My major current projects include the following: 1. Study of phase relations in mantle peridotite and eclogite coexisting with COH-bearing fluid/melt under controlling oxygen fugacity to determine melt compositions and solidi of natural mantle rocks. 2. Study of hydrogen solubility in mantle minerals under H2O-undersaturated conditions in complex COH-bearing fluid. 3. Study of the phase relations in complex silicate-COH-Cl-S-fluid systems with implication to origin of kimberlite and diamonds.

1. The oxidation state of the mantle controls the speciation of C-O-H-bearing fluids and melts, which in turn can influence the mantle solidus and properties of the resulting liquids. It therefore can play a clue role in magma genesis, magma degassing, and metasomatic processes. In particular, specific change of oxidation state at the boundary between asthenosphere and continental lithosphere and penetration of fluids to the base of the continental lithosphere can control formation of diamond and Cr-rich garnet in strongly depleted harzburgite matrix. According to estimation of the oxidation state of the mantle, CO2-H2O-bearing fluid and melt are localized in the upper mantle depth, corresponding to pressures below 4-6 GPa. At greater depths, the major carbon-bearing phase would be CH4, diamond, or metal carbide coexisting with H2O or hydrogen. Therefore, there are no data for methane-bearing fluids in the pressure range of its stability. We would like to study peridotite and eclogite equilibrated with methane-bearing fluid with different CH4/H2O ratios in the starting materials to the pressures of at least 20 GPa.

2. First measurements of water solubility in deep mantle minerals show that high pressure modifications of Mg2SiO4 (wadsleyite and ringwoodite) can contain up to 3.3 wt.% H2O. Several studies of water solubility in olivine showed that it is increased with increasing pressure, and may be 0.9 wt% H2O at 13-14 GPa. Some other minerals such as pyroxene and garnet can also accommodate significant amount of water. Most experiments on hydrogen incorporation in mantle minerals were performed at H2O fugacity close to unity. Currently, we would like to measure hydrogen solubility in minerals with different CH4/H2O ratios. As a result we can suggest hydrogen concentrations in mantle minerals coexisting with fluid, which composition close to that observed in nature.

3. Studies of fluid inclusions in diamonds and other deep minerals indicate that some other fluid components can be important in petrogenesis of deeply originated rocks, such as kimberlite and carbonatite. Chlorine and chloride may have intriguing importance. Recent results on some Yakutian kimberlites indicate that primary magmas of some kimberlite pipes can be chloride-carbonatite-bearing melt. Although this hypothesis sounds like unrealistic it is important to test influence of chloride on phase...
relations in the mantle. The presence of chloride-bearing brine inclusions in altered oceanic crust is a testament to the potential for chlorine to be subducted. The strongest evidence for significant activity of chloride and carbonate in the mantle is provided by the study of microinclusions in fibrous and cloudy diamonds from kimberlites. Chlorine and chloride geochemistry in the deep mantle is still poorly understood mainly due to lack of experimental data on Cl-bearing systems at high pressures and temperatures. In this project we would like to test experimentally the origin of chloride-bearing fluids in diamonds and reveal role of chlorides in origin of kimberlite magmas and their reactions with mantle substrate observed in natural samples.

As a result of the project we may have some advances for deep understanding of volatile cycling and evolution through the Earth’s history. As well, we would like to obtain new estimations for carbon, hydrogen and other volatile fluxes in the Earth.