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Helium and Argon Isotopic Studies of Fossil Material and the Theoretical Evolution of He and Ar in Earth ' s Atmosphere through Time

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Author(s)

Yuko Arakawa, Jun-Ichi Matsuda

ABSTRACT

We analyzed the elemental concentrations and the isotopic compositions of helium and argon in Cambrian to Jurrassic aged Gastropod, Ammonite and Trilobite fossils in order to examine variation in these gases through time. Fossil samples yielded He and Ar isotopic ratios close to the present day atmospheric values, but also indicated some addition of a radiogenic component. We compared the results to theoretical values calculated from a mathematical model of Earth ' s atmosphere assuming mantle degassing. Results from our mathmatical models showed that the 40Ar/36Ar ratio of Earth ' s atmosphere increased rapidly after the formation of the Earth, but has been almost identical to the present day value for the last 1 Ga. For atmospheric helium, model results were consistent with present day atmospheric values, assuming complete helium degassing from the continental crust into the atmosphere. The model suggests that the atmospheric 3He/4He ratio has remained relatively constant for the last 0.1 Ga. Given the similarity between present day and ancient He and Ar isotopic ratios, we conclude that the corresponding ratios measured in ancient fossil material may partially reflect composition of the ancient atmosphere and are not necessarily due to contamination by the present day atmosphere.

KEYWORDS

Fossils; Argon; Helium; Isotopes; Atmospheric Evolution

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