Argon diffusion in rocks - classical approach in view of heating and relaxation

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Since the development of the conventional K-Ar and subsequent 40Ar-39Ar dating methods fundamental noble gas diffusion processes in rocks were investigated including complex multi-scale and multi-path aspects in polyphase materials. Traditional models interpret the loss of radiogenic Argon due to an increase of temperatures. Hyodo (2017) proposed a new approach investigating the relaxation time and temperature relation within an “unclosure temperature” model. This model regards duration of a heating event as time for relaxation in a diffusion system at specific temperature. The model applies a functional form of mathematical approximation on fractional loss by diffusion. It allows fractional loss of certain amount of radiogenic 40Ar as long as the step heating model spectra in 40Ar-39Ar dating (plateau) maintains its original age within its age error. This new model approach is compared to a classical heating diffusion model (Huon et al., 1993) focusing on clay minerals (<10 and <2 μm) and larger muscovite grains (200 and 100 μm). The classical diffusion heating models applies three main parameters comprising a. grainsize (μm), b. temperature range (˚C) and c. time scale (Ma). The obtained results provide a unique insight to compare an active heating versus passive cooling time and temperature path of clay minerals and muscovite with applications for general earth sciences and economic geology such as hydrocarbon exploration.

Huon, S. et al., 1993. Mise en évidence au Maroc d'événements thermiques d'âge triascico-liasique liés à l'ouverture de l'Atlantique. Bulletin de la societe géologique de France, 164/2, 165–176.

Hyodo, H., 2017. Unclosure temperature of a mineral: Cylinder and plane geometry. Bull. Res. Inst. Nat. Sci. Okayama Univ. Sci., No.43, 13-18.

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