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# What nitrogenous geomolecules tell about Earth's history?

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In terms of Earth's history, it has been claimed that the phosphorus cycle, rather than the nitrogen cycle, is the primary control on the carbon cycle. This classical view is based on the fact that nitrogen is abundant in the atmosphere as N2, and is not, therefore, a limiting element. More recently, a contrasting view has been presented, in which the nitrogen cycle, especially the component representing the balance between N2-fixation and denitrification, is the primary driving force of the carbon cycle. Understanding the relative importance of the nitrogen and phosphorus cycles in controlling carbon cycle activity is fundamental to an understanding of the evolution of carbon cycle over geological time, and the relationship of the carbon cycle to climatological and evolutionary factors.

Examination of natural variations in stable nitrogen isotopic composition over time is a key for understanding the relative importance of the nitrogen cycle to biogeochemical cycles. Despite many efforts, investigations on the nitrogen cycle in the geological past have lagged far behind those on the carbon cycle. One important reason for this is that inorganic minerals produced in the water column contain little nitrogen. This situation contrasts with that of carbon, whose isotopic signature is faithfully recorded in calcium carbonate precipitated in the water column under thermodynamic equilibrium, and which is preserved in sediments for long period of time. Even in sedimentary organic matter, individual nitrogenous compounds have not often been examined as a means of gaining insight into the Earth's historical record. Consider, for example, the application of compound-specific isotopic techniques to study biogeochemical processes in geological samples. The compound-specific isotopic analysis has not been widely applied to the reconstruction of the nitrogen cycle in the geological past, although an extensive literature exists concerning "bulk" nitrogen isotopic investigations.

The organism produces various types of nitrogenous compounds through metabolic processes, and our knowledge of nitrogen metabolism in cells is plentiful. Thus, here I present not only an overview of previous studies on processes related to organic nitrogen in the natural environment, but also try to bridge between nitrogen biochemistry and geochemistry mainly through isotopic signature to provide useful introduction for the future studies. I also present the degradation of nitrogenous compounds, both in the water column and sediments. Such information is useful for interpreting the various types of sedimentary nitrogen represented in the isotopic record.