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Transition from Plinian to unstable eruption conditions recorded in fine-grained proximal ash layers of the Middle Laacher See Tephra (12,900 a BP), East Eifel Volcanic Field, Germany

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The 12,900 a BP eruption of Laacher See Volcano is a classic example of a complex, multi-phase Plinian eruption and one of the largest known of the Northern Hemisphere during the Late Quaternary. The wide range of primary and reworked pyroclastic deposits produced record drastically changing internal and external conditions during the course of the eruption. Here we focus on the so-called “Hauptbritzbank” (HBB), which marks a significant change in the eruptive style of Laacher See Volcano following the initial Plinian phase. The interval is characterised by a series of thin ash beds of different origin with interbedded pumice lapilli fallout layers as well as massive pyroclastic flow deposits in paleo-valleys.

The proximal distribution and stratigraphy of HBB was mapped between two depositional fans over an area of 200 km2. The exposed ash beds were sedimentologically classified in order to assess their eruptive mechanism, transport processes and depositional conditions. Correlation between the Eastern and Southern fan proved difficult with dispersal axes of deposits pointing to two different locations within the Laacher See basin and some not intersecting the basin at all. In addition, individual ash units displayed a wide spectrum of field characteristics and emplacement mechanisms. The basal unit shows characteristics of rain-flushed fallout ash, however most overlying ash layers indicate lateral transport and deposition from various types of pyroclastic flows. While the bulk of these flows was governed by topography down existing paleo-valleys, a laterally continuous overbank portion spread over higher elevations and the valley-interfluves depositing ash over a wide area. Two different kinds of ignimbrite overbank deposits occur in the HBB. Fine-grained greenish ash layers with abundant, very large accretionary lapilli are interpreted to have been produced by wet, ground-hugging ash clouds. In contrast, very poorly sorted, fine-grained red ash deposits containing small lithics, rounded pumice lapilli and small accretionary lapilli were likely emplaced by hot, dry and more energetic pyroclastic flows. Co-ignimbrite fallout ash is preserved as concentrated larger accretionary lapilli near the top of some pyroclastic flow units or overlying them as discrete beds made up entirely of small accretionary lapilli. Near source, pyroclastic surges deposited thin, laterally discontinuous, wavy ash units displaying cross-bedding and erosive basal contacts.

Overall, the HBB records a complex, unstable phase of the Laacher See eruption that was dominated by alternately convecting and collapsing eruption columns from two simultaneously active vents with resulting deposits displaying a broad spectrum of pyroclastic fall and flow processes.