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Volcanic origin and emplacement of the East Eifel tuff and its distribution as a building material since Roman times

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The landscape of the East Eifel (Germany) was created and formed by numerous intensive volcanic events during the Quaternary. Two prominent complexes are well known for their emplacement of tuff and tephra layers and their importance of influencing the technical evolution of mankind in the Rhineland.
Volcanic tuffs have been used as building stones in many countries and represent a major component of the building mass of ancient monuments in Italy, Germany, the Netherlands and Denmark. In the Netherlands and Germany, volcanic tuffs of the Eifel region (Rhenish tuff) have been used since Roman times. Tuff, well known by the Romans as a building raw material, was appreciated because of its availability in the Eifel, its lightness and resistance to physical weathering. Their knowledge of the Neapolitan Yellow Tuff and its similarity to the Rhenish tuff in particular as well as the necessity of building material for the conquered provinces probably caused the extensive exploitation of the tuff deposits in the Rhineland. Besides, the proximity to the Rhine River favoured the easy transportation and further distribution of the tuff blocs in the Roman empire. Important buildings like the Ubier monument (Cologne), defence structures (Xanten) and technical innovations like a water pipe through the Eifel panelled with tuff stone are only a few examples to express the Roman creativity.
From the 10th century onwards tuff stones were especially rediscovered for Romanesque architecture. In particular, they were used as a necessary constructional material in churches especially popular for the arches and piers of a vault.
Since the 17th century the diminishing importance of tuff blocs or bricks was influenced by the declining stone quality in the areas. Despite tuff stone was prepared for material to be ground and served as an additive to improve mortar or cement, known as the puzzolana Trass.

According to the increasing archaeological interest in investigating the excavated Roman tuff mining areas (Meurin, Kruft) and the distribution network in Roman times, it is helpful to find a way to distinguish the tuff properties of the different exploitation sites.
Consequently, the two prominent volcanic complexes of the East Eifel with their economically most important tuff deposits were taken into consideration:
(1) The Riedener Caldera in the western part of the East Eifel volcanic field is represented by intrusions, domes, tuff and widespread tephra fallout. In the area near the villages of Rieden, Weibern and Ettringen ancient as well as recent tuff quarries evidence different sources of tuff stones. The so called Riedener, Weiberner and Ettringer tuff varieties are nowadays mainly used as replacement stones in the Netherlands, in particular for restoration.
(2) The eruption of the Laacher See Volcano west of the Neuwied tectonic basin produced about 5 km^3 of phonolitic material, exclusively as pyroclastics. In addition to fallout pumice and ash deposits which covered the landscape like a blanket, pyroclastic ash flows filled mainly the valleys around the Laacher Lake and partly consolidated by the action of ground water to tuff. In particular, worth mentioning here are the historical mining areas of the Krufterbach near the villages of Kruft, Kretz and Plaidt as well as the Brohlbach valley which show remarkable archaeological evidence for Roman mining sites.

The characterization of the individual tuff properties from the mining areas is a fresh attempt at simplifying the method for provenance analysis of unknown tuff building material. Hence, samples of provable historical tuff deposits were examined according to their (1) petrographic and (2) geochemical composition (main and trace elements) as well as (3) the zeolitization of the pyroclastic flows as a tracer for the postvolcanic evolution abundant at the different sites.