Impacts onto the Early Earth: Archean Spherule Layers from the ICDP drill core BARB5.

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Introduction: An ICDP drilling campaign in 2012 recovered marine meta-sedimentary sections from the "Barberton Mountain Land". These meta-sediments contain Archean spherule layers considered to represent the oldest known traces of impact cratering events on Earth [1,2]. Until now, three to four (S1-S3; possibly S4) impact event layers (maybe more [3]) have been reported from 3.5 to 3.2 Gyr old sedimentary sections. Considering that during this time the Moon, and by implication the Earth, experienced a substantially higher impact flux than today [4], these Archean spherule layers are unique samples for studying the type of projectiles involved in the late stages of the Heavy Bombardment Eon on Earth [5].

Methods and overview: A 2 meter core section of the ICDP BARB 5 drill core hosting 5 spherule layer occurrences (Mohr-Westheide et al., this meeting; Hoehnel et al., this meeting) is investigated in a consortium study. Non-invasive and high spatial resolution (~25 µm spot size) micro-XRF element mapping of the up to 20 cm long quarter-core sections were conducted. After that the samples were prepared for further investigations using SEM, EMPA, Raman spectroscopy, LA-ICP-MS, and INNA analysis. The detailed petrographic and geochemical characterization of the samples aims on discriminating between the impact related primary characteristics and the secondary characteristics that developed during (re)deposition, diagenesis, tectonic displacement, and metamorphism [3,6]. Differences in the occurrence of "primary characteristics" such as the presence of Ni-rich chromite, target-derived zircons, and platinum group element carriers in some but not all of the four closely associated spherule layers raises questions whether any of these occurrences in one layer can be considered diagnostic for a specific event or rather depends on modifications after (re)emplacement of the impact ejecta. Enrichments in volatile siderophile elements (Ge, Ga) are identified in the spherule layers (> 4.3 ppm Ge, 24ppm Ga) compared to the shale layers (2.55 ppm Ge, 9,5ppm Ga). Future work will target possible isotope fractionation processes during the impact event. The five spherule-bearing horizons in the BARB-5 drill core present a complex succession including "primary" characteristics and "secondary" modification of these deposits.

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