Discordant ArAr ages from the Musgrave Ranges, Central Australia: Implications for the Significance of Hornblende ArAr Spectra

Abstract

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Hornblende and biotite from granulites in the Musgrave Ranges, central Australia, yield variable 40Ar□39Ar bulk ages even at the scale of a single outcrop. There is no obvious relationship between age, chemical composition, sample location, or textural characteristics of the minerals. We interpret the age variation as due to the incorporation of variable quantities of excess Ar. However, the age spectra of the minerals do not show the typical gain profiles commonly associated with excess Ar and isotope correlation diagrams do not indicate trapped Ar of non-atmospheric composition. Instead, some of the hornblendes and all the biotites show relatively simple age spectra similar to those commonly interpreted in terms of volume diffusion. These observations lead us to argue that, as is commonly the case with biotites, not all hornblende age spectra with simple patterns, similar to those predicted by diffusion theory, can be interpreted unambiguously in terms of geologically significant Ar concentration profiles. More specifically, we conclude that a relatively simple hornblende age spectrum does not necessarily indicate the absence of excess Ar.Despite their complexity, our results show that post-metamorphic cooling of the granulites was very slow. Although the incorporated excess Ar hinders the reconstruction of a more precise thermal history, the data show that following granulite-facies metamorphism ≈ 1200 Ma ago, the terrane did not cool below temperatures at which hornblende and biotite close to Ar diffusion until after ≈ 930 and ≈ 690 Ma, respectively.