VREDEFORT PSEUDOTACHYLITIC BRECCIAS AND VREDEFORT GRANOPHYRE: CHEMISTRY AND ISOTOPE CHEMISTRY FAVOR FORMATION OF PTB SANS VG-LIKE COMPONENT. W.U. Reimold[1,2], T. Mohr-Westheide[1], M. Thirlwall[3], and L. Fischer[1] , [1]Museum für Naturkunde, Invalidenstrasse 43, 10115 Berlin, Germany (uwe.reimold@mfn-berlin.de), [2]Humboldt-Universität zu Berlin, Unter den Linden 6, 10099 Berlin, Germany, [3] Department of Earth Sciences, Royal Holloway University of London, Egham, Surrey TW20 0EX, UK (m.thirlwall@gl.rhul.ac.uk).

Introduction: For years the generation of pseudotachylitic breccias (PTB) in impact structures has been controversial [1]. Variably, shock compression melting, decompression melting, friction melting, and combination of these processes were proposed for in situ melt generation. In contrast, a few have favored that PTB represent impact melt generated elsewhere and was intruded into the crater floor upon mixing with local material. Regarding Vredefort, they promoted ([e.g., 2] that impact melt (Vredefort Granophyre, VG) had intruded from the coherent melt sheet into the crater floor and mixed with local material.

Method: We have reevaluated the chemical data base for Vredefort PTB and amended it with additional major and trace element data (e.g., a further full suite of PTB and country rocks from Otavi Hill). We also discuss Rb-Sr, Sm-Nd, and U-Pb isotopic data for PTB from three major occurrences in Vredefort quarries, plus their host rocks, and for comparison VG and epidiorite samples. Also, a μ-X-ray fluorescence spectrometer (M6 Jetstream, Bruker) was used for comparison of chemical compositions of PTB and host granite in a 71 x 52 cm slab from Leeukop Hill. The instrument allows non-invasive element distribution analysis of large samples with relatively high spatial resolution of several 100 μm [4]. Finally, a previously used [3] site (188, Kopjeskraal Farm) with a wide VG dike was resampled for a complete cross-section (host granite-Granophyre dike-epidiorite). Samples were analysed by XRF for major and trace elements and these data are used to evaluate the claim that two generations (a felsic and a mafic one) of impact melt were present [3].

Results: (1) Major and trace element data for host rock-PTB pairs emphasize the significant comparability of the respective analyses. This pertains to bulk rock analysis as well as PTB groundmass microanalysis and clast population studies. Mixing calculations for the varied components of host rock at Otavi and Kudu confirm the conclusion that PTB compositions do NOT require an exotic, allochthonous component. (2) Major and trace element results [5] of < 0.5 cm PTB in mafic host rocks revealed, overall, good agreement between PTB composition (EMPA defocused beam analysis and host rock composition from XRF). Notable deviations can be explained by preferential melting of either plagioclase or hydrous ferromagnesian minerals at different proportions. (3) The isotopic results demonstrate that PTB and their host rocks have significantly different isotopic systematics from that of VG [6]. PTB and respective host rocks from different locations yielded different isotopic results for each locale. This further supports the chemical results that PTB melt was formed from local reservoirs (the respective host rocks), which are different from the reservoir of impact melt (mixture of the full crustal sequence affected by the impact). With respect to the ε_{Nd} values calculated for an age of 3.15 Ga, the approximate age for the Archean granitoids that represent the host rock to PTB and the major precursor component of VG, a significant variation between granitoid-hosted PTB and Granophyre is observed. (4) The μ-XRF derived element distribution maps of the complete slab of PTB and granitic host rock show very similar chemical compositions for the granitic host rock and the melt breccia. The two lithologies can be readily distinguished by their spectrographic "textures": Element distribution maps show medium-grained granite composed of individual mineral grains, whereas melt rock is characterized by a fine-grained matrix around host rock relics. Integration of count rates for several decimeter-sized areas in the host rock and the melt breccia, respectively, results in almost identical spectra for major and trace element abundances. (5) Finally, chemical, petrographic and microchemical analysis of the Kopjeskraal profile samples demonstrate that there is no so-called mafic VG phase. Epidiorite clasts are mixed into impact melt rock of normal composition, and clasts are partially assimilated into VG melt.

Discussion: Results support that PTB formed without admixture of an exotic component from local host lithology(ies) only, and that melt is derived from preferred melting of hydrous ferromagnesian minerals. A single Granophyre variety occurs at Kopjeskraal and presumably elsewhere on the Vredefort Dome.

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