ONAPING FORMATION, RIES SUEVITE AND MELT-FUEL-COOLANT-INTERACTION (MFCI). R. A. F. Grieve[1], G. R. Osinski [1,2], and A. Chanou[1], [1]Department of Earth Sciences/Centre for Planetary Exploration, University of Western Ontario (rgrieve@nrcan.gc.ca), [2]Department of Physics and Astronomy, University of Western Ontario, 1151 Richmond Street, London, ON, N6A 5B7, Canada.

Introduction: Recently, it was concluded that the ~ 1.5 km thick Onaping Formation, which overlies the Sudbury Igneous Complex (SIC), at the Sudbury impact structure did not conform to the characteristics of "suevite" – an impact melt-bearing breccia first defined at the Ries impact structure, Germany. An alternative working hypothesis for the origin of the Onaping was developed. Namely, it formed through an extended and changing series of MFCI explosions, resulting from the violent interaction of seawater with the still molten impact melt sheet (what was to become the SIC) at Sudbury [1]. Most recently, MFCI has also been offered as the process forming suevite at the Ries impact structure and, by extension "suevite" breccias in a number of other terrestrial impact structures [2, 3]. Here, we review some of the basic characteristics of the Onaping Formation (OF) and the Ries suevite (RS) to assess whether both are likely to have been produced by the same post-impact process of MFCI.

Comparison of Basic Characteristics:

Stratigraphy. The OF lies above the SIC and is internally layered, with different lithologies. Currently, it is subdivided into: Basal Onaping Intrusion, Garson (see, however, [4]), Sandcherry and Dowling members [5], which form a lithological sequence, which, in general, can be traced around the entire Sudbury basin [1, 5]. Previous mapping of the OF also indicated distinct lithological units; although, the terminology differed somewhat. Contacts tend to be gradational between OF members and clasts of Sandcherry occur in the lower Dowling. Internal "breccia in breccia" textures also occur within the Sandcherry and Dowling.

The RS is not known to lie above an impact melt sheet. Although there are variants of the RS, they are determined less by distinct lithological and stratigraphic differences but more by geologic context, e.g., "crater suevite" in the central basin and "outer suevite" overlying Bunte breccia ejecta [2, 3].

Internal structures. While initially appearing chaotic, the OF is generally bedded and graded, becoming finer with stratigraphic height [5, 6]. Graded bedding becomes more pronounced towards the top of the OF. Within individual members of the, OF there are identifiable variants, such as the "Equant Shard" and Fluvial" variants within the Sandcherry member [5].

The RS is generally regarded as being non-sorted, with only isolated local internal structure. There is, however, a 17 m thick "graded suevite", within the crater suevite, which has been, most recently, attributed to reworking and water deposition [2, 3].

Shock metamorphism. Although it was the discovery of PDFs in quartz in grantoid clasts in the OF that was the original basis for designating the OF as a "suevite" [7], shock effects are relatively rare in the OF. Peredery [8] noted that 90% of the lithic clasts in the OF were unshocked. To date, shock effects in mineral clasts in the OF has never been documented [1, D. Ames, pers. comm., 2009]. In contrast, only 10% of the lithic clasts in the (outer) RS are unshocked [9]. Although the lithic clasts in the crater RS appear to record somewhat lower grades of shock [2], shock effects are also present in mineral clasts in the RS.

"Melt" clasts. Technically, there are no "melt" clasts in the OF, as they are completely devitrified. The "vitric" clasts in any particular sample, however, tend to have similar shapes (which vary between lithologies) and sizes [1, 5]. They also do not contain lithic or mineral clasts.

In contrast, the melt clasts in the RS have "a wide range of sizes, shapes, and textures" [2]. In some cases in the (outer) RS, they have preferred orientations, indicative of lateral flow [10]. In addition, the melt clasts in the RS contain relatively abundant mineral and lithic clasts, often displaying shock effects.

There is also a major difference in the geochemical variation between individual "melt" particles in the OF compared to the RS [5, 2], although hydrothermal alteration is a complicating factor in the OF [5].

Concluding remarks: Different petrography implies different petrogenesis. Given the major differences in the basic characteristics of the OF and RS, it is difficult to reconcile that they had the same origin through a MFCI process. Either the interpretation of the MFCI origin of the OF or the RS is incorrect or, perhaps, both are incorrect and other process(es) are responsible. Clearly, further work and discussion is needed.

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