ENIGMATIC TUBULAR TEXTURES HOSTED IN IMPACT GLASSES FROM THE RIES IMPACT STRUCTURE, GERMANY. H. M. Sapers 1,*, G. R. Osinski 2, and N. R. Banerjee 3. 1Centre for Planetary Science and Exploration & Dept. of Earth Sciences, University of Western Ontario, London, ON, N6A 5B7, Canada. *E-mail: hsapers@uwo.ca.

Introduction: Impact cratering is a ubiquitous geological process on solid planetary bodies. Any hypervelocity impact into a H2O-rich target has the potential to generate hydrothermal systems [1]. Recent research suggests that such impact-induced environments may be conducive to microbial colonization [e.g., 2]. In volcanic environments, bioliteration of basaltic glasses produces characteristic tubular and granular aggregate textures [e.g., 3, 4]. Such bioliteration textures preserved in Archean greenstone belts constitute one of the oldest records of life on Earth [5]. Our examination of glasses from the Ries impact structure, Germany, revealed tubular textures with remarkably similar morphologies to textures observed in volcanic glasses.

Here we present preliminary data characterizing the putative bioliteration structures hosted within the Ries impact glasses.

The Ries impact structure: The 14.3 ± 0.2 Ma [6] Ries impact structure, southern Germany, was formed in a two-layer target comprised of Mesozoic flat lying siliciclastic and carbonate sedimentary rocks that unconformably overlie crystalline Hercynian basement [7]. Ries is a complex crater with a diameter of ~24 km [7]. Impactite (crater-fill and ejecta deposits) are well preserved: surficial “suevite” comprises one of four main proximal ejecta deposits [8].

The surficial “suevites” (impact melt-bearing breccias) are divided into two distinct lithological units: 1) the dominant main suevite that represents a clast-rich particulate impact melt rock or impact melt-breccia [8, 9]; 2) subordinate basal suevite [10]. Four main glass types occur within the main suevite both as groundmass phases and as discrete glass clasts [11]. Glass clasts are typically vesiculated, schlieren-rich mixtures containing abundant mineral and lithic fragments [8]. The glass clasts hosted within the suevite have been classified based on composition and microtextures [11]. Type I glasses are the most abundant in the Ries suevites, contain Al-rich pyroxene quench crystallites and have average SiO2 contents ~63%, and contain the highest concentrations of FeO and MgO of all 4 glass types [11]. Type II glasses have a similar SiO2 content as type I; however, they contain only plagioclase crystallites as well as a generation of dense, micron-scale vesicles. Type III glasses have low SiO2 contents, are hydrated relative to the other glasses, and contain relatively little FeO, MgO, and K2O, while having high Al2O3, CaO, and Na2O contents. Type IV glasses have very high SiO2 contents commonly >90%.

Enigmatic tubular textures: Tubular textures have only been observed in type I and II Ries glasses and can be organized into 3 classes based on morphology and distribution. Class A tubules are commonly observed in both type I and II glasses, are either randomly distributed or concentrated around glass rims or vesicles, and have a relatively simple morphology with few complex curves. Class B tubules are observed only in type I glass, are concentrated along fractures or clast margins, form radiating aggregates, and have complex morphologies including spirals, and other complex curvatures. Class C tubules are observed only in one sample of type I glass. Class C tubules have significantly larger length to width ratios than other tubule classes and form straight, linear features in the glass.

Class B tubules display various complex morphologies. Approximately two-thirds do not display distinct segmentation. These smooth-walled tubules typically display complex curvatures forming a morphological continuum between loose undulating curves and spirochete morphology. Curvature appears random, non-oriented and specific to individual tubules. Non-segmented tubules have diameters ~1um and commonly have length to width ratios >5. Approximately a third of class B tubules are clearly segmented. Segmented tubules typically display less curvature than non-segmented tubules. Individual segments have length to width ratios approximately 1:2. Segmented tubules vary in diameter from ~1um to approaching 3um. Rare segmented tubules with large (~3um) diameters have segments with length to width ratios approaching 1:6. Additional metrics describing tubule morphology may allow for specific subclassification of class B tubules.

Class A tubules are likely the optical expression of vesicle generation within the type I and II glass clasts comprising the ‘hair-like’ structures described by [11]. Type C tubules may represent quench crystallites; although the curved morphology is unusual. The complex morphologies of type B tubules, however, lack a parsimonious abiotic or mineralogical explanation and are reminiscent of microbial alteration textures observed in submarine basaltic glasses [4].