# Physical properties of hydrous magmas and related fluids and their role in mantle processes

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Density and viscosity of hydrous silicate melts are two geologically important physical variables that reflect the increased mutual solubility of minerals, melts and fluids with +*P* along the hydrous solidus. Although, we prefer to view the hydrous melts and mineral+$H_2O$ solubility as two separate effects, there are some simple advantages to representing them as a single phase. One is to use viscosity determinations for hydrous melts relative to pure $H_2O$ to limit the values for intermediate compositions. With available experimental data we have considered the viscosity and densities of concentrated natural fluids between $H_2O$ and silicate melts. We have examined how expected changes in *PT* during natural processes will encourage fluids to dissolve or precipitate, as rock melts dissolve or evolve $H_2O$.

Other fluid components can practically be viewed as inert dilutents.

# Stable isotope fractionation as a tool to determine substrate bioavailability

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In environmental systems, the overall dynamics of microbial degradation processes does not only depend on the abundance of microorganisms and their enzymatic capabilities but also on the bioavailability of the substrate. Substrate bioavailability depends on various factors including mass transfer processes providing the substrate to the location of the microbial cells. Degradation kinetics observed at the macro scale are thus influenced by both, the dynamics of the mass transfer processes and the kinetics of the enzymatic reaction.

Due to the inherent difficulties in measuring the kinetics of each of these processes independently in situ, indirect detection methods are required to determine which of these processes is ultimately controlling macroscopic degradation rates. In recent years, compound specific stable isotope fractionation has been established as a tool for the investigating biodegradation processes. Fractionation is caused by the enzymatic degradation with mass transfer processes assumed not to lead to any significant fractionation. The aim of this study is to investigate how isotope fractionation observed at the macro scale is influenced by bioavailability restrictions and how such effects can be used as an indicator for substrate bioavailability.

By a combination of laboratory experiments and theoretical calculations we could show that observed isotope fractionation factors increasingly differ from enzymatic fractionation factors the more the bioavailability of the substrate is limited by diffusive mass transfer at the micro scale. This allows establishing a quantitative relation between observable isotope fractionation factors and the effective bioavailability of the substrate. An analysis of this relation for the batch systems used in this study shows that even in well mixed systems the effective bioavailability depends on the concentration of the substrate and of the microbial cells. The lower the substrate concentration and/or the higher the cell concentrations the more the effective bioavailability is restricted.