

Experimental study of abiotic nitrate reduction at a high temperature and high-pressure condition and implication for nitrogen chemistry in Hadean hydrothermal environments

*Manabu Nishizawa¹, Takuya Saito¹, Akiko Makabe¹, Takazo Shibuya¹, Ken Takai¹

1. Japan Agency for Marine-Earth Science and Technology

Nitrogen is an essential element for life as a major component of biomolecules and electron donor/acceptor for energy metabolism. Currently, nitrogen cycle in surface environments is mainly driven by biological processes including nitrogen fixation, nitrification and denitrification. In contrast, little is known about nitrogen cycle in the pre-biotic Earth and its relation to chemical evolution. This study focuses on nitrate chemistry during water-rock interaction in deep-sea hydrothermal environments to understand the fate of atmospherically-derived nitrate in the Hadean ocean. In experiments, artificial seawater with nitrate was reacted with synthetic komatiite at 350°C and 500 bar. Our experiments show that a substantial amount of nitrate was reduced to ammonium in an experimental condition. This implies that the Hadean deep-sea hydrothermal vents may have been favorable for chemical evolution in that both electron acceptor for energy metabolism (nitrate) and reduced nitrogen for organic synthesis (ammonium) were continuously supplied to the hydrothermal fluid-seawater mixing zone.

Keywords: prebiotic chemistry, nitrogen, deep sea hydrothermal vents