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New modeling results of the Bunte breccia ejecta morphology and thickness variations outside the Ries impact crater, southern Germany

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The Ries impact crater with a diameter of ∼25 km represents a relatively pristine, complex impact crater in southern Germany that was formed during the Miocene (14.34+-0.08 Ma) [1, 2]. The impact occurred into a two-layered target that consists of ∼650 m partly water-saturated and subhorizontally layered sediments (limestones, sandstones, shales) of Triassic to Tertiary ages underlain by crystalline basement rocks (mainly gneisses, granites and amphibolites) [3, 4]. The continuous ejecta blanket of the crater ejected up to a distance of 45 km from the crater center is built up by so called Bunte breccias, a polymict lithic breccia. The ejected breccia material mainly consists of unshocked to weakly shocked sedimentary target clasts in addition to a minority of crystalline basement clasts and reworked surfical sediments (e.g., Upper Freshwater Molasses or Upper Seawater Molasses) [5, 6].

Here we present new results of the morphology of the (i) paleo-relief and (ii) the thickness variations of the continuous ejecta blanket with radial range. For this study we combined digital elevation data and geologic information of the recent geologic map [7] in ArcGIS (ESRI) and RockWorks14 (RockWare) to extract the elevation of the lower contact plane ("paleo-surface") and the contact between the Bunte breccia and the overlain Suevite deposits. In detail, we extracted the mapping information of the autochthonous-allochthonous ("Bunte breccia base") and allochthonous-suevite ("Bunte breccia top") intersections from the geologic map [7], descriptions of nine NASA drilling sites [6], and included up to 40 drillings carried out by the Bavarian Environment Agency to interpolate the morphology and thickness variation of the Bunte breccia ejecta outside the Ries impact crater.

Due to the highest data density and the widespread occurrence of Bunte breccia deposits as well as Suevite, the southwestern part of the ejecta blanket was selected for the study and delivered a more or less continuous morphology and thickness distribution of the Bunte breccia deposits outside the crater. Preliminary modeling results of the paleo-surface and Bunte breccia top surface provide an increasing Bunte breccia thickness with increasing distance from the crater center. The ejecta thickness distribution clearly deviates from a steady decrease with radial range. A ridge of up to 99 m thick Bunte breccia could be identified at a radial distance of ∼22 km from the crater center (1.76 crater radii), whereas the thickness decreases rapidly to less than 40 m, beyond this concentrically trending ejecta ridge. The farthest extent of the southern ejecta blanket is situated at ∼32 km distance (2.56 crater radii). The observed thickness variation of the southwestern part outside the Ries impact crater is comparable to morphology characteristics of double-layered ejecta craters on Mars that show elevated rampart features at distances of 2 crater radii from the crater center [8].

References

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