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A proxy system model framework for reconstructing past environmental conditions with cosmogenic noble gases

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Cosmogenic isotopes of helium and neon are produced at the Earth's surface and exhibit a wide range of thermal sensitivities in common minerals. We can take advantage of this range of thermal sensitivities to reconstruct past near surface thermal conditions using cosmogenic noble gas observations. For example, cosmogenic noble gases have been used to study past ambient temperatures, changes in snow cover duration, and wildfire histories. Interpreting cosmogenic noble gas observations requires a model of both production and diffusion that predicts cosmogenic noble gas concentrations for different thermal histories. Additionally, models that characterize the diffusion kinetics of helium or neon in a particular mineral sample are often needed, as laboratory-based diffusion experiments demonstrate that helium and neon diffusion kinetics are sample specific and often complex. At present, various codes are available that can carry out pieces of the modeling, but they are generally not interoperable and are often highly specific to a particular past application, limiting the codes' use for future applications. Here we present progress on creating a general forward modeling framework for inferring thermal histories using cosmogenic noble gas observations, structured around the concept of proxy system modeling. We will describe the architecture of this model framework as well as provide examples of applying it to new and existing cosmogenic noble gas datasets.

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