

The natural abundance of ^{15}N and ^{13}C in the soil and needle of the pine forest (*Pinus roxburghii*) along altitudinal gradient in Nepal.

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Abstract

This paper deals with the natural abundance of ^{15}N and ^{13}C in the soil and needle of the pine forest (*Pinus roxburghii*) along an altitudinal gradient in Nepal. The study area lies in the elevational range of 1200m to 2200 m in Kathmandu valley of Nepal. Since it has become known that plant tissue contain less of $\delta^{13}\text{C}$ than ambient air, studies of ^{13}C discrimination by plants have become a potential tool in global C-cycling studies. In this study, we have assessed the natural abundance of $^{2^{15}}\text{N}$ and ^{13}C in soil as well as plants along the altitudinal gradient. Our results indicate that C and N contents of soil, in general, decreased with increasing altitudes. Soil nitrogen content decreased about 0.07 % over an altitude of 1000 m, from 0.21% at 1200 m to 0.14% at the altitude of 2200 m. Similarly, in case of %C-content of soil, the difference between higher altitude (1.04 %) and lower altitude (2.91 %) was of 1.87 %. However, this decreasing trend of both C ($r^2 = 0.35$) and N ($r^2 = 0.59$) with altitude was not statistically. Similar to soil, green needle nutrients also declined with increasing altitude. Needle nitrogen content decreased about 0.37 % over 800 m, from 1.84 N % at 1200 m to 1.23 N% at 2000 m and this negative correlation trend, however, has not been found significant ($r^2 = 0.55$). In the case of C, the trend was same and also significant ($r^2 = 0.90$), but the difference between lower (50.0 %) and higher altitudes (50.27 %) was only 0.27%. Trends in enrichment factors indicated more positive values of $\delta^{15}\text{N}$ values at the lower (-0.56 ‰) altitudes than at the higher altitudes (-8.55 ‰), i.e., a larger (i.e. more positive or less negative) enrichment factors indicate a smaller differences between the isotopic composition of soil N and foliar N. Finally, the causal factors involved in the above mentioned trend of soil and plant isotopes along the elevation is discussed in detail.

Keywords: Stable isotopes, ^{13}C , ^{15}N , altitudes, soil, needle

Kinetic effects of Mg^{2+} on heterogeneous apatite nucleation at amorphous silica surfaces

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Mg^{2+} , Ca^{2+} and HPO_4^{2-} adsorption on silica and nucleation of MgHPO_4 and CaHPO_4 clusters (precursors to apatite) is modelled using Hartree-Fock theory. Effective core potentials and valence double- ζ basis set with polarization functions are used. Solvation is calculated using a modified Born model.

The partially deprotonated surface site, $\text{Si}_3\text{O}_6\text{H}_5^{1-}(\text{H}_2\text{O})_3$, promotes inner-sphere and outer-sphere metal cation adsorption, which facilitates subsequent HPO_4^{2-} ion attachment resulting in the surface cluster, $\text{Si}_3\text{O}_6\text{H}_5[\text{MHPO}_4(\text{H}_2\text{O})_3]^{1-}$, where M is Ca or Mg. The most facile pathway for Ca^{2+} involves formation of an inner-sphere intermediate before HPO_4^{2-} attachment. For Mg^{2+} , the outer-sphere cluster is formed first by slow partial dehydration of $\text{Mg}^{2+}_{(\text{aq})}$, followed by conversion to the inner-sphere complex and HPO_4^{2-} attachment (Fig. 1). Thus, Mg^{2+} does not directly compete with the most facile Ca^{2+} pathway but, rather, by slow dehydration of $\text{Mg}^{2+}_{(\text{aq})}$ and formation of the outer-sphere cluster which then blocks access of Ca^{2+} to surface sites.

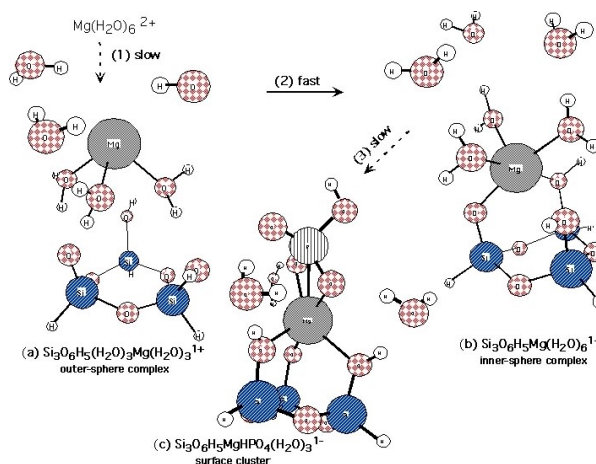


Fig. 1. Most facile pathway for $>\text{MgHPO}_4$ surface cluster formation at intermediate pH.

In this manner, Mg^{2+} can retard apatite nucleation, without completely preventing it, even from pore-waters with high total Mg/Ca ratio. The implication is that pore-water chemistry does not necessarily need to be altered significantly from seawater composition by ad hoc geochemical processes. The results are relevant to nodular apatite formation as overgrowths on detrital diatom tests.