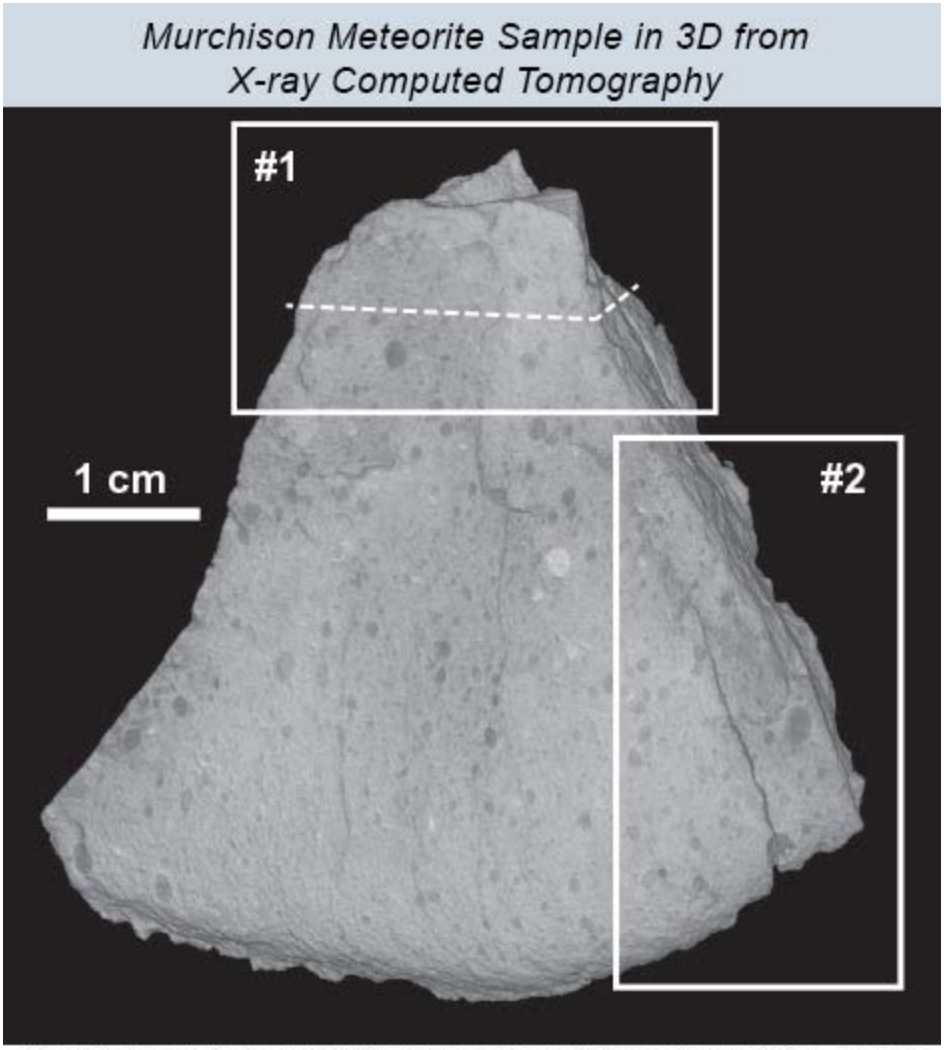
PLANETARY SCIENCE RESEARCH DISCOVERIES
CosmoSparks

Quick Views of Big Advances

Impacting the Properties of Asteroids

Researchers assess damaged and deformed ***chondrules*** in a meteorite to understand the impact-induced changes on chondrite parent bodies. A team has used a variety of laboratory techniques including X-ray computed tomography (XCT) to study and make 3D scans of three volumes of a 44-gram sample of the Murchison ***CM*** chondrite [***Data link*** from the Meteoritical Bulletin].



(From Hanna, R. D. *et al.*, 2015, *Geochimica et Cosmochimica Acta*, v. 171, p. 256-282, doi: 10.1016/j.gca.2015.09.005.)

This 3D volume rendering of a Murchison meteorite sample was obtained by Hanna and colleagues using X-ray computed tomography. They scanned the entire stone and two smaller volumes at high resolution, indicated by white boxes.

Led by Romy Hanna (University of Texas, Austin) with colleagues from UT Austin and NASA Johnson Space Center, the work delves into the micro textures, grain-scale fabrics, fractures, and alteration features in this meteorite that has a low shock stage classification of S1–S2. (See **PSRD** article ***Asteroid Heating: A Shocking View*** for a description of shock stages and microscopic views of shocked and unshocked minerals.) Hanna and

colleagues suggest the chondrules in the Murchison sample were deformed by brittle, rather than plastic, mechanisms and that the sample shows multiple episodes of fracturing and mineralization. Aqueous alteration occurred during or after deformation. The team used the data, including the no-longer-spherical shape of the chondrules, to investigate how much strain led to the impact-induced deformation. This information combined with the currently measured, average bulk porosity of Murchison (22.1%) allowed the team to estimate the original, bulk porosity of the Murchison parent asteroid as 32.2–53.4%. These laboratory analyses show how porosity loss and deformation from impact on a chondrite asteroid can be teased out from detailed, submillimeter-grain-scale studies in a meteorite whose minerals are only very weakly shocked. This information is crucial for ongoing and future asteroid explorations and improving our understanding of the evolution of the asteroid belt.

See Reference:
Hanna, R. D., Ketcham, R. A., Zolensky, M., and Behr, W. M. (2015) Impact-induced Brittle Deformation, Porosity Loss, and Aqueous Alteration in the Murchison CM Chondrite, *Geochimica et Cosmochimica Acta,* v. 171, p. 256-282, doi: 10.1016/j.gca.2015.09.005. [***abstract***] Online supplementary data (for *GCA* subscribers) include videos of the XCT 3D volume renderings of the Murchison sample.

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