

MANSON IMPACT STRUCTURE ROCKS: EVIDENCE FOR AN EXOTIC COMPONENT; J. Hartung¹, A. Kracher², R. Anderson¹, O. Plocher¹, ¹ Iowa Dept. of Natural Resources, Geological Survey Bureau, 123 N. Capitol St., Iowa City, IA 52242, ² Dept. of Geological and Atmospheric Sciences, Iowa State Univ., Ames, IA 50011

A single unusual clast was observed in breccia composed of mostly crystalline rocks at a depth of 669.5 feet (200 meters) in the Manson M-1 core, which is located about 3 km NNE of the inferred center of the structure. The clast (Figure 1) is contained in a polymict breccia, dominated by poorly sorted, angular fragments of crystalline rocks, probably derived mostly from granitic-syenitic-amphibolitic basement rocks from pre-impact depths ranging from about 1 km at the northwest to more than 4 km at the southeast edge of the structure. The clast has an irregular shape, similar to fladen (pancakes) which are abundant in Ries suevite deposits. It consists of a glassy interior which is almost completely surrounded by a 1-mm-thick layer of dark green glassy material, which is, in turn, covered by a white layer, also about 1 mm thick.

Defocussed beam microanalyses for major element abundances present along a transect were made at intervals of 100 micrometers with a beam diameter of 30 micrometers. Abundances measured are shown for each spot location in Figure 2.

The matrix material around the clast is characterized by quite variable SiO₂ (range between 40% and 60% of total) and remarkably constant Al₂O₃ (near 18%). Abundances of FeO, CaO, MgO, and usually TiO₂ vary directly with one another and inversely with SiO₂ and Na₂O abundances. These relationships suggest that the matrix was derived from a mixture of silicate minerals found normally in crystalline rocks. One exception to this general observation is that the concentration of TiO₂ reaches a maximum of about 3% of the total, about 1/2 the abundances of CaO. This abundance is anomalously larger in comparison with known TiO₂ values for crystalline rocks in Iowa.

The interior of the clast has a slightly higher average abundance of SiO₂ than does the matrix. Analyses yielding nearly 100% SiO₂ indicate the presence of quartz inclusions. The K₂O abundance is higher than Na₂O in the clast interior, and CaO is less abundant in the interior (around 3%) but TiO₂ abundance remains about 1/2 that of the CaO throughout the clast interior. The sources of the apparently anomalously high TiO₂ are not known, but are most likely related to TiO₂-bearing country rocks not recognized previously.

With the exception of CaO and TiO₂, which are quite variable with abundances ranging from 0 to 8% and 7% respectively, the inner, dark green zone is remarkably uniform: SiO₂ ~ 30%, FeO ~ 25%, MgO ~ 13%, Al₂O₃ ~ 18%. FeO and MgO are effectively segregated into the green mantle. Because surrounding materials are mostly granitic or feldspathic and have lower concentrations of FeO and MgO, and Fe and Mg are not considered mobile elements, it is most likely that this mantle is the product of alteration of the matrix or the glassy clast. These elements may have been derived from the impactor. The reproducibility of the measurements in this layer and its presence around the entire clast suggests that a large, well-mixed reservoir of material, perhaps in the gaseous state, existed and condensed onto the clast as it moved through this reservoir.

The white outer layer is also quite uniform and has a composition near that of albitic plagioclase, but in this case the composition is more likely that of an alkali-water-rich alteration product. The source of the Na₂O enrichment in this layer may have been

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salt-bearing fluids present in the breccia soon after the impact event.

In summary, a volume of Ti-rich feldspathic melt was produced by the Manson impact. A portion of this melt may have been bathed in a mafic gas, which condensed to form the anomalous green mantle on the object while it was above the ground surface. The still-molten object was incorporated into a large volume of breccia to become an exotic clast with a history which may have included acquiring a mantle composed partially of material once part of the K/T impactor. The white outer zone could be a product of hydrothermal alteration.

Figure 1. Photograph of glassy clast in matrix, Manson M-1 core, 669.5 ft. T = analytical traverse, M = matrix, W = white layer, G = green zone, CI = clast interior

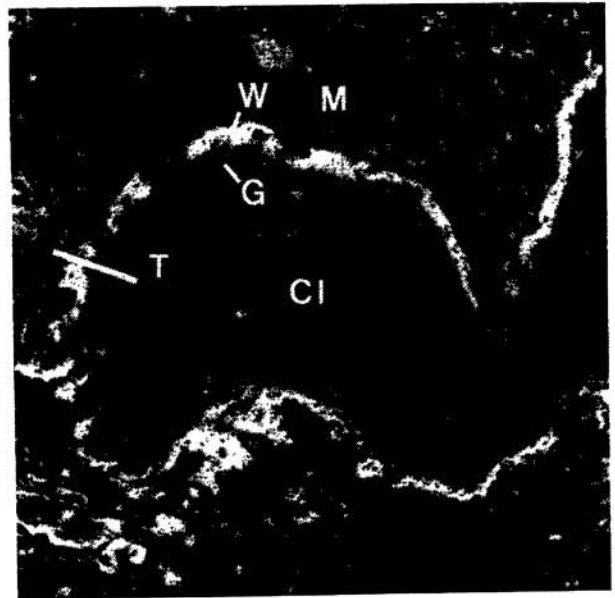
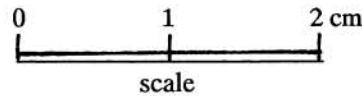


Figure 2. Results of microprobe transect of glassy clast from Manson M-1 core, 669.5 ft

