RE-DATING THE BARRINGER METEORITE CRATER (AZ) IMPACT USING THE COSMOGENIC CHLORINE-36 SURFACE EXPOSURE METHOD

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Introduction: Barringer Meteorite Crater (aka Meteor Crater) is extraordinarily well-preserved and relatively young. An age of 49 or 50 ka is commonly cited based on a thermoluminescence age of shock-metamorphosed rock [1], a cosmogenic ^{36}Cl exposure age of ejected blocks [2], and a ^{10}Be-^{26}Al exposure age of those same ejected blocks [3]. An additional value of ~75 ka is based on exposure ages of surviving material from the impacting asteroid [4]. We revisit the ^{36}Cl age here.

Exposure Age. Five samples from the crater were collected, processed, and analyzed by accelerator mass spectrometry at the University of Rochester in the late 1980's. Those were among the earliest geological samples (as opposed to calibration materials) analyzed for ^{36}Cl. Using the ^{36}Cl production rates calibrated by [5], a mean age of 49.7±0.85 ka was obtained by Phillips and others [2]. After 20 yrs of method development, a reassessment of that age determination was deemed appropriate. The original samples were relocated, four of them were reprocessed with the addition of a ^{35}Cl spike to enable isotope dilution mass spectrometry analysis, and analyzed at PRIME Lab, Purdue University. The reprocessed samples, using modern methods, gave ^{36}Cl ratio analytical results close to the original values: the average absolute deviation between the two sets of analyses is 8%. However, due to differences in the analytical Cl concentrations and the cosmogenic ^{36}Cl production rate parameters, the re-evaluated samples gave significantly older ages. Using the Phillips [6] calibration data set (excluding the Meteor Crater samples), the weighted mean age of the four samples is 56.0±2.4 ka for the case of no erosion of the rock surface.

Discussion. This result is preliminary and may change slightly as additional analyses are obtained. The discrepancy between the 56.0±2.4 ka reported here and the thermoluminescence age of 49±3 ka of [1] is unclear. The 56.0±2.4 ka age is only slightly younger than that for the Odessa impact crater field, which was produced by a similar type iron asteroid shortly before 63.5±4.5 ka [7], so both impact events may have been produced by material perturbed into an Earth-crossing orbit at the same time. The revised age does not greatly change the paleoenvironmental reconstruction of the Barringer impact site [8], although it may mean we will be unable to use ^{14}C techniques to calibrate the chronology of the fossil assemblages in the basal portion of the lake sediments that cover the crater floor.

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