



Ordered structures and textures in volcanic debris avalanche breccia: description and implications for emplacement kinematics and dynamics

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Textures and structures in seemingly chaotic debris avalanche breccia could provide information about emplacement kinematics and dynamics, if suitable methodologies for description and interpretation are developed. Here we investigate breccia in two volcanic debris avalanches, developing ways of describing them. In previous seemingly chaotic breccia, we can now find structure and sequences of events. In the Cheix unit (French Massif Central, < 1Ma), the clasts have different structures with a specific distribution on and between clasts. There is a general breccia structure with conjugate fracture systems. For blocks (=clasts) surface structures are an oriented abrasion, impact structures. Internal structures can be brittle or ductile and there can be schistosity development in sedimentary clasts, often associated with interactive structures and displacement between the clasts. We observe a preservation of preferentially orientated structures, which implies that a coherent and persistent structure is maintained in the deposit during transport. There is also a specific distribution of structures on blocks (e.g. upstream abrasion, lower downstream brecciation). This indicates a clear order to structural events imposed by the moving mass through its density, the interaction of forces and transport conditions.

In the Perrier unit 4 (French Massif Central, 2Ma), the sheared basal contact is well exposed. The kinematics and specific clast transformations are observed. Impacts and splash structures indicating local matrix motion are preserved, requiring a partial fluidisation (probably thixotropy) along a tangential and vertical gradient from the impact. A vertical deformation gradient changing from ductile to brittle response is observed over 3 horizons, (1) a lower layer with a high concentration mobilized fluvial pebbles, (2) a middle zone with a concentration of sheared pumice indicating different densities and strains between the two layers, (3) an upper layer with matrix and fibrous pumices separated from the main avalanche body by a dark line (0,5-1 cm) composed of impacted, crushed and sheared pebbles.

In each breccia, we can describe a coherent structural framework from the textures, structures and shapes. We provide first a methodology for description and then an interpretation of the local avalanche kinematics that is also related to the topography and local environment on emplacement.

Key words: Mont Dore, volcanic debris avalanche, deposit structures and textures, emplacement kinematics and dynamics.