**IMMISCIBILITY FEATURES BETWEEN SILICA-RICH AND CARBONATE-RICH MATERIAL IN BRECCIA FROM THE SIERRA MADERA IMPACT STRUCTURE.** S. A. Huson, M. C. Pope, F. F. Foit, Jr. and A. J. Watkinson, School of Earth and Environmental Sciences Washington State University, Pullman, WA, 99164-2812 (sahuson@hotmail.com)

**Introduction:** Since the initial studies of the Sierra Madera crater in the 1960's and early 1970's [1, 2] there have been many advances in our understanding of the processes that form craters and cratering products. We now know that impact craters in carbonate rocks can contain melt-rich impactites [3, 4, 5]. Additionally, recent studies of the Ries and Haughton craters have revealed textural evidence of carbonate-silicate liquid immiscibility [3, 6]. Both craters have similar diameters, ~24 km, and contain carbonate sedimentary rocks as part of the target rock succession.

Impact generated breccias from Sierra Madera were re-examined applying modern research techniques and the current knowledge of cratering products to look for and identify possible melt products at a smaller diameter carbonate crater.

**Geologic Setting:** The Sierra Madera impact structure located in west Texas is a 12 km diameter, well-exposed, eroded remnant of a complex impact crater hosted in carbonate and siliciclastic sedimentary rocks [2]. It is one of ~60 impact craters that formed in predominately carbonate rocks. Past studies documented shock deformation features such as shattercones in carbonates, siltstones and fine-grained sandstones, planar deformation features (PDFs) in quartz, grain fracturing, impact breccias, and deformed quartz and carbonate minerals [1,2].

Two impact generated breccias were identified at the Sierra Madera impact structure by Wilshire et al [2]. The first, called a "monolithic breccia", is characterized by an in place shattering of rock with little or no rotation of clasts in a fine-grained matrix. The second breccia, termed "mixed breccia", contains clasts of two or more lithologies in a fine-grained carbonate matrix. This study uses the terms "monolithic impact breccia" and "polymict impact breccia" to refer to Wilshire et al's [2] breccia types after the terminology of Stöffler and Grieve [7].

**Methods:** Samples of monolithic and polymict impact generated breccias from the central uplift of Sierra Madera were analyzed for evidence of melt features through use of field and hand sample observation and petrographic and scanning electron microscopy (SEM). Carbon coated, polished thin section slides were analyzed using SEM with backscatter electron (BSE) imagery and energy dispersive spectrometry (EDS) which allowed for the easy identification of silica-rich phases from carbonate material.

**Results:** Field and hand sample observations revealed that polymict impact breccias in some areas of the crater have injection dike characteristics while thin section work identified subtle flow features. Using SEM, immiscibility features were identified from samples of polymict impact breccias of the south eastern central uplift (Figure 1). These features were recognized by an irregular boundary between materials and the incorporation of one material as blebs within another. EDS identification of the materials confirmed the presence of silica-rich and carbonate-rich materials.

**Discussion:** Silica-rich regions probably originated as quartz sand grains incorporated into the carbonate-rich breccia due to deformation of sandstone layers within the target rock succession. When temperatures became great enough during the crater formation process these grains melted or partially melted along with the surrounding carbonate material and cooled fairly rapidly preserving the immiscibility features.

This is the first report of carbonate melt rocks from the Sierra Madera impact crater. Therefore, an additional term is needed to distinguish between impact generated breccias found here. We propose using the term "impact melt breccia" after Stöffler and Grieve [7] to describe those breccias at Sierra Madera containing immiscibility features between silica and carbonate material.

**References:** [1] Eggleton R. E. and Shoemaker E. M. (1961) *USGS Prof. Paper 424-D*, D151-D153. [2] Wilshire H. G. et al. (1972) *USGS Prof. Paper 599-H*. [3] Graup G. (1999) *MAPS*, 34, 425-438. [4] Osinski G. R. and Spray J. G. (2001) *EPSL*, 194, 17-29. [5] Tuchscherer

M. G. et al. (2004) *MAPS*, 39, 899-930. [6] Osinski G. R. et al. (2005) *MAPS*, 40, 1789-1812. [7] Stöffler D. and Grieve R. A. F. (1994) *LPS XXV,* 1437-1438.

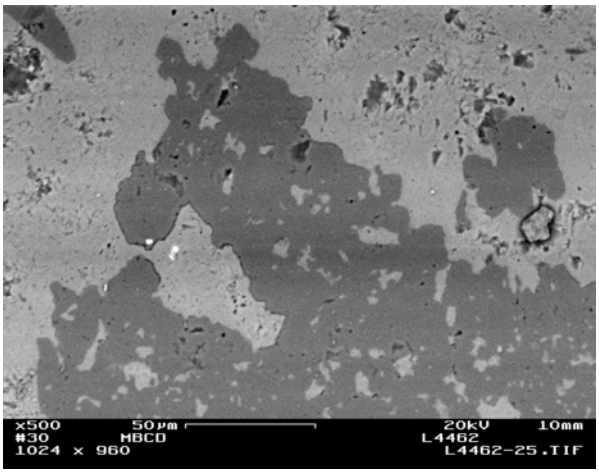


Figure 1. BSE SEM image showing immiscibility between silica-rich (dark gray) and carbonate-rich (light gray) material from a polymict impact breccia from Sierra Madera impact structure.