PETROGRAPHIC AND MICRO-XRF ANALYSIS OF ARCHEAN IMPACT-DERIVED SPHERULE LAYER IN DRILL CORES FROM FAIRVIEW MINE, NORTHERN BARBERTON GREENSTONE BELT (SOUTH AFRICA).

G. J. G. de Oliveira[1,4], R. Tagle[2], T. Mohr-Westheide[3,4], A. P. Crósta[1], W. U. Reimold[5], N. Hauser[5], D. Hoehnel[6] and D. Galante[7]. [1]Institute of Geosciences, University of Campinas, Brazil. [2]Bruker Nano GmbH, Berlin, Germany. [3]Institute of Geosciences, Free University Berlin, Germany. [4]Museum für Naturkunde Berlin, Germany. [5]Institute of Geosciences, University of Brasília, Brazil. [6]Kiwa GmbH, Berlin, Germany. [7]Brazilian Center for Research in Energy and Materials (LNLS/CNPEM), Brazil. Corresponding author: gracejuliana.oliveira@gmail.com

Introduction: Over more than three decades of investigation, a number of Archean spherule-rich or-bearing layers (SLs) have been described from all parts of the Barberton Greenstone Belt (BGB), and their impact or terrestrial origin has been strongly debated [e.g., 1,2]. These SLs contain sand-sized spherical particles that have been interpreted as the product of molten ejecta from impact structures, or condensation products from high-temperature rock-vapor plumes formed as a result of large cosmic impacts. They provide the only known evidence of large impact events on the early Earth. Recently, four mineral exploration drill cores (labelled 5901, 5907, 5911 and 5949) with SL intersections from Fairview Gold Mine (FV; 25°43'53"S/31°5'59"E) were made available for research. This offers a new opportunity to gain insight into meteorite bombardment of the early Earth. Stratigraphic, sedimentary, petrographic and geochemical characteristics of these new FV SL occurrences will be used to try to correlate them with SLs that have been previously described from the BGB.

Methods: Detailed evaluation of the geological context, which includes the determination of the adjacent host rock lithologies and the characterization of the respective interbedded SLs, was done for all FV drill core intervals. Transmitted and reflected light microscopy were used to characterize of the mineralogy, texture, morphology, size and abundance of the spherules, and the structural-textural character of the respective host rocks, as well as the deformation and the secondary overprint on all intervals studied. In addition, non-invasive, spatially resolved µXRF spectrometry scans were generated for all four drill core intervals.

Results and discussion: The FV SL intersections occur associated with banded black chert and/or volcanic tuffs within the uppermost unit of the Onverwacht Group, superposed by greywacke of the lowermost unit of the Fig Tree Group. The SLs, thus, are confidently placed at the contact between these groups. The shapes of the spherules range from spherical to ovoid. Spherules show the remains of thin dark rims and, in part, have complex forms due to deformation. They have bimodal size distributions, with large droplets $\geq$ 2 mm and small ones $\leq$ 1 mm, are densely packed, and commonly replaced by microcrystalline quartz and phyllosilicate minerals that also constitute the fine-grained groundmass between spherules. The main textures of spherule interiors are cryptocrystalline, fibroradial and porphyritic. With increasing depth, spherule deformation (flattening, stretching, and cracking) becomes more prominent. The most striking feature is the spatial distribution of major elements. Most undeformed spherules are composed of high SiO_2, versus generally low Al_2O_3 and K_2O abundances. This inverse relationship is observed in the groundmass and in the filling of the highly-deformed spherules. It reflects the pervasive secondary alteration and transformation into potassium-aluminum-rich phyllosilicates. Subordinate spherules, mostly in the smaller size fraction, are filled with light-green phyllosilicate. Some spherules are associated with spinel that exhibits octahedral or skeletal crystal habits, cavities, and corroded forms, similar to those previously described and classified by [3]. These unusual habits are typically formed in high-temperature melts. Both the spherules filled with light-green phyllosilicate and the spinels are spatially correlated with significant Cr and V, as well Ni and As, as determined by micro-XRF analysis. These are the sites to search for possible presence of remains of extraterrestrial components.

Conclusions: Our preliminary findings indicate that these four new SL intersections may be correlated with any of the three previously described SLs, known as S2, S3 and S4, at the contact between Onverwacht and Fig Tree groups. Maybe these S2-4 layers represent the same layer. At the conference, we will discuss the semi-quantitative geochemical findings from micro-XRF against quantitative INAA results.

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