THE QUESTION OF THE EVOLUTION OF THE EJECTA PLUME AND THE ORIGIN OF SUEVITE OF THE RIES CRATER, GERMANY. C. Meyer[1], U. Reimold[1]; K. Wünnemann[1], M. Jébrak[2], [1]Museum of Natural History, Humboldt University of Berlin, Germany; email: cornelia.meyer@museum.hu-berlin.de, [2]Université du Québec à Montréal, Canada

Introduction: Hypervelocity impacts of asteroids or comets into solid rock targets lead to instantaneous vaporization, melting and comminution of target rocks in the central excavation cavity. The currently least understood aspect of impact cratering is the process of ejecta plume development and evolution (and related – formation of suevitic breccias). With the current knowledge, a substantial fraction of the central part of the growing impact crater will immediately become engulfed in an upward-rising hemispherical plume that contains a mixture of vaporized, molten, shock metamorphosed, fractured, and unshocked material and expands almost vertically [1]. After collapse of the plume mixed material falls back into the crater, on top of the ballistically emplaced continuous ejecta blanket (deposited within and outside of the crater) forming a hot polymict breccia deposit thought to be represented by the so-called suevite.

We are investigating the suevite of the 14.8 Ma, 24 km wide Ries crater in southern Germany [e.g. 2]. Samples for this work have been obtained from the drill cores “Nördlingen 1973”, 3.5 km laterally from the impact point, with a 300 m thick suevite package; “Wörnitzostheim”, 8 km from the impact point, with a 80 m thick suevite sequence; and “Otting”, outside the crater, 17 km from the impact point, with 9 m of suevite (Fig. 1). Representative core sections have been subjected to digital analysis by a new technique developed by the Université du Québec à Montréal, which will be published in a forthcoming paper.

Observations and results: In the upper 150 m of the suevite sequence in the “Nördlingen 1973” core we found 4 sequences (with increasing width) with increasing particle sizes for rock and mineral clasts with increasing depth (gradation). Below these layers the particle sizes decreases towards the bottom of the suevite sequence. In the “Wörnitzostheim” core, the particle sizes of the rock clasts increases with increasing depth. The “Otting” samples revealed a heterogeneous particle sizes throughout the whole suevite sequence except for the lower two meters where the sizes decreases with depth (Fig. 1).

Melt particles in suevite have so far only been investigated in “Wörnitzostheim” and “Otting” suevite samples. For “Wörnitzostheim” we found an increasing melt content with increasing depth, which is correlated with an increase of average particle size of the melt clasts – corresponding to the size record for the lithic clasts in “Wörnitzostheim” suevite. In the “Otting” suevite, a decrease of the melt content with increasing depth is also correlated with a decrease of average particle size of the melt clasts. The melt particles of both drill cores show an almost horizontal arrangement.

Discussion and further work: Our work attempts to address the questions whether particle size distributions in the suevites are caused by quasi-fluviatile deposition as expected for a lateral, basal transport comparable to a volcanic pyroclastic flow as proposed by [3], or whether it might indicate continuous deposition out of a collapsing ejecta plume (in texture similar to the result of compaction), or deposition through a combination of both processes.

Bearing in mind the results of the investigations of ejecta in the Chixculub crater [3] and based on our present knowledge, it can be suggested that in a first stage of ejecta plume development, the ejecta will be accelerated in a column as it interacts with the atmosphere. A lighter upper part of vaporised, condensed and fine-grained particles rises higher because of its lower density than the atmosphere. These particles fall back at the end of all deposition on top of earlier deposited ejecta and form the fine-grained layer in the uppermost part of the suevite inside the crater [4]. The lower part of coarser-grained rock and melt particles will fall to the ground first and spread outward as a glowing avalanche. First the avalanche has low viscosity and turbulent flow, and might even spill over the crater rim and deposit a heterogeneous suevite as seen in the “Otting” core. After a while the avalanche becomes more viscous due to cooling and fades to a fluent stream, which at first could still flow (e.g., over the inner crater ring at Ries) and forms the graded suevite in the “Wörnitzostheim” core between the inner ring and the crater edge. At an even later more viscous stage, suevite could flow back and forth, perhaps several times, inside the crater to form the graded upper suevite of the “Nördlingen 1973” core in the inner crater.

To resolve these questions and to prove our first model we want to measure now the orientation of melt particles in 3 dimensions to establish the full fabric. In addition, the currently available macroscopic results will be complemented with microscopic image analysis data, and the distribution of particles of different shock stages shall be quantified.

References: [1] Melosh H.J. (1989) *Impact cratering; a geologic process.* [2] (1977) *Geologica Bavarica 75* [3] Salge T. (2006) *PhD-Thesis* [4] Köberl C. et al. (2007) *Meteoritics, 42*, 709-729

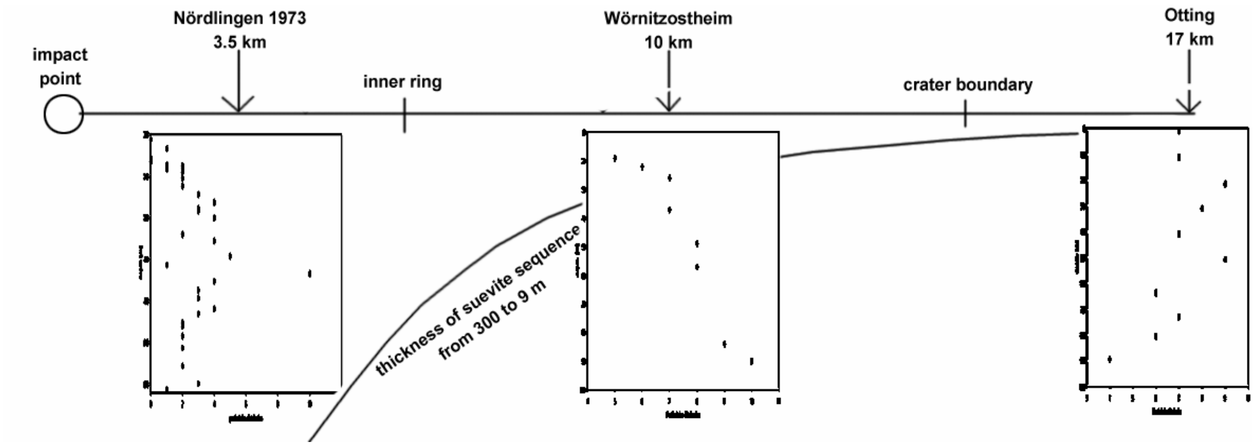

Fig. 1: location of the drill core related to the point of impact, inner ring and crater boundary
The lower line shows the variation of the thickness of the suevit sequence in the drill cores from 300 m at the “Nördlingen 1973” core to 9 m at the “Otting” core.
The diagrams show the particle size distribution of the rock clasts on the x-axis against the depth on the y-axis.