EARLY ARCHEAN SPHERULE BEDS OF POSSIBLE IMPACT ORIGIN FROM BARBERTON, SOUTH AFRICA: A DETAILED MINERALOGICAL AND GEOCHEMICAL STUDY. Christian Koeberl1, Wolf Uwe Reimold2, and Rudolf H. Boer3, 1Institute of Geochemistry, University of Vienna, Dr.-Karl-Lueger-Ring 1, A-1010 Vienna, Austria, 2Economic Geology Research Unit, University of the Witwatersrand, P.O. Wits, Johannesburg 2050, South Africa.

The Barberton Greenstone belt is a 3.5- to 3.2-Ga-old formation situated in the Swaziland Supergroup near Barberton, northeast Transvaal, South Africa. The belt includes a lower, predominantly volcanic sequence, and an upper sedimentary sequence (e.g., the Fig Tree Group). Within this upper sedimentary sequence, Lowe and Byerly [1] identified a series of different beds of spherules with diameters of around 0.5-2 mm. Lowe and Byerly [1] and Lowe et al. [2] have interpreted these spherules to be condensates of rock vapor produced by large meteorite impacts in the early Archean. This interesting hypothesis is based mainly on the structure of the spherules, which is reported to be similar to quench structures, and on the discovery of Ir anomalies of up to several hundred ppb in some of the spherule beds [2]. Although Lowe et al. [2] reported the abundances of the platinum group elements (PGEs) to be of roughly chordritic proportions, a more detailed study by Kyte et al. [3] showed that the PGEs are fractionated relative to the chordritic abundances. They interpreted this to be due to later hydrothermal alterations.

The study of impacts early in the history of the Earth is of great importance and interest; we feel that therefore a more detailed investigation of the Barberton spherule beds is warranted, especially because no detailed mineralogical study of the spherules (and of all secondary mineralizations such as abundant sulfide mineralization) and no detailed geochemical stratigraphy (including, e.g., the rare earth elements) is available so far. The host phase of the Ir (and PGE) anomaly is also unknown.

We have collected a series of samples from drill cores from the Mt. Morgan and Princeton sections near Barberton, as well as samples taken from underground exposures in the Sheba and Agnes mines. These samples seem much better preserved than the surface samples described by Lowe and Byerly [1] and Lowe et al. [2]. Over a scale of just under 30 cm, several well-defined spherule beds are visible, interspersed with shales and/or layers of banded iron formation. Some spherules have clearly been deposited on top of a sedimentary unit because the shale layer shows indentations from the overlying spherules. Although fresher than the surface samples (e.g., spherule bed S-2), there is abundant evidence for extensive alteration, presumably by hydrothermal processes. In some sections of the cores sulfide mineralization is common.

For our mineralogical and petrographical studies we have prepared detailed thin sections of all core and underground samples (as well as some surface samples from the S-2 layer for comparison). For geochemical work, layers with thicknesses in the order of 1-5 mm were separated from selected core and underground samples. The chemical analyses are being performed using neutron activation analysis in order to obtain data for about 35 trace elements in each sample. Major elements are being determined by XRF and plasma spectrometry. To clarify the history of the sulfide mineralization, sulfur isotopic compositions are being determined. We hope to be able to identify the host phase of the platinum metal anomaly by separating spherules and matrix. At the time of the conference we will report on the first geochemical and mineralogical results and their bearing on the impact hypothesis.

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Fig. 1. U-Pb data for single zircons from the K-T boundary fireball Layer, Raton Basin, Colorado.