IDENTIFICATION OF REIDITE FROM THE RIES IMPACT CRATER USING MICRO-RAMAN SPECTROSCOPY: A REVIEW

A. Gucsik. University of West Hungary, Bajcsy-Zs. u. 4., Sopron, Hungary. E-mail: ciklamensopron@yahoo.com

Introduction: The phase transformation from the zircon crystal structure (ZrSiO₄) to a scheelite (CaWO₄)-structure phase (reidite) was described in shock-metamorphosed zircon by Kusaba et al. [1] to begin at about 30 GPa and to be complete at around 53 GPa. These observations were confirmed by Leroux et al. [2] through their TEM investigations of experimentally shocked zircon. More recently, according to Scott et al. [3] the high-pressure x-ray data show that a small amount of residual zircon-structured material remained at 39.5 GPa. Glass et al. [4] found the scheelite-type phase in zircon samples from marine sediments from an upper Eocene impact ejecta layer sampled near New Jersey and Barbados. They named this mineral phase ‘reidite’ after Alan F. Reid, who first produced this high shock-pressure polymorph of zircon [4]. The purpose of this investigation is to further investigate the capability of the Raman spectroscopy to document shock deformation and to determine whether specific Raman effects in zircon/scheelite-structure can be utilised to determine particular shock pressure stages.

Experimental Procedure: Raman spectra were obtained on shocked single zircon grains from the Ries impact structure with a Renishaw RM1000 confocal micro-Raman spectrometer with a 20 mW, 632 nm He-Ne laser excitation system and a thermoelectrically cooled CCD detector. The power of laser beam on sample was approximately 3 mW. Spectra were obtained in the range 100-1200 cm⁻¹ with approximately thirty seconds total exposure time. The spectral resolution (apparatus function) was 4 cm⁻¹.

Results and Discussion: The Raman spectra of the naturally shock-deformed zircon samples from the Ries Crater (Stage-II: 35-45 GPa, Stage-III: 45-50 GPa, Stage-IV: >50 GPa) cut parallel and perpendicular to their crystallographic c-axis do not exhibit significant differences from each other. Stage-II samples are characterized by five peaks at 224, 356, 439, 974 and 1007 cm⁻¹. Addition Raman spectrum of the Stage-III (45-50 GPa) sample (parallel) shows eleven peaks at 202, 224, 327, 356, 404, 439, 465, 558, 845, 974 and 1007 cm⁻¹, which indicate the presence of the scheelite-type phase among predominant zircon-type material. In general, the fluorescence background in the parallel-sample is considerably higher than in the perpendicular-sample. In both cases, the peak intensities are similar. The spectra of the Stage-IV samples (parallel- and perpendicular-samples) are characterized by seven peaks at 202, 215, 225, 356, 439, 974 and 1007 cm⁻¹.

Conclusion: Raman spectroscopy is a potentially useful tool that can be used to characterize the shock stages of zircon from impactites. These results also give new insight into the structural changes that occur in zircons during shock metamorphism, and the pressures associated with these changes.

Acknowledgement: This work has been partly supported by Hungarian Space Office (TP-293)