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Sedimentary control of volcanic debris-avalanche structures and transformation into lahars

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Volcanic debris avalanche structures and related transformations into lahars have been extensively analysed in order to establish a sedimentary classification of the deposits. Textural and structural variations of eight debris-avalanche deposits (DADs) have been correlated with Shape Preferred Orientation of 30,000 clasts together with grain-size distributions and statistical parameters from 156 sieved matrix samples. Granular segregation patterns have been observed with structural fault controls: proximal granular-segregation structures of the Tutupaca DAD ridges in Peru, basal sheared bands along overthrust lateral levee (Mt. Dore, France), mixing and cataclasis of fault-controlled deposits in half-graben during lateral spreading of distal thrust lobe (Pichu-Pichu, Peru), neo-cataclasis at the frontal thrust lobe (Meager, Canada and Mt. Dore, France). A logarithmic regression characterises the % matrix vs. matrix/gravels showing proximal and primary cataclasis, hybrid DADs with polymodal matrix and mixed facies up to transformations into lahar (Misti, Mt Dore). The sequential fragmentation helps to distinguish DAD that belong to Andean and Cascade Volcanic arcs (Tutupaca and Misti, Peru; Meager, Canada) to the hybrid DADs, before distal transformation into lahars (Pichu-Pichu); and hydrovolcanic fragmentation characterises the transformed lahar deposits (Misti). The fractal values of 150 sieved samples range between 2.3 and 2.7, implying extensional fractures with granular disaggregation. Skewness vs. kurtosis values help to distinguish the proximal mass wasting deposits and the transformed deposits by dilution. The sorting vs. median values enable us to differentiate the hybrid DADs with the transformed deposits by dilution. The sedimentological statistical parameters with Shape Preferred Orientation analysis that have been correlated with textural and structural observations show textural fabrics resulting from kinematic processes: cataclasis, hybrid matrix facies and transformations. Inherited fractures from tectono-volcanic structures contribute to the particle size distributions of DAD and associated deposits such as pyroclastic and lahar deposits (Misti, Mt Dore, Tutupaca). The statistical results highlight granular structure and kinematic process of DAD transformations into lahars and associated deposits, which would contribute to understand the rheological process behind the excess DAD run-out and to test granular models for DAD transformations.
Key words: volcanic debris-avalanche deposits, lahar transformation, structure, sedimentology, hazard