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Freshwater transport forms of Na, Mg, and Ca in streams of adjacent headwater catchments composed of differing vegetation

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To understand the freshwater transport forms of major metals, concentrations of Na, Mg, Ca, Si, and fulvic acid-like materials (FAM) were measured in streams of headwater catchments with differing vegetation (coniferous and deciduous forests).

The proportion of non-ionic forms (NIF) relative to total elements in the coniferous and deciduous catchments ranged from 0% to 40% and from 0% to 70%, respectively, in baseflows, and from 5% to 60% and from 20% to 60%, respectively, in stormflows. In the baseflows, NIF and total Si (T-Si) were highly correlated ($r > 0.9$) in both catchments. In contrast, in the stormflows, T-Si and FAM showed a good correlation ($r > 0.8$) in both catchments, implying that stormflow may have enhanced organic–inorganic binding. However, in the coniferous catchment, good correlations ($r > 0.8$) between NIF and T-Si or FAM were associated with only the rising limb of the hydrograph, whereas in the deciduous catchment, good correlations ($r > 0.8$) were associated with both the rising and falling limbs.

These results indicate that:
(1) under low-flow conditions, major metals may form binding with clay minerals and thus be transported as NIF,
(2) storm events may enhance the binding of clay minerals with humic substances,
(3) in the coniferous catchment, the complexation of NIF with the organic–inorganic binding and their transport in stormflows are associated with the rising limb of the storm hydrograph, whereas NIF transport during the falling limb may reflect the effect of other materials, and
(4) in the deciduous catchment, NIF transport may occur mainly in association with organic–inorganic binding throughout a storm event.

These findings show that active binding of Na, Mg, and Ca in freshwater environments with organic and inorganic substances, under the effect of differing vegetation on that binding, should be carefully examined in studies of chemical hydrology in headwater catchments.

Key words: fulvic acid, major metal, complexation, humic substance, organic–inorganic interaction