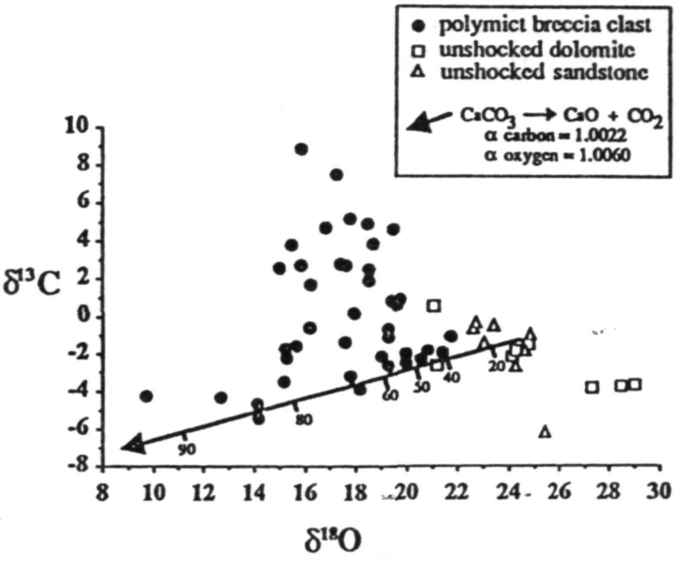

Fig. 2. $\delta^{13}C$ vs. $\delta^{18}O$ diagram. The numbers along the curve correspond to the degree of Raleigh degassing.

instead of being depleted as they should be if they were residues resulting from the ^{13}C-enriched CO_2 losses (Fig. 1). On the other hand, these carbonates are systematically depleted in ^{18}O. The magnitude of the ^{18}O depletion is variable (Fig. 2). Thus no systematic correlation between ^{18}O and ^{13}C was observed as expected from the Rayleigh model or the batch model for CO_2 loss (Fig. 2), nor was any clear relationship observed between the carbon and oxygen isotopic shifts and CaO + MgO contents of the shock clasts. The spread of the carbon and oxygen isotopic composition is probably due to a variety of processes that may affect C and O during the shock. Several explanations can be suggested for the volatile release from sedimentary rocks: (1) degassing of CO_2 with a peculiar carbon isotope fractionation coefficient ($\alpha < 1$, CO_2 preferentially concentrates ^{12}C), (2) other reactions with production of CO or C, or (3) oxygen isotope exchange with coexisting silicates. Moreover, the absence of CaO + MgO enrichments in the shocked clasts, which is a general feature, may indicate that substantial amounts of CaO + MgO are mobilized during the shock processes since original sedimentary samples contain up to 66 wt%. The modalities of this inferred mobilization of CaO + MgO are still unknown.

However, for some samples, late secondary processes may have partly altered the primary characteristics (nature) of the residues resulting from the volatile release because carbonate crystals are observed along cavity walls (bubbles, cracks). It suggests that some C-rich fluids (CO_2?) were pervasive during the formation and the cooling of the polymict breccia. In these samples, the observed ^{13}C enrichments can therefore be partly explained by the trapping of some heavy CO_2 released during the shock process itself.

References: [1] Kieffer S. W. and Simonds C. H. (1980) *Rev. Geophys. Space Phys., 18,* 143–181. [2] Lange M. A. and Ahrens T. J. (1986) *EPSL, 77,* 409–418. [3] Tyburczy J. A. and Ahrens T. J. (1986) *JGR, 91,* 4730–4744. [4] Bottinga (1968) *J. Phys. Chem., 72,* 800–808. [5] McCrea J. M. (1950) *J. Chem. Phys., 18,* 849–857.

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RESEARCH CORE DRILLING IN THE MANSON IMPACT STRUCTURE, IOWA.

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The Manson impact structure (MIS), located in north-central Iowa, has a diameter of 35 km and is the largest confirmed impact structure in the United States. The MIS has yielded a $^{40}Ar/^{39}Ar$ age of 65.7 Ma [1] on microcline from its central peak, an age that is "indistinguishable" from the age of the Cretaceous-Tertiary boundary.

In the summer of 1991 the Iowa Geological Survey Bureau and U.S. Geological Survey initiated a research core drilling project on the MIS. The first core (M-1) was located on the edge of the Central Peak (Fig. 1). Beneath 55 m of glacial drift, the core penetrated a 6-m layered sequence of shale and siltstone and 42 m of Cretaceous shale-dominated sedimentary clast breccia (Fig. 2). Below this breccia, the core encountered two crystalline rock clast breccia units. The upper unit is 53 m thick, with a glassy matrix displaying various degrees of devitrification. The upper half of this unit is dominated by the glassy matrix, with shock-deformed mineral grains (especially quartz) the most common clast. Clast content increases toward the base of the unit. The glassy-matrix unit grades downward into the basal unit in the core, a crystalline rock breccia with a sandy matrix, the matrix dominated by igneous and metamorphic rock fragments or disaggregated grains from those rocks. The unit is about 45 m thick, and grains display abundant shock deformation features. Preliminary interpretations suggest that the crystalline rock breccias are the transient crater floor, lifted up with the central peak. The sedimentary clast breccia probably represents a postimpact debris flow from the crater rim, and the uppermost layered unit probably represents a large block associated with the flow.

The second core (M-2) was drilled near the center of the crater moat in an area where an early crater model suggested the presence of postimpact lake sediments. The core encountered 39 m of sedimentary clast breccia, very similar to that in the M-1 core. Beneath the breccia, 120 m of poorly consolidated, mildly deformed and sheared siltstone, shale, and sandstone was encountered. The

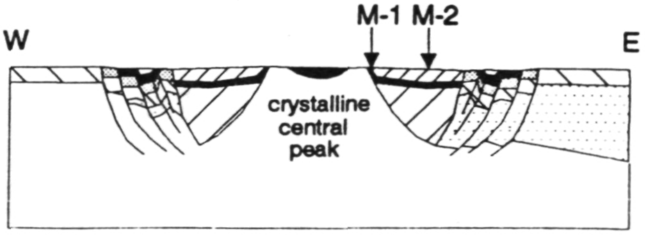

Fig. 1. East-west cross section of the Manson Impact Structure showing the location of the Manson M-1 and M-2 cores.

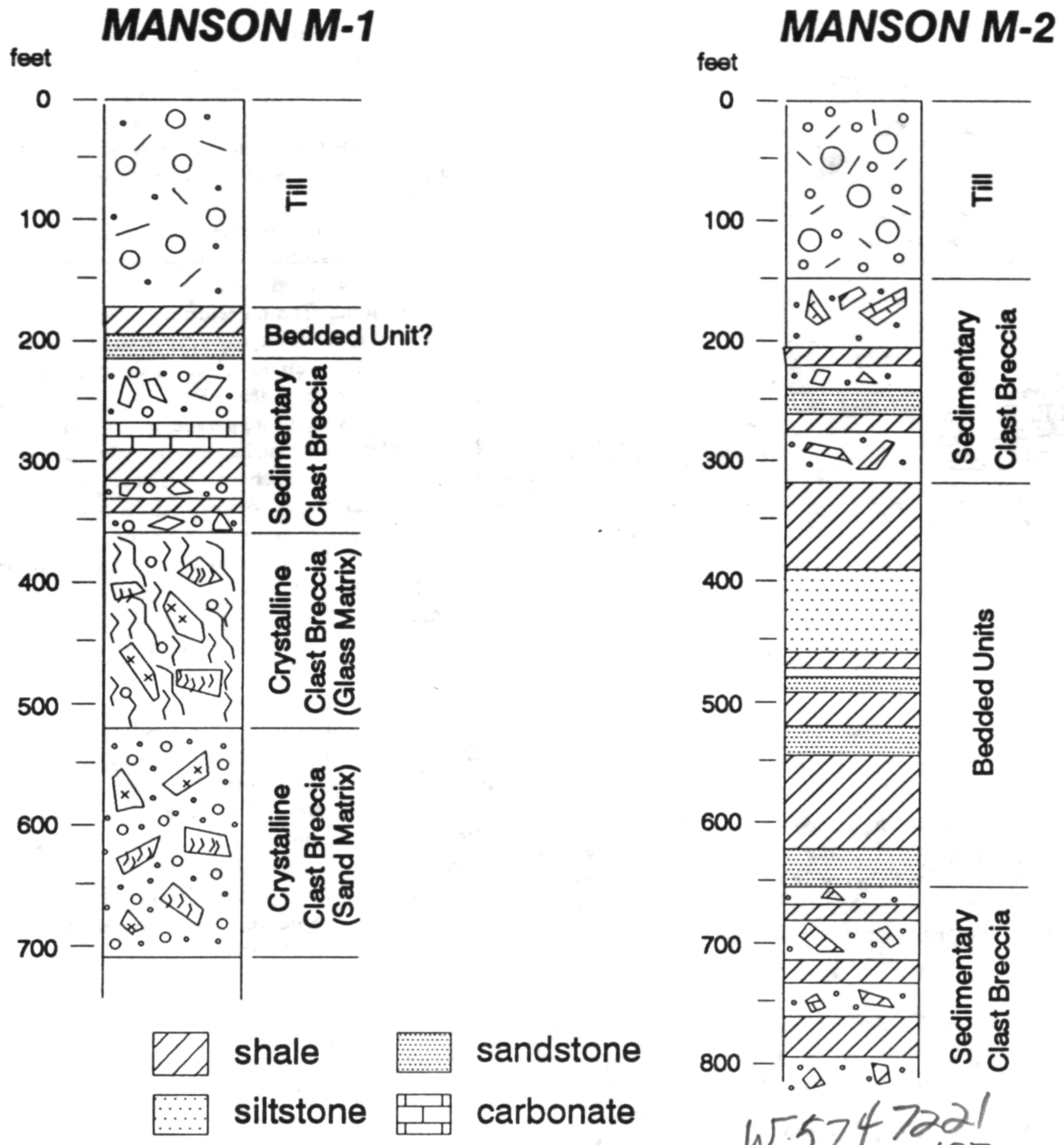

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Fig. 2. Generalized lithologic logs of the Manson M-1 and M-2 cores.

basal unit in the core was another sequence of sedimentary clast breccia, 51 m thick, and similar to the upper interval in the core. The two sedimentary clast units, like the lithologically similar unit in the M-1 core, probably formed as debris flows from the crater rim. The middle, nonbrecciated interval is probably a large, intact block of Upper Cretaceous strata transported from the crater rim with the debris flow. Alternatively, the sequence may represent the elusive postimpact lake sequence.

Additional drilling is planned for the late spring and summer of 1992. Targets include structurally preserved Upper Cretaceous strata on the Terrace Terrane, a zone of complete melting, and postimpact lake sediments in the Crater Moat.

Reference: [1] Kunk M. J. et al. (1989) *Science, 244,* 1565–1568.

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A QUASI-HERTZIAN STRESS FIELD FROM AN INTERNAL SOURCE: A POSSIBLE WORKING MODEL FOR THE VREDEFORT STRUCTURE. L. A. G. Antoine[1], W. U. Reimold[2], and W. P. Colliston[3], [1]Department of Geophysics, University of the Witwatersrand, Private Bag 3, Wits 2050, Johannesburg, South Africa, [2]Economic Research Unit at the Department of Geology, University of the Witwatersrand, Private Bag 3, Wits 2050, Johannesburg, South Africa, [3]Department of Geology, University of the Orange Free State, P.O. Box 339, Bloemfontein 9300, South Africa.

The Vredefort structure is a large domal feature approximately 110 km southeast of Johannesburg, South Africa, situated within and almost central to the large intracratonic Witwatersrand Basin.