Do fluorine and chlorine follow water and carbon dioxide fluid in magma?

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Fluorine and chlorine are commonly considered as volatile elements in volcanic system, together with hydrogen, carbon, and sulfur. This is because molecular species of these elements were found in volcanic gasses. We have been examining potentials of using these elements as tracers of magmatic processes, especially to serve as an alternative to major degassing elements such as hydrogen and carbon. Based on glass and melt inclusion data both newly acquired and extensively compiled from previous publications, we report geochemical systematic fluorine and chorine. First, fluorine and chlorine do not correlate with H_2O and CO_2 among degassed volcanic glasses, suggesting these halogens are inefficient in degassing, fractionate during that process. While this finding is consistent with several previous studies, this implies that there is a potential that these halogen elements can infer volatile abundance in magma even for the quenched material that has experienced degassing. Therefore, these elements are suitable for detecting volatile fractionation and transport processes before an eruption. For example, trace element ratios of F/Nd and Cl/Nb are higher in primitive melt inclusions from arcs than in those from MORB and OIB. Because these ratios are thought to fractionate so little during their melting and mineral fractionation processes, these element ratios reflect the nature of volatile element abundance at the time of magma formation. Specifically, F/Nd in some arc samples ranges from comparable values to dry mantle samples to values higher by an order of magnitude. On the contrary Cl/Nb of all arc samples are higher than dry mantle samples. Given F is weakly soluble in aqueous fluid compared to Cl, in presence of amphibole, mica and humites, the enrichment of Cl without an enrichment of F suggest the volatile addition to the source via fluid. On a contrary, the simultaneous F-Cl enrichment trends in arc magmas are consistent with the addition of volatile to arc magma via melt derived from slab. Further trace element systematics is examined to determine to constrain the quantity of fluorine and chlorine added to the source. With combination of previous phase relation data, the abundances of H_2O and CO_2 are potentially constrained as well.