Division of Environmental Studies

Department of Environment Systems

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Energy and Environment Laboratory	Dr. Masaatsu AICHI	Current approaches to energy supply and consumption face problems such as climate changes and dwindling resources. The development of key technologies for saving energy, switching to renewable energy resources, and appropriate waste disposal is required. Our goal is to perform research that will contribute to the development of these technologies, especially by taking advantages of the characteristics of subsurface formations. For example, we study ways of developing a sustainable energy system, especially through hydrogeological and thermo-poro-mechanical modeling of geothermal heat pumps, geothermal power plants, and the geological sequestration of carbon dioxide. On the other hand, we also start to study how to adapt to global warming. Combining mitigation and adaptation is an attractive choice but it is not simple because one countermeasure possibly causes another environmental effects. For example, though the groundwater becomes more important water resource under changing climate, the overexploitation of groundwater possibly causes another environmental problem such as land subsidence, sea water intrusion in coastal area, so on. We try to predict and prepare for this kind of domino-like propagation to other environmental problems in advance.	water resource, groundwater, land subsidence, modeling, monitoring	**Analysis of land subsidence caused by groundwater abstraction to design monitoring system for a groundwater management** Land subsidence caused by groundwater abstraction has been a severe environmental problem in Asian coastal megacities. By strictly regulating the groundwater abstraction, the land subsidence in several cities in Japan ceased today. On the other hand, the groundwater becomes more important water resource under changing climate. In addition, the high groundwater pressure is harmful for the subsurface infrastructures. Then, the possibility to restart groundwater abstraction is becoming a matter of debate. However, it is essential to avoid the restart of land subsidence problem. Theoretically, it can be achieved by controlling the groundwater abstraction rate so that the effective stress does not exceed the preconsolidation stress. However, it is very difficult practically because of the heterogeneity in subsurface formations. The practical approach will be a gradual change of ground water abstraction rate with appropriate monitoring to check whether the plastic deformation occurs or not. Then, the questions are what kind of and how accurate monitoring system is required, and how we can interpret

				the monitored data. In this program, we try to answer these questions by analytical or numerical modeling for typical hydrogeologic settings. The schedule is roughly planned as follows: 1st-2nd week: Introduction to land subsidence modeling and monitoring system. 3rd -4th week: Simulation and design of monitoring system.

Oshima Laboratory	Dr. Yoshito OSHIMA	"Supercritical fluid" refers to a fluid in which the material's critical points of temperature and pressure are being exceeded. Dramatic physical changes are possible depending on the operating conditions of the material. In particular, the ionic content and dielectric constant of supercritical water changes extensively based on temperature and/or pressure. As a result of this, it becomes possible to select a reaction based on one's objective: from an ionic atmosphere suitable for inorganic reactions, to one implementing the dissolving of organics, which is equivalent to a non-polar solvent. Taking advantage of these properties, it is expected that this new, inexpensive, environmentally-friendly reaction medium will replace conventional organic solvents. Our laboratory has many research goals, covering a broad range of topics: Degradation of harmful waste products using the oxidation reaction in supercritical water, organic synthesis using solid catalysts, and synthesis of inorganic materials such as nanoparticles and polymers. In regards to all of these fields, by designing, analyzing, and controlling reactions based on a study of chemical reaction rate and reaction engineering, we are advancing extensive research, from fundamental research related to the chemical reaction of supercritical fluids, to the cultivation of new engineering application technologies.	Supercritical Water, Reaction Engineering, Organic Synthesis, Tunable Solvent, Catalysis	**Organic synthesis using supercritical water as an environmental technology** Supercritical water is a promising reaction medium for organic reactions because its solvent properties can be varied with the temperature and the pressure, and these properties affect reaction kinetics and mechanisms. The aim of this study is to propose a methodology which enables to control the reaction rate and the selectivity of organic synthesis reactions only with the change of temperature and pressure of supercritical water.