DISCOVERY OF POSSIBLE METEORITIC MATTER ON SHATTER CONES – 3. MARQUEZ DOME, TEXAS, USA

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Introduction: Shatter cones from several impact structures worldwide are currently investigated in the context of the "Shatter Cone Coatings Project". Schmieder et al. [1] reported brecciated schreibersite and Fe-Ni oxide flakes on a shatter cone surface from Agoudal, Morocco, interpreted as remnants of an (iron) meteorite. Similarly, rare elements on shatter cones in Malmian limestones from the Steinheim Basin [2] were interpreted as altered and likely hydrothermally remobilized meteoritic matter. Metal (Fe-Ni-Co-rich aggregates), phosphide (schreibersite?), and oxide phases on shatter cone and slickenside surfaces from the Ries crater, as well as notable enrichment of Fe, Ni, Co, and P in associated surface coatings, may also represent possible traces of the impacting projectile [3]. In addition, kamacite and taenite particles occur on a shatter cone from the crystalline basement of the Clearwater East impact structure in Canada [4]. We here report on the first discovery of Fe,Ni–metal and Fe,Ni-rich oxide particles adherent to shatter cone surfaces from the Marquez Dome impact structure, Texas, USA.

Samples and Analytical Methods: The Marquez Dome in central-east Texas is the inner part of a ~12 km-diameter, Late Paleocene to Early Eocene (~58 Ma) complex impact structure [5] formed in poorly consolidated sediments of a near-shore environment [6]. The crater lies in a sequence of interbedded sands, silts, shales, and minor carbonates. Rare impact breccias and shatter cones (Fig. 1A) are only known from bedrock exposures within the central uplift of the eroded and largely buried impact structure. Shatter cones occur in boulders of the Upper Cretaceous Pecan Gap limestone exposed in a ~2–3 km-wide area in the central uplift domain [6]; samples were collected around 31°17'08"N, 96°17'57"W. Shatter cone surfaces are locally covered by faint reddish to brown coatings. The shatter cone surfaces and polished separates of adherent particles were analyzed using a CamScan SC44 scanning electron microscope and a CAMECA SX100 electron microprobe (20 kV) at the University of Stuttgart.

Characterization of Coatings: Electron microprobe results indicate individual Fe-Ni-Co particles within the shatter cone coatings that are rich in Ca, Si, Al, Fe, Ni, and Co. Where only SEM–EDS was applied, the presence of Co remains uncertain. One randomly selected shatter cone surface contains several Fe-Ni-Co-rich metal particles typically ≥10 µm in size adherent to the surface, presumably kamacite (Fig. 1B), mainly composed of Fe (>90 wt%) and Ni (~5–6 wt%). Some of the Fe,Ni-rich particles also contain minor amounts of Si, Al, Ca, and S. One fractured Fe-sulfide particle (Fig. 1C) contains ~61 wt% Fe, ~38 wt% S, and subpercent Ni, suggesting this particle is troilite or possibly pyrrhotite. Fe-Ni-Cr-Co-rich oxide flakes also occur (up to ~13 wt% NiO; ~9 wt% Cr_2O_3; ~2 wt% CoO). The shatter cone surfaces, including metal and oxide particles, are covered by microcrystals of halite and sylvite.

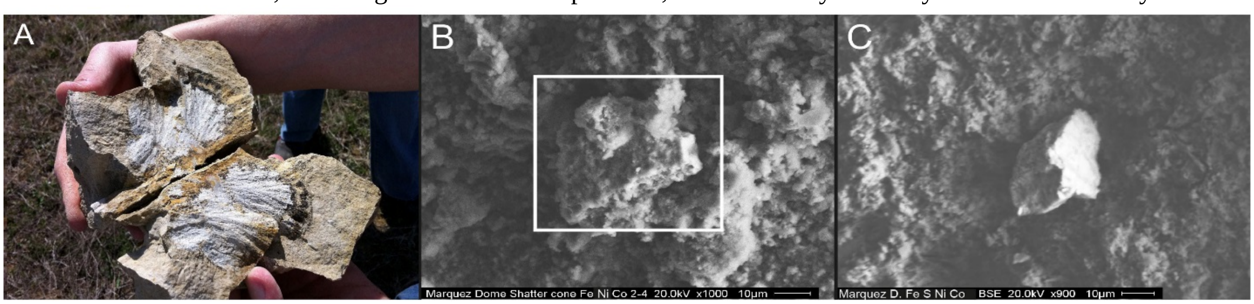

Fig. 1: Shatter cones from Marquez Dome, Texas. **A**: Freshly exposed, well developed shatter cone with reddish coating; photograph by David Rajmon. **B**: Kamacite aggregate on shatter cone surface, overgrown by sylvite, halite, and calcite (backscattered electron image). **C**: Fe-sulfide particle on shatter cone surface (backscattered electron image).

Discussion: The sedimentary nature of the target rock sequence (shallow marine limestones and fluvio-deltaic marls, sands, and shales) makes an indigenous–detrital contribution of Ni-rich metal and oxide particles to the shocked crater floor appear somewhat unlikely. On the other hand, the Ni-rich metal and oxide particles associated with the shatter cone surfaces might represent relict meteoritic contamination from the Marquez impactor. The precipitation of salt microcrystals on the shatter cone coatings may have occurred during post-impact infiltratrion and evaporation of saline brines, and/or may be a more recent diagenetic effect. Additional analyses are planned.

References: [1] Schmieder M. et al. 2015. *Geological Magazine* 145:586–590. [2] Buchner E. & Schmieder M. 2015. Abstract #5007. 78th MetSoc. [3] Buchner E. & Schmieder M. 2016. 79th MetSoc, #6027 (this issue). [4] Buchner E. & Schmieder M. 2016. 79th MetSoc, #6028 (this issue). [5] Sharpton V. L. and Gibson J. W. 1990. LPSC XXI, pp. 1136–1137. [6] Buchanan P. C. et al. 1998. *Meteoritics & PIanetary Science* 33:1053–1064.