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Plinian eruptions and their impact on human settlements: stratigraphy of the 79 AD Vesuvius fall deposits and detailed study of their downwind and substrate-induced variations inside the archaeological excavations of Pompeii and Stabiae (southern Italy)

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Plinian eruptions are highly energetic events that release cubic kilometres of magma in the form of pyroclastic material (pumice, lithic clasts and ash). These products tend to accumulate near the vent with considerable thickness. The rapid burial of the territory around the eruptive centre makes these eruptions extremely dangerous. For this purpose, the renowned 79 AD Vesuvius eruption, which destroyed the ancient cities of Pompeii and Stabiae (where Pliny the Elder found his death) located respectively 10 and 15 km from the vent, was studied in detail. The recent excavations carried out in collaboration with the Archaeological Park of Pompeii, both in Pompeii and in the Stabian villas, have shown the complete sequence of products of the 79 AD eruption that destroyed and covered these Roman cities. The discovery of thick sequences of reworked material accumulated during previous excavations, testifies for the presence of underground tunnels dug for the Royal House of Bourbon. Fall products of the 79 AD eruptive sequence, accumulated during the main Plinian phase and the successive sustained column phases, were studied in detail to investigate their sedimentological characteristics and how these were influenced by anthropic structures. Results from field investigation show that in both archaeological sites, fall deposits consist of white and grey pumice lapilli in the lower part of the eruptive sequence (units A and B), and of thin, lithic-rich layers interstratified to ash products emplaced by pyroclastic currents, in the highest part of the pyroclastic deposit (units D, G1, G3, I). A new thin lithic-rich layer (X2) has been observed near the top of the sequence at Stabiae. The internal structure of the Plinian pumice lapilli deposit appears weakly stratified in open areas, while it is strongly stratified near steep roofs (e.g., impluvium areas), where the deposit thickens. The observed stratification is confirmed by a significant variation of sedimentological parameters with the stratigraphic height (e.g., median ranging from -3.5 to -0.1), possibly related to fluctuations in the eruptive parameters. Locally, rolling of pyroclastic clasts on sloped roofs produced a well-stratified deposit with laterally discontinuous layers and rounded clasts. Several roofing-tiles, either intact or in fragments, were recovered at various stratigraphic heights in the

pumice lapilli deposit both at Pompeii and Stabiae. These tiles testify for the progressive collapse of the roofs under the increasing load of the falling lapilli clasts.