CHARACTERIZATION OF POLYMICT CRYSTALLINE BRECCIAS, RIES CRATER, GERMANY.

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Introduction: First recognized by Shoemaker and Chao in 1961, the Ries Crater of Southern Germany is one of the most studied impact structures in the world. This is owed mainly to the relatively young age of the crater (~14.4 Ma), resulting in very little erosion. The impact facies are also further protected by thick paleolacustrine deposits formed by the post-impact lake [1]. Some of the most thorough studies of Ries Crater have been by von Engelhardt (e.g., see review in [2] and references therein), characterizing the various allochthonous impactites, including the crater suevite, surficial suevite ejecta, and Bunte Breccia. Though suevites overlay the Bunte Breccia in most regions of the crater, in some instances, the suevite is said to overlay polymict crystalline breccia (PCB). "They form either veins in crystalline blocks in the Megablock Zone… or larger masses in the Inner Ring (Maiers Keller at Nordlingen… and outside the southeastern rim (Itzing)." [2]. PCB are categorized as "highly shocked", to Stage I or II, which correlates with pressures ranging anywhere from 10–30GPa [2]; although few detailed studies have been carried out.

Petrographic analysis of these PCB, as well as microXRD reveal the shock and strain features, resulting in a re-categorization of shock level for the samples. A comparison is also made between clasts and groundmass of both PCB and surficial suevites, with special attention paid to shock features, mineral composition, and alteration phases.

Analysis: The texture of the PCB is quite heterogeneous. Clast size ranges anywhere from 0.5mm to several meters in size and does not show any preferred orientation or sorting of grain size. Clasts are angular, and frequently show suture lines, where two separate clasts have been crushed together. The matrix is fine grained micro-crystalline, and is difficult to distinguish with a petrographic microscope. In some instances, larger crystals are visible (~10um), though these occurrences are random.

Composition of PCB: Compositional analysis was completed through the use of a petrographic microscope, micro X-Ray diffraction (XRD) analysis and back-scattered electron detection (SEM-BSE). In accordance with the origins of the PCB [2], analysis of thin sections revealed the presence primarily of quartz, plagioclase end-members (anorthite and albite), K-feldspar and calcite. In some sections biotite had a distinct presence within clasts, sometimes comprising up to 50% of the clast. MicroXRD analysis further revealed the presence of other alteration phase minerals such as chamosite and flourite, as well as a strong iron presence in combination with calcium, possibly indicating ankerite. SEM-BSE detection confirmed the presence of TiO_2, in the form of rutile inclusions, which were frequently associated with biotite, as well as the presence of garnets.

Shock Level: Many of the crystals within the PCB did show a certain level of strain and fracturing associated with the impact event. However, only in larger quartz clasts was it possible to discern any diagnostic shock features. Prelimnary analysis revelaed that approximately 10% of clasts show planar fracturing (PFs), and an even smaller number reveal planar deformation features (PDFs). Only slight kink-banding was observed in some of the mica. The presence of glass clasts was observed in some samples, but was not incorportated within PCB clasts. This indicates that the glass was incorporated into the breccia during emplacement, and is not representative of shock level within the sample. It should be further noted that classification of the PCB as "highly shocked" is somewhat misleading, as the limited presence of PDFs as well as lack of diaplectic glass phases indicate shock levels generally below ~10 GPa [3].

Suevites: In contrast to the polymict breccia, suevites – though equal in the level of heterogeneity among clast orientation, composition and size – represent a much higher shock level. Features such as toasted quartz, PDF's, kink-banding in micas, diaplectic glass as well as glass bombs all point to incorporation of more highly shocked phases.

Discussion and further work: The location of the PCB within the crater is quite sporadic in comparison with other ejecta, such as the Bunte Breccia. Composition of the PCB suggests that it originated within the pre-Varisican gneisses [2], which may explain the limited surface occurrence of the rock-type. This is in contrast to the extensive deposits of megablocks and monomict crystalline breccia, which have a primarily granitic origin, and the Bunte Breccia which comprises large amounts of upper Jurassic limestone [2], indicating much shallower origins. Further diagnostic work on these samples must be completed to fully understand their origins and anomalous presence within the Ries Crater.

References: [1] Dennis, J.G. (1971) *JGR, 76,* 5394-5406. [2] von Engelhardt, W. (1990) *Tectonophysics, 171,* 259-273 [3] Stöffler, D. (1971) *JGR, 76,* 1344–1345.