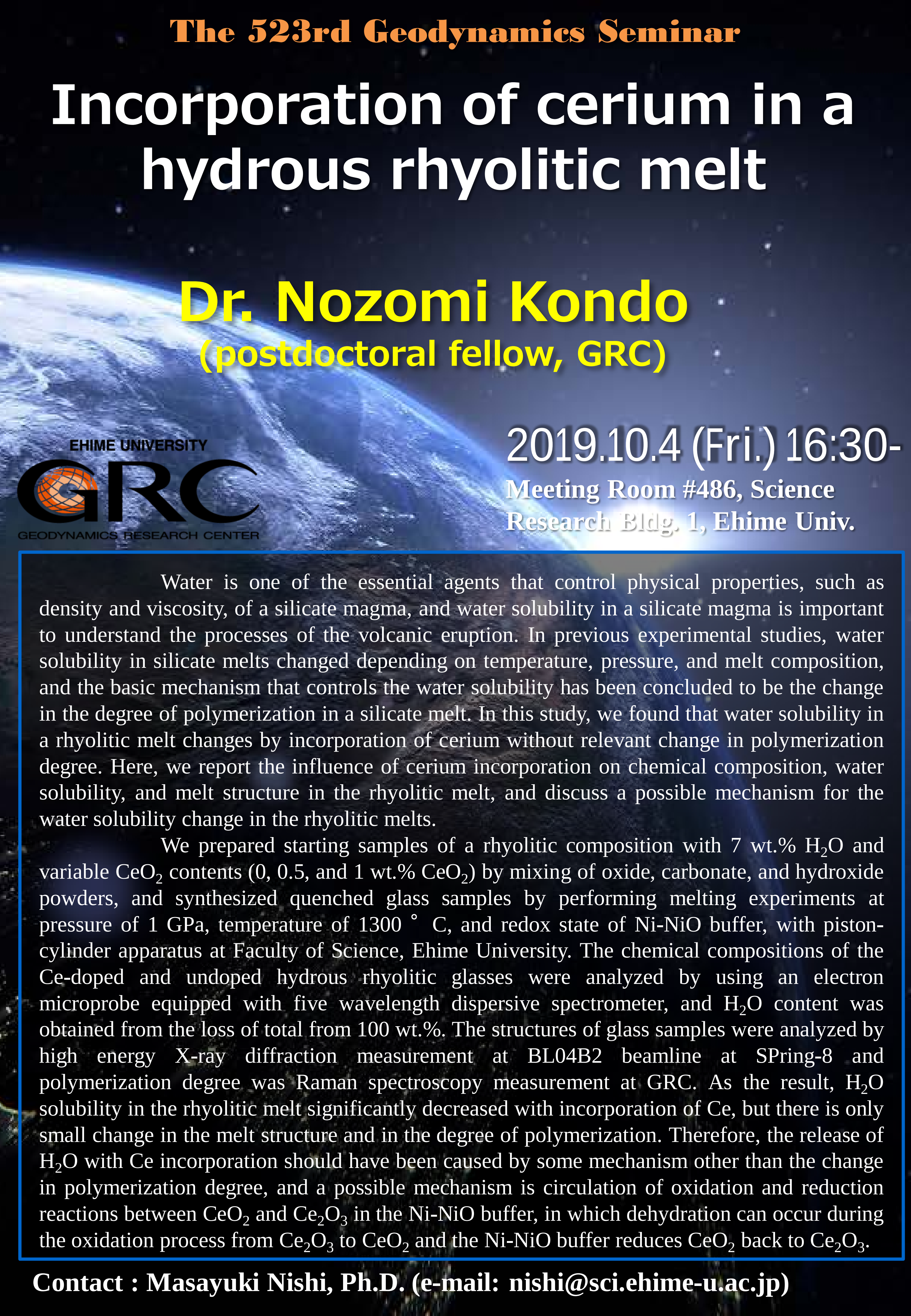

The 523rd Geodynamics Seminar

Incorporation of cerium in a hydrous rhyolitic melt

Dr. Nozomi Kondo
(postdoctoral fellow, GRC)

EHIME UNIVERSITY
GRC
GEODYNAMICS RESEARCH CENTER

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Water is one of the essential agents that control physical properties, such as density and viscosity, of a silicate magma, and water solubility in a silicate magma is important to understand the processes of the volcanic eruption. In previous experimental studies, water solubility in silicate melts changed depending on temperature, pressure, and melt composition, and the basic mechanism that controls the water solubility has been concluded to be the change in the degree of polymerization in a silicate melt. In this study, we found that water solubility in a rhyolitic melt changes by incorporation of cerium without relevant change in polymerization degree. Here, we report the influence of cerium incorporation on chemical composition, water solubility, and melt structure in the rhyolitic melt, and discuss a possible mechanism for the water solubility change in the rhyolitic melts.

We prepared starting samples of a rhyolitic composition with 7 wt.% H_2O and variable CeO_2 contents (0, 0.5, and 1 wt.% CeO_2) by mixing of oxide, carbonate, and hydroxide powders, and synthesized quenched glass samples by performing melting experiments at pressure of 1 GPa, temperature of 1300 ° C, and redox state of Ni-NiO buffer, with piston-cylinder apparatus at Faculty of Science, Ehime University. The chemical compositions of the Ce-doped and undoped hydrous rhyolitic glasses were analyzed by using an electron microprobe equipped with five wavelength dispersive spectrometer, and H_2O content was obtained from the loss of total from 100 wt.%. The structures of glass samples were analyzed by high energy X-ray diffraction measurement at BL04B2 beamline at SPring-8 and polymerization degree was Raman spectroscopy measurement at GRC. As the result, H_2O solubility in the rhyolitic melt significantly decreased with incorporation of Ce, but there is only small change in the melt structure and in the degree of polymerization. Therefore, the release of H_2O with Ce incorporation should have been caused by some mechanism other than the change in polymerization degree, and a possible mechanism is circulation of oxidation and reduction reactions between CeO_2 and Ce_2O_3 in the Ni-NiO buffer, in which dehydration can occur during the oxidation process from Ce_2O_3 to CeO_2 and the Ni-NiO buffer reduces CeO_2 back to Ce_2O_3.

Contact : Masayuki Nishi, Ph.D. (e-mail: nishi@sci.ehime-u.ac.jp)