

Paleomagnetic constraints on the age of the Decaturville impact structure, southwest Missouri. S. A. Dulin¹ and R. D. Elmore¹, ¹University of Oklahoma, School of Geology and Geophysics, Norman, OK. Email: smyers@ou.edu.

Introduction: The Decaturville impact structure is a circular area 5.5km across and located ~15 miles south of Camdenton, Missouri. The presence of shock features delineates the structure as an impact. The date of the impact has been suggested as Pennsylvanian to Cretaceous [1]. There are two types of breccias associated with the impact within the Ordovician Jefferson City Dolomite (JCD) : a mixed breccia that is composed of clasts of different units and a monolithologic breccia that is intraformational. Paleomagnetic tests, such as a modified conglomerate test, can be performed on these breccias by sampling different clasts within the breccia and then comparing the magnetic directions of each clast. If the clasts hold different magnetizations, then the breccia was magnetized pre-depositionally—before (or during) impact. If the clasts have the same magnetization direction, they were remagnetized post-depositionally. If the remagnetization was caused by heat or impact-related fluids, then the age of the impact may be determined.

Methods: Samples of the breccias and the JCD were collected along State Highway 5, in the southeastern quadrant of the impact. Cores were collected in clasts of different lithologies and matrix within the mixed breccia, clasts of the monolithologic breccia, and the host JCD. Samples were also collected from the JCD outside of the impact structure along Interstate 44, north of Springfield. All samples were subjected to stepwise thermal demagnetization and rock magnetic studies to determine magnetic direction and magnetic carriers, respectively.

Results: At low demagnetization temperatures (<250°C) the mixed breccia clasts and matrix contain a Modern viscous magnetization. At higher temperatures (250-500°C) all samples contain a characteristic remanent magnetization (ChRM) with southeasterly declinations ($D = 155.6^\circ$) and shallow inclinations ($I = -9.2^\circ$). The ChRM is well grouped ($k = 42.9$ and $\alpha_{95} = 2.4^\circ$; $n = 16$ sites). The host JCD and clasts within the monolithologic breccia did not contain a stable magnetization. The ChRM corresponds to a pole position of 50°E , 127°N , which plots on the mid-Permian portion of the apparent polar wander path (APWP). Since all the magnetization directions within the clasts and matrix are the same, the rocks were magnetized post-impact. Therefore the Decaturville impact can be no older than the mid-Permian.

The JCD outside of the impact contains a ChRM ($D=151.7^\circ$, $I=3.1^\circ$, $k=1237$, $\alpha_{95}= 1.2^\circ$, $n = 12$ specimens). The preliminary pole lies close to the Pennsylvanian portion of the APWP, at 42.5°N , 127.4°E , and is distinct from the mixed breccia pole. This suggests a different ChRM is present in the dolomite outside the impact. More sampling is planned to test this result.

Rock Magnetism. The demagnetization characteristics suggest that the dominant magnetic carrier within the breccias is a low-coercivity phase, probably magnetite. The rock magnetic results are consistent with this interpretation. Petrographic analysis with the scanning electron microscope is planned to further identify the magnetic mineralogies that are present.

Geochemistry. Strontium isotopic analysis was also performed on representative samples. The $^{87}\text{Sr}/^{86}\text{Sr}$ values were compared to the coeval seawater values for the early Ordovician [2]. Most of the samples have coeval to depleted $^{87}\text{Sr}/^{86}\text{Sr}$ values, ruling out externally-derived radiogenic fluids as an alteration source.

Conclusions: The ChRM directions within the mixed breccia clasts and matrix are the same, indicating a post-depositional magnetization. The ChRM is mid-Permian which places a limit on the age of the impact. The impact can be no younger than the mid-Permian, regardless of the origin of the magnetization. The paleomagnetic and stratigraphic constraints, therefore, indicate that the impact occurred during the Pennsylvanian through the mid Permian which is much less than the Pennsylvanian-Cretaceous estimate by Offield and Pohn. The origin of the remagnetization mechanism is currently under investigation with two likely possibilities: heat remagnetization related to the impact or chemical remagnetization due to fluid flow, driven by the impact or a later event. If impact heat or impact related hydrothermal fluids caused remagnetization, the mid-Permian pole dates the impact. The lack of elevated strontium values rules out radiogenic fluids as an agent for the remagnetization. Conodont alteration analysis is underway to test if the breccia was hot at deposition, and if heat can explain the remagnetization.

References:

- [1] Offield T. W. and Pohn H. A. (1979) USGS Professional Paper 1042. [2] Gao G. and Land S. D. (1991) *Geochemica et Cosmochimica Acta*, 55, pp. 2921-2920.