Geophysical Research Abstracts
Vol. 14, EGU2012-2184, 2012
EGU General Assembly 2012

Breakdown of Clays by Ectomycorrhizal Fungi Through Changes in Oxidation State of Iron

J. M. Arocena (1) and B Velde (2)

(1) University of Northern British Columbia, Prince George, BC Canada V2N4Z9 (arocenaj@unbc.ca), (2) UMR 8538 CNRS Ecole Normale Supérieure, 24 rue Lhomond 75231 Paris France

Organisms are known to play a significant role in the transformation of clay minerals in soils. In our earlier work on canola, barley and alfalfa, we reported that Glomus, an arbuscular mycorrhizae, selectively transformed biotite into 2:1 expanding clays through the oxidation of Fe (II) in biotite to Fe(III). In this presentation, we will share similar results on clay transformations mediated by ectomycorrhizal fungi colonizing the roots of coniferous trees. Clay samples were isolated from rhizosphere soils of sub-alpine fir (Abies lasiocarpa (Hook.) Nutt.) in northern British Columbia (Canada). Chemical and mineralogical properties of these soils had been reported in our earlier paper. In this study, we subjected the clay samples to iron X-ray Absorption Near Edge Spectroscopy (Fe-XANES) at the Canadian Light Source synchrotron facility in Saskatoon (Canada). Our initial results showed relatively higher amounts of Fe (III) than Fe(II) in clays collected from rhizosphere of Piloderma (an ectomycorrhizal fungus) compared to soils influenced by non-Piloderma species and Control (non-rhizosphere soil). Coupled with the results of X-ray diffraction (XRD) analysis, there seems to be a positive relationship between the relative amounts of Fe(III) and the 2:1 expanding clays. This relationship is consistent with our results on agricultural plants in laboratory experiments on biotites where we suggested that oxidation of Fe(II) to Fe(III) results in the formation of 2:1 expanding clays. In a related data set on chlorite alteration we observed that after dithionite-citrate-bicarbonate (DCB) treatment, the d-spacing of a slight portion of chloritic expanding clays shifted to higher angles indicating decreased d-spacing towards micaceous clays. The reductive process initiated through the action of the DCB treatment seems to indicate the collapsed of expandable clays upon the reduction of Fe(III) to Fe(II). Initial results from the Fe-XANES and XRD analysis of DCB-treated clays seem to compliment each other and may suggest that the reversible transformation of clays is possible via the oxidation/reduction of Fe which changes the electronic charge balance on the clay structure. We conclude that the amounts of 2:1 expanding clays in soils maybe variable depending on the extent of microbial activities (mainly fungi) in the rhizosphere which change oxidation – reduction conditions in the soil environment. Nevertheless, our results indicate that the change in clay mineralogy, hence the cycle of nutrients in agricultural and forested environments can be significantly influenced by soil fungal action.