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High-resolution Ar-Ar dating of volcanic rocks from Central and Southern Germany - methodical limitations and a (preliminary) re-evaluation of timing of volcanic activity within Central Europe

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Precise dating of volcanic activity applying the Ar-Ar step-heating method ideally requires fresh and unaltered, pure mineral separates. In volcanic rocks, where phenocrysts are absent, dating of unaltered whole-rock fragments may provide the required age information. A straightforward interpretation of whole-rock Ar-Ar data, however, is often hampered by the polycrystalline nature of whole-rock fragments and the presence of several primary and secondary mineral phases having different argon retention and diffusion behaviour, leading to complex argon release patterns.

Here we present whole-rock Ar-Ar ages from six volcanic regions within Southern and Central Germany (Hocheifel, Rhön, Siebengebirge, Vogelsberg, Bayerische Rhön, Heldburger Gangschar and Oberpfalz) determined by applying high-resolution step-wise heating experiments. About 50 mg of irradiated whole-rock fragments were heated incrementally using a Mo-resistance furnace, and released and purified gas fractions were measured using an ARGUS noble gas mass spectrometer equipped with five Faraday cups in static mode. Commonly, 30 or more steps per sample were measured to resolve the presence of different "Ar-components" within each sample. In many cases, this allows to distinguish frequently present argon-loss and "excess-argon" from pure mixtures of radiogenic and atmospheric argon, identified by at least three or more contiguous temperature steps resulting in an atmospheric or near atmospheric $^{40}Ar/^{36}Ar$ intercept in an inverse isochron diagram. Although this procedure often provides the required age information from only low amounts of the released ^{39}Ar, it enables a good control on the reliability of the derived ages.

Whole-rock Ar-Ar ages from the Bayerische Rhön, Heldburger Gangschar and Oberpfalz indicate more or less continuous and long lasting volcanic activity between 13.1 and 34.2 (48.7?) Ma in this region, probably with a major eruptive pulse at ∼15 Ma, and minor pulses at around 17.5, 30.5 and 33 Ma. Ages from the Hocheifel range from ∼21 to ∼36 Ma, whereas those from the Siebengebirge are mostly younger (<4 to ∼20 Ma). Magmatic activity in the Rhön was between ∼18 and ∼25 Ma, the Vogelsberg volcanic complex was active between 16.3 and 16.7 Ma, and at ∼10 Ma.