A PETROGRAPHIC ANALYSIS OF PYROCLASTIC ROCKS FROM LAKE TAUPO, NEW ZEALAND AND IMPACTITES FROM THE POPIGAI IMPACT CRATER IN SIBERIA, RUSSIA. J. R. Graff[1,2] and G. R. Osinski[1,2], [1]Department of Earth Sciences, University of Western Ontario, London, ON, Canada (Jgraff2@uwo.ca), [2]Institute for Earth and Space Exploration, University of Western Ontario, London, ON, Canada.

Introduction: The products created by both pyroclastic and impact processes can often appear morphologically very similar, often producing heterogeneous rock formations interspersed with glass, fractured rock fragments, and mineral clasts produced by either eruptions of ash or lava (volcanic origin) [1, 2] or from the impact of asteroids or comets with planetary crusts (impact origin) [3].

The nomenclature used to identify impactites is complicated and confusing due to the use of locale-specific names being used to classify other impactites with similar characteristics, but which are found in different regions from different events. A common occurrence of this is the term 'suevite', which was originally characterized at the Ries impact site in Germany. 'Suevites' are descriptively named 'impact melt-bearing breccias' [3-5], defined as "polymict breccias with a particulate matrix, containing lithic and mineral clasts in all stages of shock metamorphism, including melt particles [4, 6].

Here we aim to assess the potential similarities in texture and mineralogy between pyroclastic ash flow tuffs and shocked impactite rocks by using thin section samples obtained from Lake Taupo and Popigai crater. In the larger scope, this study aims to lay the groundwork for revisiting the classification and nomenclature used to describe and name various types of impactite rocks.

Lake Taupo contains some of the world's most active rhyolitic calderas where violent ultraplinian eruptions have produced extensive units of ash flow deposits from pyroclastic flows [4, 7-9]. The Popigai crater lies within the Anabar Shield and was formed ~35.7 Ma [10]. The pre-impact geology consists of a mix of Precambrain gneisses, Proterozoic sandstones and carbonates, and Quaternary alluvial and glacial deposits [10, 11].

Petrography: This study examines a total of 24 rock samples (12 each from Lake Taupo and Popigai crater) via thin section petrography, conducted at Western. The volcanic samples (*Figure 1*) represent a range of pyroclastic to molten-fuel-coolant interaction (MFCI) deposits and are predominantly comprised of very fine to medium grained ash-sized (< 2 mm) tephra and are often poor to moderately sorted. Some samples exhibit small degrees of flow-like textures within the glassy matrix (NZ-1004B, 1007, and 1008), though the majority are unwelded. The dominant mineralogy is quartz, potassium feldspar (orthoclase), plagioclase (albite), biotite, amphibole (hornblende and tremolite), lithic fragments, and volcanic glass, in addition to trace muscovite, olivine, and epidote observed in a few samples (NZ-1006B, 1007, 1008, and 1010). Nearly half of the samples (NZ-1006A, 1006B, 1007, 1008, and 1010) show signs of iron oxidation, likely a result of hydrothermal alteration, which has persisted throughout the Lake Taupo region [8]. Sample NZ-1010 is an interesting outlier among the pyroclastic rocks, exhibiting the highest degree of hydrothermal alteration, moderate to well sorting and a layered texture indicative of a multi-stage deposition [1, 2]. The other 11 samples display no observed evidence of bedding or layering at the thin section level.

The Popigai impactites (*Figure 2*) exhibit a greater degree of variance in overall texture, but many similarities, notably among mineralogy, grain size, and sorting has been observed. The primary mineralogy observed is varying degrees of quartz, feldspar, biotite, amphibole, lithic fragments, and impact melt, with lesser amounts of pyroxene, olivine, and epidote. Two of the samples (POP-BO-26 and 27) are interesting outliers that seem to be predominantly comprised of a less variable, uniform grain size of shocked calcite, dolomite, and quartz – likely a result of being obtained from the region of Popigai crater that experienced impact into quartzite, dolomite, and limestone target rock [11]. POP-BO-21 is the only sample observed to contain diaplectic glass within its matrix. The common textures observed throughout the samples is a variable grain size, consisting of poorly to moderately sorted, fine to coarse grained lithic / mineral clasts and impact 'melt'. The impact 'melt' examined in many of these samples is also observed to be hypocrystalline, containing a mixture of glass and lithic clasts [cf. 12]. A variety in texture is observed regarding the overall structure as being either a predominant clast- or matrix-supported rock. Six samples (POP-BO-18, 19, 21, 26, 27, and 82) are more clast-supported, while the others (POP-BO-20, 40, 41, 42, 43, and 44) are matrix-supported. The carbonate samples (POP-BO-26 and 27) exhibit a very granular texture and a more consistent fine to medium grain size and moderate sorting.

Discussion: Many of the pyroclastic samples from the Lake Taupo region exhibit consistent properties with only a slight variety among them. The general mineralogy of these rocks remains relatively consistent among dominant rock-forming minerals found in felsic volcanic rocks. Textures are also consistent as overall fine-grained, poor to moderately sorted, unwelded ash tuffs, with some degree of hydrothermal alteration present within most samples. Previous workers [cf. 9] have classified most of the rocks from the Taupo region as ignimbrite deposits, however, petrography at the thin section level finds little to no evidence of welding among the samples, more indicative of an unwelded ash tuff deposit.

The Popigai impactites are generally consistent in overall mineralogy (except for the two carbonate samples) and textures, displaying a variable grain size from fine to coarse grained, and often poorly sorted among lithic / mineral clasts and hypocrystalline impact melt. Impactites from this region have been previously characterized as 'suevites' [cf. 10, 11]; however, we propose using the more descriptive term 'impact melt-bearing breccia' [cf. 4] to name most of these impactites. The carbonate samples appear to be predominantly glass-free and could potentially be described as lithic impact breccias. From this petrography, some textural similarities have also been observed between the pyroclastic rocks and impactites, notably with regards to flow features, variable grain size, and overall poor sorting (*Figure 3*).

Future Work: This work will proceed with further analysis of volcanic rocks and impactites from other localities. Investigation of well-studied impact craters will provide additional insight for updating the current nomenclature used to classify various impactites – notably, with rocks from the Ries impact structure, where the term 'suevite' was initially coined [cf. 4].

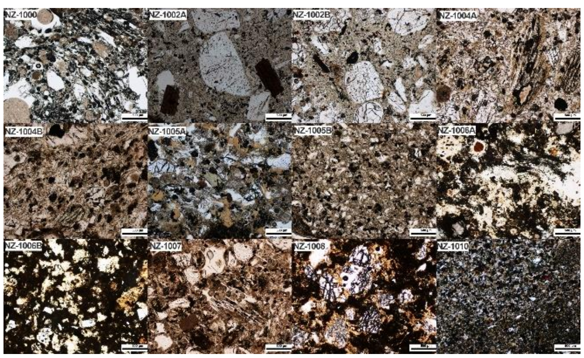

Figure 1. Overviews of pyroclastic thin sections in plain polarized light at 5x magnification.

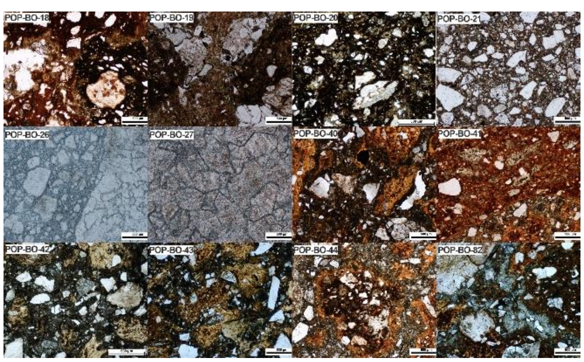

Figure 2. Overviews of impactite thin sections in plain polarized light at 5x magnification.

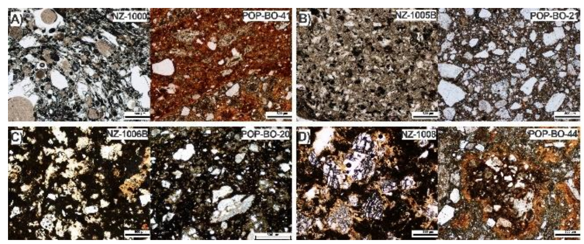

Figure 3. Comparison of textures observed between pyroclastic rocks and impactite rocks. Note the many similarities between flow textures (A, D), fractured crystals (D), variable grain sizes (A-D), and overall poor sorting (A-D) throughout each sample.

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