POSSIBLE PLANAR ELEMENTS IN ZIRCON AS INDICATOR OF PEAK IMPACT PRESSURES FROM THE SIERRA MADERA IMPACT CRATER, WEST TEXAS. S. A. Huson, M. C. Pope, A. J. Watkinson and F. F. Foit, Department of Geology, Washington State University, Pullman, WA 99164, sahuson@hotmail.com.

Introduction: Shock features found in impact craters are used as indicators of pressure and temperature conditions at the time of crater formation [1]. This study uses shock features in zircon grains to tentatively place an upper limit on pressure during the Sierra Madera impact event.

Geologic Setting: The Sierra Madera structure in west Texas is an ~12km well-exposed eroded remnant of a complex impact crater. Permian and Cretaceous age siliciclastic and carbonate rocks were deformed during the impact event. Shock deformational features at the Sierra Madera crater include breccias, shatter cones, planar deformational features (PDFs) in quartz, grain fracturing and deformed quartz and carbonate minerals [2]. The structure was last studied in the late 1960's and early 1970's and is an excellent site for large- and small-scale deformation studies using modern research techniques.

Samples and Methods: Zircon grains separated from sandstones located in the central uplift of the Sierra Madera impact structure were studied for shock deformational features. Sandstone samples were collected from the Basal Cretaceous sandstone, sandstone beds of the Permian Gilliam Limestone and the sandstone member of the Permian Word Formation. Zircon grains (<100μm) were separated using a Gemini table, magnetic separator and heavy liquid (methelyene iodide). Zircon fractions were etched with NaOH at 70ºC for 1.5 hours to reveal shock features for SEM analysis [3, 4]. Fractions also were mounted in epoxy, polished and studied under high magnification using both reflected and transmitted light.

Preliminary Results: Using reflected and transmitted light microscopy both euhedral and rounded zircon grains appear highly fractured. Planar fractures (Figure 1) were identified from the rounded fraction. SEM analysis of zircon grains reveals both euhedral and rounded grains. Most euhedral grains remain unaffected by the etching process and show no signs of shock deformation. Some rounded grains show evidence

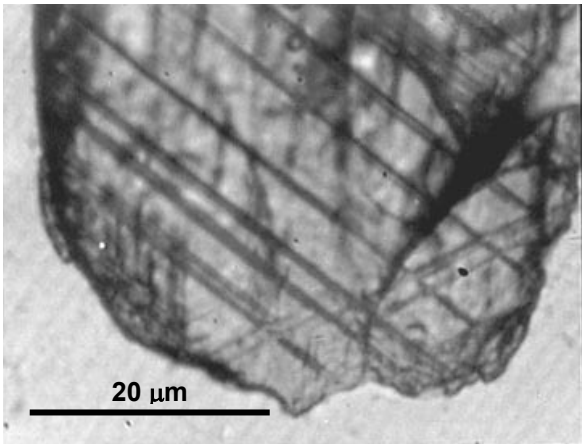

Figure 1. Zircon grain sampled from the Basal Cretaceous sandstone of the central uplift showing unidentified features (possible planar elements?). Plane light microscopy photograph, note scale bar in micrometers.

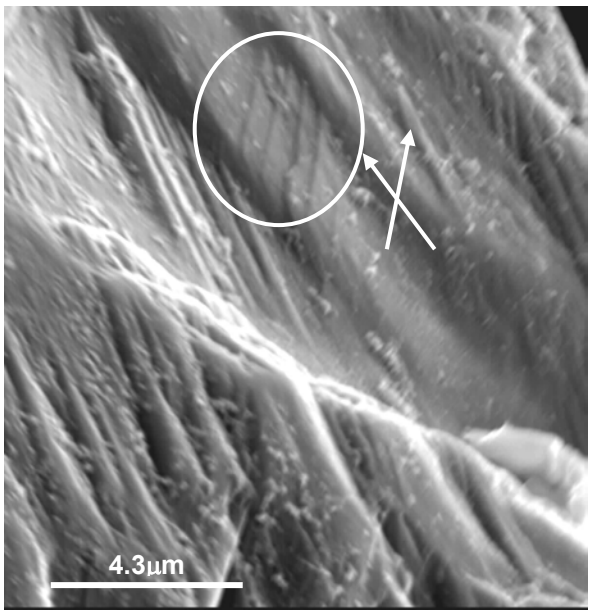

Figure 2. Possible planar features (circled) on surface of zircon grain. SEM photograph, note scale bar in micrometers. Arrows indicate two directions of planar elements.

of possible planar elements (Figure 2) however; these features are not as well developed as in previous studies [3, 4].

Further Study: The presence of shattercones and PDFs in quartz indicate a shock pressure during crater formation of ~20 GPa. However, SEM and light microscopy analyses of zircon grains with possible planar elements suggest pressures during formation of the Sierra Madera crater was at least ~40 GPa [5]. A maximum peak pressure of ~40 GPa during crater formation is not unreasonable since flow textures were noted in thin section and hand samples of mixed breccia from Sierra Madera [2]. To resolve peak pressures X-ray diffraction techniques may be used to identify high-pressure polymorphs of zircon and quartz if present in the crater. Further study on an environmental SEM should clarify the planar elements identified on zircon grain surfaces.

References: [1] French B. M. (1998) *LPI Contr. No. 954*, 120pp. [2] Wilshire H. G. et al. (1972) *USGS Prof. Paper 599-H.* [3] Bohor B. F. et al. (1993) *EPSL, 119*, 419-424. [4] Glass B. P. and Liu S. (2001) *Geology, 29*, 371-373. [5] Leroux H. et al. (1999*) EPSL, 169*, 291-301.