Low-molecular weight organic compounds in throughfall and dew on forest canopy

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Introduction

Organic compounds dissolved in the precipitation that has passed through the forest canopy are partly derived from the leaching of the internal parts of plants and leaf wash. Although dissolved organic carbon (DOC) has been well studied in forest ecosystems, low molecular weight organic compounds such as organic acids and aldehydes in throughfall and in related environmental samples, have not yet been understood. In this study, the concentrations of organic acids and aldehydes were determined in throughfall, dew from pine needles, and rainwater samples in order to understand the behaviour and the role of these compounds in the atmospheric phase. Sampling was conducted at the urban- and mountain-facing sites of Mt. Gokurakuji, located 15 km west of Hiroshima city.

Results and Discussion

Positive values of NTF (net throughfall = throughfall – rainfall) deposition of organic acids were observed at the urban-facing site, suggesting the supply of organic acids from atmospheric dry deposition and/or from the pine foliage leaching. However, negative values of net-throughfall deposition of aldehydes were observed at both the urban- and mountain-facing sites except for glyoxal at the urban-facing site. It was highly likely that the degradation and/or retention of aldehydes by the pine canopy occurred during the time that incidental precipitation passed through it. Organic acids in dew from pine needles showed much higher concentrations than those in throughfall, which may be caused by the smaller volume of dew and the longer contact time with the pine needle surfaces. Oxalic acid was found in dew on pine needles and it is speculated that an iron (III)-oxalato complex is formed and then photochemically produces hydroxyl (OH) radicals in dew on pine needles via the photo-Fenton reaction.

Physico-chemical response of volcanic-hydrothermal systems to volcanic unrest: Evidence from some New Zealand crater lake environments

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Mt Ruapehu, an andesite volcano in the Taupo Volcanic Zone, has had two crater lake ejecting events since 1945, with the most recent taking place during the 1995-96 eruptions. The lakewater consists predominantly of meteoric water which convectively recirculates through the upper vent complex. A "leaky heatpipe" transfers heat and mass from the degassing magma column at depth to the convective lakewater recirculation zone (Christenson & Wood, 1993). Controls over the lake water chemistry include the composition and flux of magmatic volatiles into the lake, the flux of meteoric water into the system, and interaction between these fluids and fresh magma and its hydrothermally altered derivatives.

The earliest geochemical signals of unrest leading to the 1995-96 eruptions included increased gas flux through the system. This resulted in minor dissolution of earlier-formed hydrothermal alteration phases (eg. natro-alunite) in the vent. Subsequent intrusion of magma into the convective lakewater recirculation zone and increased degassing (SO_2 and HCl) resulted in rapid dissolution of the quenched magma with observed dissolution rates approaching 500 m^3/day (Christenson, 2000). The eruptions removed many of the hydrothermal alteration products from the vent which, combined with evolving volatile compositions and small lake volumes, resulted in large lakewater compositional variations during re-establishment of the lake. Lakewater compositions have once again stabilised as the lake approaches full capacity.

Raoul Island (Kermadecs) is an oceanic arc volcano which last erupted in 1964. Prior to the eruptions, a crater lake situated adjacent to the vent consisted largely of fresh meteoric water (Weissburg & Sorbutt, 1966). At the onset of activity, hydrothermal fluids of approximately sea water composition were expelled into the lake. TOUGH2 modelling of this behaviour indicates that increased flux of magmatic heat and volatiles led to the increased buoyancy of the deep saline fluids, and consequent updoming of the Ghyben-Herzberg interface. This effect is a potentially sensitive indicator of volcanic unrest on this and other such oceanic island volcanoes.

References

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