TWO-POLARITY MAGNETIZATION IN THE MANSON IMPACT BRECCIA.

M.B. Steiner, Dept. Geology/Geophysics, Univ. of Wyoming, Laramie, WY 82071 and E.M. Shoemaker, U.S. Geol. Survey, Flagstaff, AZ 86001

Preliminary paleomagnetic study of the impact breccia matrix and clasts has produced surprising results: nearly antipodal normal and reversed polarity magnetic vectors are observed in different portions of the core. Near-antipodal magnetizations within a segment of matrix, and within individual samples rule out core inversion as the explanation of the dual polarity. In both the dense and the sandy matrix breccias, the magnetizations of clasts and matrix within the same core segment are identical; this negative 'conglomerate test' indicates that magnetization originated after impact.

Paleomagnetic study of the Manson Impact Structure is an attempt to refine the Ar^{40}/Ar^{39} age (65.7±1 m.y. [1]) that suggests Manson to be a Cretaceous-Tertiary boundary impact. Refinement is possible because the boundary occurs within a reversed polarity interval (29R) of only 0.5 m.y. duration. The two breccia types in the Manson structure were both examined, one of a very dense matrix and apparently partially melted, and the breccia stratigraphically below it of granular or "sandy" chloritic matrix. Samples were taken from the matrixes and a wide variety of clast compositions, including granite, diabase, gneiss, amphibolite, and melted granite. Currently, measurements have been made on 22 samples, using 30-35 steps of either alternating field (AF) or thermal demagnetization.

Samples display either a dominantly reversed or normal polarity magnetization, but vectors of both polarities are observed within most of the samples. The dominant magnetization is held between 250^{o} and 570^{o}C and decays linearly to the origin of orthogonal axes plots; the opposite polarity magnetization is commonly observed as a vector removed, below 250^{o} or above 570^{o}C, and also as the vector remaining at heating steps above 570^{o}C. One sample, a diabase clast, particularly clearly displays both of the near-antipodal polarities both at low and at high temperatures. Most of the samples, regardless of dominant polarity, display two unblocking temperatures: 250^{o}C and 500^{o}C.

AF demagnetization shows the removal at fields $\leq$10 mT of vectors of the opposite polarity to that of the remanence observed at high fields. Above 10mT, the remanence of both polarities decay univectorially to the origin. Both AF and thermal demagnetization of samples of the same clast or matrix piece give the same directions for magnetizations held between 250-570^{o}C and above 10 mT within a sample. The inclinations observed are steeper than the Cretaceous inclination for the site (64^{o}): normal inclinations average $+80^{o}$, and reversed, -76^{o}. The Iowa site has had no geologic events subsequent to this impact, hence no obvious mechanism for remagnetization in the Tertiary. Tertiary inclinations at this site would lie between only 61^{o} and 71^{o}, hence the steep inclinations may represent unaveraged secular variation.

MANSON DUAL POLARITY: Steiner M. B. and Shoemaker E. M.

The dense matrix breccia has entirely normal polarity dominant magnetizations, with reversed polarity seen as removed vectors both at low and high temperatures, as the vector remaining at some steps above 570°C, and as the vector removed by low field AF demagnetization. The sandy matrix breccia samples display a dominant magnetization that is either of normal or reversed polarity depending on the depth in the core. Of six core segments examined, the magnetization polarity of three is normal, two reversed, and one normal interrupted by a small interval of reversed polarity. The opposite polarity vector is observed as the vector removed during both types of demagnetization (at both high and low temperatures), and both polarities are alternately observed as the remanent vector during thermal demagnetization of the diabase clast mentioned earlier. Normal and mixed polarity were found 60 m deeper in this breccia by an earlier study [3].

At this preliminary stage of the study, the only definitive evidence of which polarity may represent the earliest magnetization is the fact that the hottest material has a normal polarity dominant magnetization (although only 3 core segments thus far have been studied). Rock-magnetic and mineralogic studies currently in progress will assist in resolving this question.

The data indicate that either a reversal of the geomagnetic field has been recorded or the core mineralogy includes a self-reversing magnetic mineral. Self-reversal seems the less likely explanation because the two polarities are observed in both matrix and clasts, and in a wide variety of clast compositions.

Several possibilities could explain a magnetic field record of normal and reversed polarity near the Cretaceous-Tertiary boundary: 1) Manson may be younger or older than the K/T boundary. The boundary is thought to lie in the middle of marine magnetic anomaly 29R, and these data may suggest that Manson is closer to the upper or lower boundary of 29R. (If so, this may suggest that the K/T event was a comet shower.) 2) Large impacts have been speculated to cause excursions or reversals of the geomagnetic field; although Manson is not large enough, if it is associated with the Chicxulub impact, this explanation might be tenable. 3) A later heating event (e.g., hydrothermal) may have occurred after impact, occurring sufficiently later in time that the field had changed polarity. 4) A hitherto unknown short normal polarity event may have occurred at the K/T boundary, a suggestion already advanced by Lerbeckmo [2].

References: [1] Kunk M. J., et al (1989) Science, v. 244, 1565. [2] Lerbeckmo J. F. (1991) in Joint meeting of IGCP Projects 216, 293, 303, Aug. 28-30, 1991, Calgary, Alberta, Canada, 48. [3] Cisowski S. M. (1988) in Lunar and Planetary Science XIX, pp. 188-189.