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Characterising transport and emplacement mechanisms of volcanic debris avalanches through 3D Micro Tomography.

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Volcanic communities near long-lived stratovolcanoes are susceptible to the significant threat associated with edifice collapse events which produce volcanic debris avalanches. These events can have runout distances > 100 km and are the largest mass flows on Earth with volumes ranging from 0.1 to 100 km^3 which have the potential to bury large sectors of the landscape posing a severe risk to people and infrastructure. However, the emplacement mechanisms of these large destructive phenomena are still poorly understood with the inability to accurately quantify the physical parameters such as frictional regimes, velocity, and temperature which contribute to the extreme runout. The internal structure and minerology of the avalanche deposits hold the key to understanding the transportation mechanisms. During transportation inter-particle collision and shearing occurs reducing grainsize and generating new minerals such as Pseudotachylytes, Frictionites and Silica polymorphs along shear zones between larger clasts and along the base of the flow. Twenty-five volcanic debris avalanches and rock avalanches of varying sizes were sampled from New Zealand and the USA to provide a representative variety of flow types to better understand transportation mechanisms. Using 3D Micro-Computed Tomography at the Australian Synchrotron the internal structure of the avalanche deposits were analysed to identify different minerals and structures present. Analysis of the microstructures of the samples show a variety of different fracture patterns that can be categorized based on the different source lithologies sampled as well as the different rheological emplacement conditions from the collapse and flow. Features seen at the micro-scale mimic larger centimeter to meter scale features traditionally observed in the flow. Investigating the formation of new minerals along collision and shear zones can provide insights on the physical constraints of the flow e.g., velocity and temperature. Data from this study will provide quantitative input parameters forming the foundation for developing a model for transportation and emplacement of long-runout volcanic debris avalanches. Data from these models can be used to assess the volcanic debris avalanche hazards from volcanoes globally, better informing risk assessments.