THE DOUGLAS CRATER FIELD, WYOMING, USA: DISCOVERY OF AN UNEXPECTED CRATER CLUSTER AT THE CARBONIFEROUS-PERMIAN BOUNDARY.

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Introduction: The currently known impact crater strewn fields are Sikhote-Alin [1], Wabar [2], Henbury [3], Kaali [4], Morasko [5], and Odessa [6]. All these strewn fields have a Quaternary age and are formed by particularly strong iron meteoroids. Their lateral spreading is strongly reduced with respect to meteorite strewn fields and does not exceed one kilometer perpendicular to the trajectory. Craters in these strewn fields range in size between 10 and 150 m, cluster and overlap, and the biggest crater is usually situated toward the downrange end of the strewn field ellipse. Here we present a new crater cluster that is remarkably different from the strewn fields known so far.

Observation and Regional Geology: More than forty circular and ellipsoidal confirmed and possible impact craters have been identified on the northeast facing flank of the Sheep Mountain anticline near Douglas, Wyoming, USA centered on 42°40'00"N, 105°27'16"W. The crater structures are exposed in the uppermost quartz-cemented sandstone of the Permo-Carboniferous Casper Formation. Rim-to-rim diameters of the crater pits range from 16 meters to 66 meters. Five of these craters were previously reported without conclusive proof of their impact origin [7]. The size of the crater field is momentarily not well constrained as only some of the morphological craters could be confirmed as impact craters by microstructure so far. However the craters extend over a distance of more than 7 km along the Sheep Mountain anticline.

Satellite and drone imagery has revealed crater shape, orientation, and size. The best preserved craters show a raised rim, an overturned flap, an apparent continuous proximal ejecta blanket, and an ovoid shape oriented SE to NW coinciding with the apparent strike of the strewn field. From these features, an impact from SE towards NW can be inferred. Craters 3-6 form a chain of craters with NW-SE orientation. Crater cavities 3 and 4 overlap each other and form one elongated basin. Crater 5 may be even a result of ricochet of the projectile. Several craters show dike injections along the rim and the inner crater slopes. Monomict brecciation is well-exposed along the raised rims of craters 34 and 36, but the fragments are sub-rounded indicating soft-sediment deformation. Some craters are eroded below the original crater floor level and expose a pedestal substructure.

The craters are exhumed from beneath the Permo-Triassic Goose Egg Formation Opeche Shale Member red beds on a very resistant Casper sandstone surface. Strata were tilted by 15° E-NE during the Laramide Orogeny in the Upper Cretaceous and Paleogene. Satellite imagery shows that the craters occur only in this narrow stratigraphic band along strike at the top of the Casper Formation. The impact age is inferred to be immediately after Casper Formation deposition (lithostratigraphic age ~280 Mya), as there is no crater filling with younger Casper sandstone. The original craters would have been eroded away in a short time without rapid low energy transgression and burial by Opeche muds.

Microstructure: So far we found two grains with cross-cutting PDF lamellae in various crystallographic directions and ten grains with PDFs either along (0001) or parallel to the c-axis in four different craters confirming a minimum size of the crater field of 2 km. All PDF lamellae are decorated with fluid inclusions. Very frequent are fluid decorated concussion fractures in quartz that form along stress chains and grain-to-grain contacts. Brittle deformation affected rounded quartz grains but not the quartzitic overgrowth seams, implying that the impact occurred in unconsolidated sand prior to diagenesis. Shock loading of the water-saturated sand target caused shock lithification [8] and increased the cohesion of the rocks. Evidence for shock-lithification can be inferred from microstructure. Many quartz grains lost their original roundness upon impact loading, and developed angular corners and indented grain boundaries. Comminuted grains fit tightly against close-pressing neighbors.

Discussion: The inferred lithostratigraphic age date of ~280 Mya and the estimated size make Douglas the oldest and probably one of the largest impact strewn fields on Earth. The elliptical outline of craters 1-4 indicate a very shallow impact angle of less than 15° where even ricochet of the projectile occurred. This indicates that the projectiles have not been decelerated much during their atmospheric traverse. This is an ongoing study.

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