A SUMMARY OF DATA ON THE MANSON IMPACT STRUCTURE

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The Manson impact structure is of particular interest because of its possible association with the Cretaceous-Tertiary (K-T) boundary. The structure is about 35 km in diameter, the largest recognized in the U.S. Its center is near the town of Manson in northwest central Iowa. Attention was drawn to Manson initially by the unusual quality of the ground water there. Geological information on the structure is incomplete because it is covered by several tens of meters of glacial deposits. Under the glacial deposits in central Iowa normally are Phanerozoic sedimentary rocks (mostly flat-lying carbonates) and Proterozoic red clastic, metamorphic, volcanic and plutonic rocks. Based mainly on drill cuttings from water wells it has been found that in a generally circular area around Manson this normal sequence is absent. In its place are centrally uplifted igneous and metamorphic rocks, peripheral faulted or slumped Cretaceous shales, and in roughly intermediate locations completely disrupted or otherwise unusual rocks (Figure 1). The stratified rocks surrounding the structure are slightly warped upward toward its center.

A total of over 600 meters of drill core has been obtained from three locations within the structure. Two of the cores contain completely disrupted rocks and one contains uplifted igneous and metamorphic rocks (1). Manson was interpreted as a cryptovolcanic structure (2) and then established as an impact structure based on its circular shape, its central uplift and the presence of shocked quartz within the uplifted granitic rocks (3). An interpretive cross section of the Manson structure is shown in Figure 2 (4).

A gravity survey of the entire structure with stations at approximately one-mile intervals identified higher-density uplifted crystalline rocks about three miles (5 km) west of near-surface granitic rocks recovered by drilling (5). Lower-density brecciated rocks were also identified, but the boundary of the structure could not be established. Magnetic data display complexities near the center of the structure consistent with the presence there of basement rocks (6), but a one-to-one correspondence of gravity and magnetic anomalies does not exist. A refraction seismic survey using 107 sites approximately fitting a 2x2 mile (3.2 x 3.2 km) grid identified the crystalline central uplift and was used to map the bedrock topography within the structure (7).

An Argon 40-39 analysis of shocked microcline from a depth of 231 feet (70m) along the core into crystalline rock produced an age of less than 70 Ma for a reheating event probably related to the Manson impact (8). The corresponding age spectrum is shown in Figure 3. Two additional spectra for samples from different levels within the same core were obtained, and they indicate a time of reheating of about 66 Ma ago, a time indistinguishable from the age of the K-T boundary (9).

References

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THE MANSON IMPACT STRUCTURE

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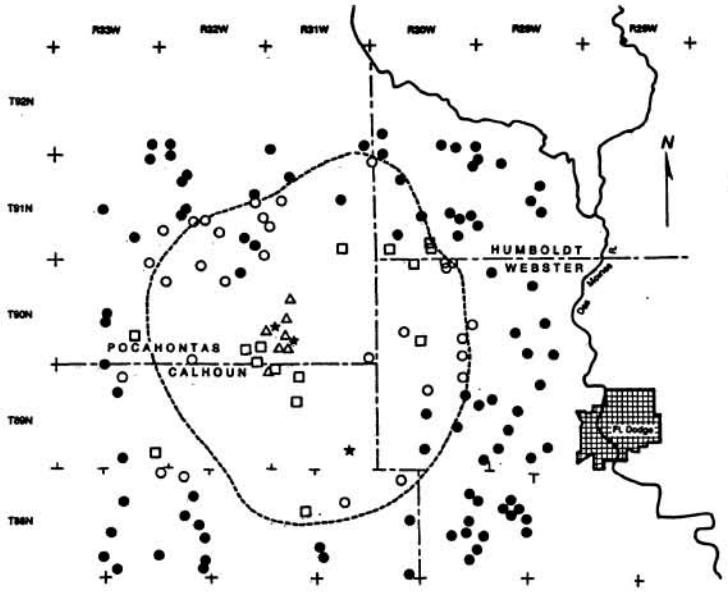

Figure 1. Map of the area around Manson, Iowa, showing the locations of wells which a normal Phanerozoic section (●), displaced strata (○), completely disrupted strata (□), and igneous and metamorphic rocks (△). Data shown are from Anderson (private communication, 1987). Locations where cores have been obtained are also indicated (★). The symbols (+) are township corners and are 6 miles apart. The dashed line delineates the Manson "disturbed" area, from Hershey (1969).

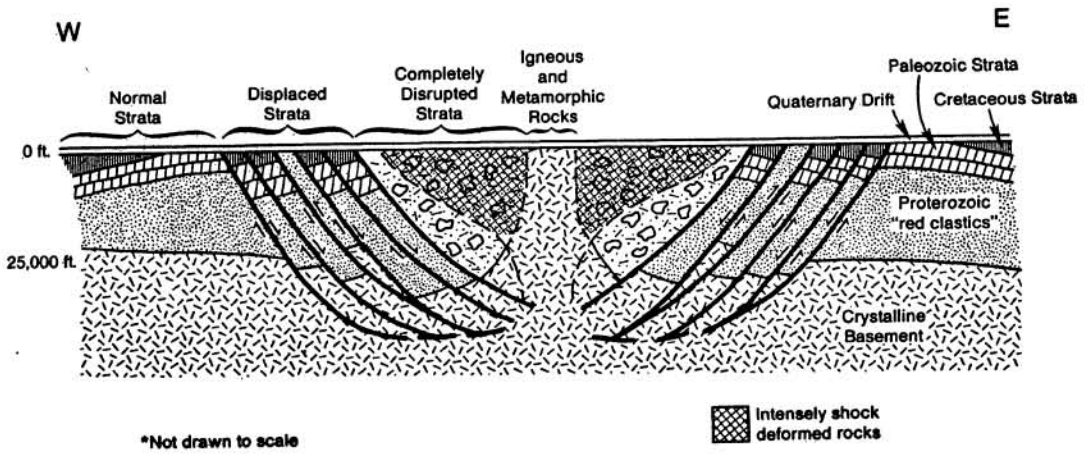

Figure 2. Interpretive cross-section of the Manson Impact Structure (4).

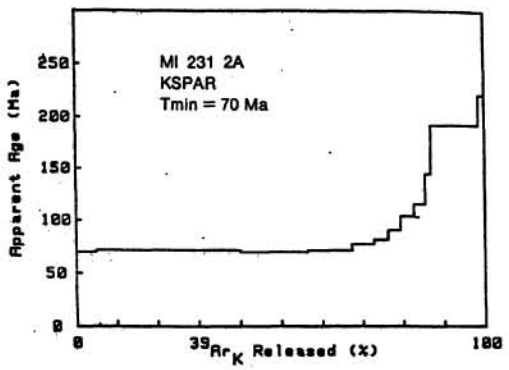

Figure 3. $^{40}Ar/^{39}Ar$ age spectrum for a potassium feldspar sample from the Manson 2-A core, 231 feet (70 m) from the ground surface (8). The first 60 to 70% of ^{39}Ar released indicates an upper limit for the time of post-impact cooling of 70 Ma.