

The Origins of Asteroidal Rock Disaggregation: Interplay of Thermal Fatigue and Microstructure

Kavan Hazeli, Charles El Mir, Stefanos Papanikolaou, Marco Delbo, K.T. Ramesh

PII: S0019-1035(17)30029-5
DOI: [10.1016/j.icarus.2017.12.035](https://doi.org/10.1016/j.icarus.2017.12.035)
Reference: YICAR 12755

To appear in: *Icarus*

Received date: 13 January 2017
Revised date: 11 December 2017
Accepted date: 22 December 2017

Please cite this article as: Kavan Hazeli, Charles El Mir, Stefanos Papanikolaou, Marco Delbo, K.T. Ramesh, The Origins of Asteroidal Rock Disaggregation: Interplay of Thermal Fatigue and Microstructure, *Icarus* (2017), doi: [10.1016/j.icarus.2017.12.035](https://doi.org/10.1016/j.icarus.2017.12.035)



This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

The Origins of Asteroidal Rock Disaggregation: Interplay of Thermal Fatigue and Microstructure

Kavan Hazeli^{a,b}, Charles El Mir^a, Stefanos Papanikolaou^{a,c}, Marco Delbo^d,
KT Ramesh^a

^a*Department of Mechanical Engineering, The Johns Hopkins University, 3400 N.
Charles St., Baltimore, MD 21218, USA*

^b*Mechanical and Aerospace Engineering Department, The University of Alabama in
Huntsville, 301 Sparkman Drive, Huntsville, AL 35899, USA*

^c*Mechanical and Aerospace Engineering Department, West Virginia University, WV
26506*

^d*Laboratoire Cassiopée, Observatoire de la Côte d'Azur, B.P. 4229, 06034 Nice Cedex 4,
France*

Abstract

The distributions of size and chemical composition in regolith on airless bodies provide clues to the evolution of the solar system. Recently, the regolith on asteroid (25143) Itokawa, visited by the JAXA Hayabusa spacecraft, was observed to contain millimeter to centimeter sized particles. Itokawa boulders commonly display well-rounded profiles and surface textures that appear inconsistent with mechanical fragmentation during meteorite impact; the rounded profiles have been hypothesized to arise from rolling and movement on the surface as a consequence of seismic shaking. This investigation provides a possible explanation of these observations by exploring the primary crack propagation mechanism during thermal fatigue of a chondrite. Herein, we present the evolution of the full-field strains on the surface as a function of temperature and microstructure, and examine the crack growth during thermal cycling. Our experimental results demonstrate that thermal-fatigue-driven fracture occurs under these conditions. The results suggest that the primary fatigue crack path preferentially follows the interfaces between monominerals, leaving the minerals themselves intact after fragmentation. These observations are explained through a microstructure-based finite element model that is quantitatively compared with our experimental results. These results on the interactions of thermal fatigue cracking with the microstructure may ultimately allow us to distinguish between thermally

Download English Version:

<https://daneshyari.com/en/article/8134454>

Download Persian Version:

<https://daneshyari.com/article/8134454>

[Daneshyari.com](https://daneshyari.com)