MICRO-RAMAN SPECTROSCOPY OF THE BARBERTON IMPACT SPHERULES FROM SOUTH AFRICA: AN APPLICATION TO THE IDENTIFICATION OF SHOCK METAMORPHISM. A. Gucsik [1,2,*], P. Futó[2], R. Szarvas[1], A. Nagy[1], D. Nagy[1], I. Simonia[3], J. Vanyó[1], Cs. Árpád[2], A. Rázsi[1], F. Kristály[4], M. Veres[5] [1]Research Group of the Planetary Sciences and Geodesy, Eszterházy Károly University, Eger, Hungary; [2]Cosmochemistry Research Group, University of Debrecen, Hungary; [3]Ilia State University, Tbilisi, Georgia; [4]Department of Mineralogy and Geology, Miskolc University, Miskolc, Hungary; [5]Wigner Research Center of Physics, Hungarian Academy of Sciences, Budapest, Hungary ([*]E-mail:sopronianglicus@gmail.com)

Introduction: Barberton Impact Spherule (South Africa) layers are the oldest impact cratering records (3.4 Ga) on Earth. Their impact origin was identified by the spherule and spinel compositions, Ir anomalies as well as Cr isotope ratio. These observations suggest the extraterrestrial origin of the spherules, especially highlighting the carbonaceous chondritic projectile [1]. However, these authors were not able to provide contribution to the shock metamorphism, which is still a matter of discussion. The purpose of this study is to provide structural data of the spherules by means of Raman spectroscopy, which can aid to understand more about the formation mechanism of the spherules.

Experimental Procedure and Samples: *Micro-Raman Spectroscopy:* A WITec alpha300R confocal laser Raman microscope (at the Department of Geology, University of Johannesburg) was used to perform in-situ Raman analyses of the impact spherule layers with the following operating conditions. Raman spectral measurements were done using a non-polarized laser source such as a monochromatic, frequency doubled Nd:YAG (532 nm, Ar-ion) with the spectral range of the spectrometer 100-4100 cm^{-1}. Grating type 600 gratings/mm was used for the spectral range up to 4100 cm^{-1}, whereas 1800 gratings/mm for the spectral range up to 1300 cm^{-1}. Raman spectra were collected by Nikon objectives using 20 X and 100 X magnification. Beam centering and Raman spectra calibration were performed daily before spectral acquisition using a Si standard (111). The laser power was set at approximately 10 mW. Accumulation was 3 and intervals were 15 sec. Raman maps of portions of crystals have been obtained by collecting consecutive spectra at 1 – 2 μm spacing.

Samples: An impact spherule layer (approximately 20 cm long and was selected from the S2 sampling site from the contact of a banded chert and sandstone in the Fig Tree Group of the central part of the Barberton Greenstone Belt, South Africa.

Results and Discussion: A representative single Raman spectrum of a Barbertone Impact Spherules shows five spectral features, which are centered at 143 (vs-very strong), 200 (vw-very weak), 398 (m-medium), 521 (w-weak) and 645 cm^{-1} (m-medium). The 2D Raman imaging exhibits a distribution of the 645 cm^{-1} peak within the selected Raman analyzing area. Broad peaks with relatively low peak intensities as well as high background fluorescence indicate a highly disordered structure, which is similar to the impact-derived glasses and their Raman properties. This suggests that the crystalline structure was affected by the high shock pressure regime (over 50 GPa) causing short-range ordering/amorphization in the structure of the spherules, which was controlled by post-shock temperature, as well [2]. These observations above confirm a possible impact plume evolution of the Barberton impact spherules [3].

Conclusion: This preliminary study clearly demonstrates that Micro-Raman spectroscopy is a powerful, easy-to-use, and non-destructive technique to study structural properties of the Barberton impact spherules. Further systematic studies using cathodoluminescence spectroscopy, scanning electron microscope (SEM), X-ray diffraction (XRD) and transmission electron microscope (TEM) observation will be done on the selected samples in order to determine shock wave history of the samples above.

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