Chemistry of some river waters with respect to bedrock lithology

Chemical weathering of silicate minerals other than quartz depends largely on the acidity of carbonic acid (H_2CO_3). One important result is the production of bicarbonate (HCO_3^-) in solutions generated by weathering. The ratio of bicarbonate to dissolved silica produced by chemical weathering is greatest for mafic minerals and decreases downward through the minerals of Bowen's Reaction Series, as the following reactions show.

Mineral	*Weathering Reaction*	*HCO_3^-/SiO_2*
Olivine	$4H_2CO_3 + MgFeSiO_4 \rightarrow Mg^{2+} + Fe^{2+} + 4HCO_3^- + H_4SiO_{4(aq)}$	4 : 1
Pyroxene	$4H_2CO_3 + 2H_2O + MgFe(SiO_3)_2 \rightarrow Mg^{2+} + Fe^{2+} + 4HCO_3^- + 2H_4SiO_{4(aq)}$	2 : 1
Amphibole	$14H_2CO_3 + 8H_2O + (MgFe)_7Si_8O_{22}(OH)_2 \rightarrow 7(Mg,Fe)^{2+} + 14HCO_3^- + 8H_4SiO_{4(aq)}$	1.75 : 1
Anorthite	$2H_2CO_3 + 2CaAl_2Si_2O_8 + H_2O \rightarrow 2Ca^{2+} + 2HCO_3^- + Al_2Si_2O_5(OH)_{4(s)}$	∞
Plagioclase (An_{50})	$6H_2CO_3 + 2CaNaAl_3Si_5O_{16} + 11H_2O \rightarrow 2Ca^{2+} + 2Na^+ + 6HCO_3^- + 3Al_2Si_2O_5(OH)_{4(s)} + 4H_4SiO_{4(aq)}$	1.5 : 1
Albite (same stoichiometry for K-feldspar)	$2H_2CO_3 + 2NaAlSi_3O_8 + 9H_2O \rightarrow 2Na^+ + 2HCO_3^- + Al_2Si_2O_5(OH)_{4(s)} + 4H_4SiO_{4(aq)}$	1:2
Quartz	$SiO_2(s) + 2H_2O \rightarrow H_4SiO_{4(aq)}$	0:1

Table adapted from Railsback et al. (1996)
A survey of the major-element geochemistry of Georgia groundwater: *Southeastern Geology*, v. 36, p. 99-122.

The effect of these chemical relationships can be seen in the plot of chemistry of river waters below, where watersheds with more mafic bedrock are shown with darker symbols and watersheds with more sialic rocks are shown with lighter symbols.