED IMPACT STRUCTURES. AGOUDAL IMPACT STRUCTURE (MOROCCO) CASE STUDY

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Study from Ries crater in Germany showed that peaks in X-ray diffraction patterns of shocked carbonates are broadened due to increased domain size and microstrain [1] and the deformation is correlated with peak pressure [2]. It is expected that shock-induced deformations of calcite unit-cell decreases with increasing distance from the impact structure centre, which would allow for estimation of the structure size by analysis of diffractograms of a number of samples from a deeply eroded structure. We have tested this hypothesis by analyzing target limestone samples from various locations within the Agoudal impact structure in Morocco.

The shape of Agoudal impact structure [3, 4, 5] is not apparent in modern topography, so various geophysical and structural studies attempted to reconstruct its size [5, 6]. The structure is deeply eroded and shatter-cones are the only remaining evidence of the impact [3, 4, 5]. The target rocks seem to have been Aalenian-Early Bajocian marly limestones that are dark-colored micrites with small amount of dispersed quartz silt. We have studied samples collected from various locations in and around the Agoudal structure to check whether we could find difference in the degree of shock induced deformation in calcite crystals which would help to reconstruct the size of the structure and locate its center.

The XRD powder analysis revealed peak broadening in X-ray diffraction pattern, as well as peak shift that indicates shock induced effects in calcite. The observed peak broadening was determined by calculation of Full Width at Half Maximum (FWHM). The domain size and strain are determined after Williamson-Hall method by calculations in XPowderX software. Also, unit-cell parameters were refined from peak positions. Comparison of X-ray diffraction patterns from different locations in the Agoudal impact structure revealed that shock-induced effects decrease with distance from the presumed impact centre.

Various analyzed samples showed different domain size and scatter of strain in span from ? 0.05% to 0.46% that indicated various "stages" of shock deformations. For the purpose of map representation, we have defined low "stage" as below ? 0.2%, middle "stage" as ? 0.20 - 0.30%, and high "stage" as over ? 0.30%.

The position of samples with highest shock deformation at the opposite slopes of Akhiam alluvial valley, suggests that the actual crater floor has been completely eroded, deepest in the presumed structure center, possibly due to highest mechanical fracturation of target rocks.

References:

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