Mineral chemistry control of cosmogenic 3He and 21Ne production rates

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Abstract

Accurate calculation of the surface exposure age and erosion rates determined from cosmogenic nuclide concentrations requires knowledge of their production rate. *In situ* cosmogenic 3He and 21Ne tends to be used in a small number of rock-forming minerals, yet they are theoretically usable in a wide range of minerals. The production rate of cosmogenic 3He and 21Ne is strongly dependent on mineral chemical composition. Theoretical models for mineral chemistry control on production have been developed but reveal conflicting results. Empirical determinations of are sparse and not systematic. Here we test the two prevailing theoretical models using cosmogenic 3He and 21Ne in cogenetic olivine, orthoyroxene, clinopyroxene and spinel from several small lherzolite xenoliths from the peak of the Mount Hampton volcano, West Antarctica. The long exposure duration (several hundred kyr) and high altitude (3,200 m above sea level) has allowed precise determinations to be made on small sample volumes. The results reveal a systematic chemical composition control of the 3He and 21Ne production rates that demonstrate the need for a compositional scaling factor for accurate exposure age determinations, leaving the choice of theoretical method to the user.

Keywords: 3He, 21Ne, production rate

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