Radiogenic Argon Released by Stepwise Heating of Glauconite and Illite: The Influence of Composition and Particle Size

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Abstract: Various size fractions of several samples of glauconitic clay and illite were heated stepwise under vacuum for extended periods to: 1) evaluate radiogenic-argon (Ar) yields in relation to composition and size range; and 2) investigate the kinetics of radiogenic-Ar release. Each sample was heated at 250, 375, 500 and 1000 ° C.

The radiogenic-Ar release patterns are nearly the same for the various size fractions of each sample. The Ar yields are not functions of particle size, at least not in these size ranges. This observation suggests that the kinetics of radiogenic-Ar release from these materials under these experimental conditions may be controlled by some mechanism other than diffusion.

The experiments show distinct differences in yield of radiogenic Ar from glauconitic clay and illite, which were most evident in the 375 and 500 ° C steps. The yield (relative to the total amount of radiogenic Ar in the sample) at a particular temperature is inversely related to potassium (K) content, and there appears to be a direct dependence of yield on the iron (Fe) content. Because the literature provides evidence that Ar release during heating of phyllosilicates under vacuum is controlled by dehydroxylation and also provides evidence that dehydroxylation of clay may follow first-order kinetics, the kinetic data on Ar release from these samples were compared to simulated first-order reactions. To match the observational data requires more than 2 activation energies in each simulation, which is consistent with the known mineralogical heterogeneity of such samples.

Key Words: Argon • Dehydroxylation • Glauconite • Illite

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