THE STRUCTURAL CONFIGURATION OF THE MANSON IMPACT STRUCTURE, IOWA, AS INTERPRETED FROM SEISMIC DATA AND CONFIRMED BY DRILL SAMPLES

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The structural configuration of the Manson Impact Structure (MIS) in Iowa was interpreted from excellent reflection seismic data provided by AMOCO Production Company. The seismic data is 24 fold vibroseis, with the final migrated section very nearly approximating an extended radius of the MIS. The interpreted profile (Figure 1) displays a classic complex crater with a central uplift, crater moat area, and ring graben juxtaposed against undisturbed strata. In the area of undisturbed strata east of the MIS, the parallel reflectors within the 750 m of Paleozoic sedimentary strata (P) are evident, overlying the Proterozoic "Red Clastics" strata (RC). The upper portion of the "Red Clastics" is characterized by a series of weakly defined parallel horizontal reflectors, the lower portion by similar, east-dipping reflectors. The prominent double reflector that identifies the base of the "Red Clastics", and the Proterozoic crystalline surface, shows a pronounced basin-ward dip. The region of the MIS between the limits of the apparent crater (AC) and the transient crater (TC) is the ring graben, formed by the slumping of materials into the transient crater. The subsidence of large blocks within the ring graben led to the structural preservation of at least 190 m and probably as much as 330 m of Cretaceous strata (K) that was present at the time of crater formation, but was subsequently erosionally removed from the region outside of the MIS. As much as 190 m of this Cretaceous strata is known from wells in the MIS. In some areas of the ring graben crater ejecta material (E) is interpreted above Cretaceous strata. This material has been confirmed as polymictic breccias in several wells in the region and is strongly suggestive of the preservation of the latest Cretaceous surface, that was probably buried nearly instantaneously at the time of impact. Post impact, Tertiary (?) lake deposits (T) may also have been preserved, above ejecta material, within the ring graben. Samples of siltstones and mudstones from several wells, presently under investigation, may be examples of these lake deposits. The area between the approximate limits of the transient crater (TC) and the central peak is called the crater moat. All pre-impact materials were blown from this region by the impact explosion. The moat area was partially filled with ejecta material (E) and material that slumped off the sides of the transient crater and the central peak. This material is characterized by discontinuous reflectors below the two parallel reflectors that mark its upper surface. After the crater area stabilized in the early Tertiary, a moat lake apparently formed. Lake deposits (T) are interpreted above ejecta deposits in most areas of the crater moat. These deposits are characterized by a series of weak, undulating, parallel reflectors. Samples from a number of wells in the moat area of the MIS, containing as much as 110 m of strata tentatively identified as Tertiary lake deposits, are currently being studied. Near the center of the MIS (A), the central peak of uplifted Proterozoic crystalline rocks is interpreted by the pronounced double reflector that identifies its contact with younger sedimentary rocks. To date 9 wells near the center of the MIS are known to have encountered these uplifted crystalline rocks, including the 110 m of the Manson 2-A core. An area of ejecta material preserved on the central peak is probably the remnants of a peak ring crater. This material is observed above the double reflector on the western edge of the seismic section. These ejecta materials were encountered in 5 wells on the central uplift, including the Manson 1-A core. The presence of this material on the central uplift is interpreted as evidence that the central peak "over shot" its ultimate height and partially collapsed. Interpretations of the seismic data, other geophysical data, and the study of samples from wells in the area, have allowed the interpretation of a sequence of events that may have led to the formation of the MIS. Future drilling and investigations will provide an even greater understanding of this exquisitely-preserved impact crater.

Figure 1. Interpreted seismic reflection profile approximating an extended radius of the Manson Impact Structure. Data provided by AMOCO Production Company.