EVOLUTION OF THE NITROGEN BIOGEOCHEMICAL CYCLE ON THE EARLY EARTH: IMPLICATIONS FOR OTHER PLANETS. M. A. Kipp[1], E. E. Stüeken[1], M. C. Koehler[1], and R. Buick[1]. [1]University of Washington, Department of Earth & Space Sciences and Astrobiology Program.

Nitrogen is an essential nutrient that regulates the productivity of Earth's biosphere. It is also a common substrate in dissimilatory metabolic reactions, and its gaseous species (N_2, N_2O, NH_3) exert climatic effects when present in the atmosphere. The nitrogen cycle is unique among global biogeochemical cycles in that it is almost entirely microbially mediated. Secular trends in nitrogen bioavailability and speciation have thus been controlled in large part by biological evolution. Recent isotopic studies have revealed major trends in the Precambrian evolution of the nitrogen cycle. Among the key events are: early nitrogen fixation [1] possibly leading to drawdown of atmospheric N_2 [2], the onset of aerobic nitrogen cycling with the appearance of free oxygen [3], spatially heterogeneous nitrogen speciation in Earth's "middle age" [4], and apparent biogeochemical stability since the Neoproterozoic. Because nitrogen is widely abundant in the universe and a biological necessity for life as we know it, these large-scale trends in nitrogen cycle evolution on Earth may provide a general model for other planets. In particular, the ability of life to alter the composition of the atmosphere, and thus global climate, has implications for long-term planetary habitability.

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