MAPPING EJECTA ON THE EAST AND SOUTHEAST SIDE OF BARRINGER METEORITE CRATER (a.k.a. METEOR CRATER), ARIZONA. M. Schmieder[1,2], S. Boschi[3], C. Caudill[4], M. Chandnani[5], N. J. DiFrancesco[6], S. M. Hibbard[7], K. Hughson[8], M. Kinczyk[9], A. C. Martin[10], E. Martin[3], M. Martinot[11], C. B. McCarty[10], K. E. Powell[12], A. Sarafian[13], D. R. Schaub[6], K. Shirley[6] and D. A. Kring[1,2], [1]USRA–Lunar and Planetary Institute, 3600 Bay Area Blvd., Houston, TX 77058, USA, [2]Solar System Exploration Research Virtual Institute, [3]Dept. Physics, Lund University, 22100 Lund, Sweden, [4]Dept. Earth Science, Western University, London, Ontario N6A 5B7, Canada, [5]Geophysical Institute, University of Alaska, Fairbanks, AK 99775, USA, [6]Dept. Geosciences, Stony Brook University, Stony Brook, NY 11794, USA, [7]Dept. Earth and Environmental Science, Temple University, Philadelphia, PA 19122, USA, [8]Dept. Earth, Planetary and Space Science, University of California, Los Angeles, CA 90095, USA, [9]Dept. Marine, Earth and Atmospheric Science, North Carolina University, Raleigh, NC 27607, USA, [10]Dept. Earth and Planetary Sciences, University of Tennessee, Knoxville, TN 37996, USA, [11]Dept. Earth and Life Science, Vrije Universiteit, 1081 Amsterdam, The Netherlands, [12]Washington University, St. Louis, MO 63130, USA, [13]Massachusetts Institute of Technology, Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA.

Introduction: The distribution of impact ejecta around the ~1.2 km-diameter Barringer Crater (*a.k.a.* Meteor Crater), Arizona, was initially mapped by Barringer [1] and then by Shoemaker [2] (Fig. 1), the latter of which tied the processes of excavation, overturning, and deposition to the same processes seen in high-energy and nuclear explosion cratering events. Roddy [3] later had an opportunity to conduct a rotary drilling campaign, systematically sampling the ejecta blanket and surrounding terrain. Based on those results, he extended the distribution of continuous ejecta around the crater (black solid line in Fig. 1) to far greater radial distances than had been recognized previously. The discrepancy between Shoemaker's map [2] and Roddy's estimate [3] has never been reconciled with geologic mapping. It is not yet clear which lithologies exist in the extended continuous ejecta blanket of [3]. Here we explore a part of the terrain classified as continuous ejecta by Roddy [3] on the east and southeast sides of the crater to identify the lithologies present, and effectively extend the geologic map of [2].

Ejected Units: Meteor Crater is excavated from three stratified sedimentary units, all of which are well exposed at the crater. The oldest, basal unit is dominated by the Permian Coconino Sandstone (≤240 m total thickness) with a thin (~3 m) section of Toroweap sandstone at the top. The sandstone is covered with sandy carbonate of the Permian Kaibab Formation (~80 m). The top of the sequence, which would have formed the land surface at the time of impact, is composed of Triassic Moenkopi siltstone and shale (≤10 m preserved) (e.g., [4]). Those units were overturned when ejected during crater excavation. As shown by Shoemaker [2], the deepest-sourced Coconino-Toroweap is also concentrated near the crater rim. With greater radial distance, one encounters Kaibab and Moenkopi, sequentially, although there are isolated variations to that sequence as discussed by [4].

Mapped Units: Recent alluvium is >50% soil and/or fine-grained sand with pebbles and cobbles. It is moderately sorted, with multiple target lithologies, although Kaibab and Moenkopi clasts are far more abundant than Coconino-Toroweap clasts. Boulders of Kaibab sit on this unit.

An older, Pleistocene alluvium has very little soil and sand, is clast-supported, and is composed of Moenkopi, Kaibab, and Coconino-Toroweap. The average clast size is larger than that of the recent alluvium, ranging from pebbles to boulders. The older alluvium commonly forms morphologic terraces.

Kaibab ejecta is poorly sorted in size and often contains boulders >1 m in size that can be <5 m apart. A small amount of Moenkopi debris may be mixed with the Kaibab, but it is <20% of the surface unit.

In the area mapped, we encountered a deposit transitional between Kaibab and Moenkopi ejecta. It contains significant numbers of clasts derived from both units, with sizes ranging from cobbles to boulders (Kaibab up to 3.7 m; Moenkopi up to ~1 m in boulder size). Both the Wupatki and Moqui members of the Moenkopi are present, as are clasts of the Kaibab-Moenkopi boundary breccia seen in the crater walls.

Results: Most of the region interpreted as continuous ejecta by Roddy [3] is mapped here as alluvium, radially extending the mapped alluvium unit of Shoemaker [2]. We encountered, however, several areas with deposits identified as Kaibab ejecta, as shown in Fig. 1, that are beyond those mapped by Shoemaker [2]. The largest area extends nearly ~450 m (~1,500 ft) in the northeast map quadrant.

In the southeast quadrant, we mapped a knoll that is composed of both Kaibab and Moenkopi ejecta. The Kaibab is concentrated on the face towards the crater, while Moenkopi debris dominates the far side of the knoll. This location may be similar to a location on the north side of the crater where lobes of discontinuous

Kaibab ejecta mantle the face of a ridge of Moenkopi bedrock [5].

Intervening areas, even where mapped as alluvium, are still richly covered with pebbles and cobbles of Kaibab debris. In some locations, there are isolated Kaibab boulders with dimensions up to ~8 m (e.g., close to the southeastern limit of the ejecta deposits of [3]). Some of those boulders were deposited in what Roddy considered the continuous ejecta blanket, while other boulders were deposited far beyond the edge of that blanket.

Conclusions: The extent of the continuous ejecta blanket inferred by Roddy [3] from subsurface rotary drill cuttings is not easily discernible as mappable units because of an extensive cover of alluvium. However, in a few locations, ejected debris survives as mappable units, effectively extending the ejecta mapped by Shoemaker [2].

References: [1] Barringer D. M. (1910) *Meteor Crater (formerly called Coon Mountain or Coon Butte) in northern central Arizona*, 24 p., 18 plates, 3 maps. [2] Shoemaker E. M. (1960) *Internat. Geol. Congr. XXI Session*, Copenhagen, 418–434. [3] Roddy D. J. et al. (1975) *Proc. LSC 6th*, 2621–2644. [4] Kring D. A. (2007) *Guidebook to the Geology of Barringer Meteorite Crater, Arizona*. LPI Contrib. No. 1355, 150 p. [5] Kring D. A. et al. (2015) *LPS XLVI*, Abstract #1186.

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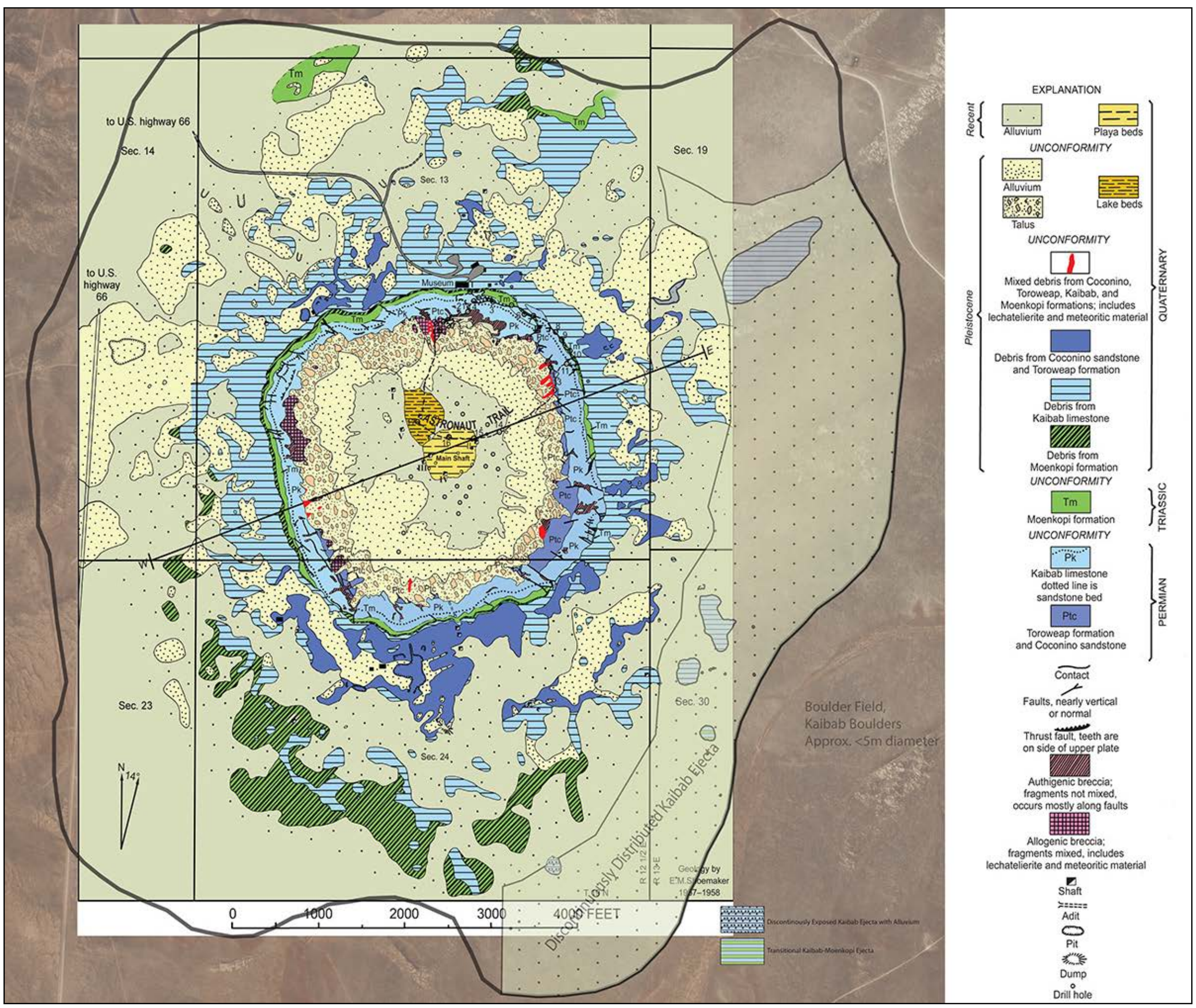

Fig. 1. Preliminary geologic map of the east and southeast sides of Meteor Crater that extend the work of Shoemaker [2] to the limit of the continuous ejecta blanket as defined by Roddy [3] (thick black, solid line). The scale bar has 500 ft subdivisions.