# Synchrotron radiation X-Ray fluorescence analysis of aqueous fluids and high-Mg Andesite melt under high-temperature and high-pressure conditions

TATSUHIKO KAWAMOTO[1], KENJI MIBE[2], KEN-ICHI KUROIWA[1] AND TESTU KOGISO[3]

[1]Institute for Geothermal Sciences, Graduate School of Science, Kyoto University, Kyoto 606-8502, Japan; kawamoto@bep.vgs.kyoto-u.ac.jp

[2]Earthquake Research Institute, The University of Tokyo, Tokyo 113-0032, Japan; mibe@eri.u-tokyo.ac.jp

[3]Graduate School of Human and Environmental Studies, Kyoto University, Kyoto 606-8501, Japan; kogiso@gaia.h.kyoto-u.ac.jp

Chemical fractionation of slab-derived supercritical fluids can play an important role in elemental transfer from subducting slab to the mantle wedge and arc magmatism [1]. Synchrotron radiation X-ray fluorescence (XRF) analysis is conducted to know elemental partition between aqueous fluids and high magnesian andesite melt with Kawai-type large-volume press at BL04B1, SPring-8, Japan. Incident X-ray is a white beam with energy ranging from 20 keV to 150 keV. During heating at a given pressure, synchrotron XRF spectra are collected from the melt and the aqueous fluid with help of X-ray radiography under HT-HP [2]. The spectra show characteristic X-ray peaks of the doped elements (Cs, Ba, Rare Earth Elements (REE)) superimposed on a continuous X-ray background. A series of experiments has been carried out to obtain partition coefficients between them at 1000-1200 °C and 0.5 - 2.2 GPa. The results suggest that (Na, K)Cl in aqueous fluids have large effects on the partition as previous studies [3]. Two slab-derived components: a melt and a fluid component are suggested to explain trace element characteristics of basalts and basaltic andesites in the Mariana arc [4]. Both components are characterized by enrichment of alkali and alkali earth elements. In addiiton to these, the melt component has immobile elements such as REE [4]. Such features can be explained if the fluid component is a Cl-rich aqueous fluid [3]. We suggest that slab-derived components have compositional features consistent with a Cl-rich aqueous fluid and a melt, which can be formed through a separation of a slab-derived supercritical fluid [1].

[1] Kawamoto *et al* (2012), Proc Nat Acad Sci USA **109**, 18695 [2] Mibe *et al* (2004) *Geochim Cosmochim Acta* **68**, 5189 [3] Keppler, (1996) *Nature* **380**, 237 [4] Pearce *et al*. (2005) *Geochem Geophys Geosys* **6**, Q07006

# Difficulty of the self-replication of prebiotic RNA molecules

K. KAWAMURA[1]*, Y. MARUOKA[1], K. HAMAHIGA[1] AND N. KONAGAYA[2]

[1]Department of Human Environmental Studies, Hiroshima Shudo University, Hiroshima, Japan (*correspondence: kawamura@shudo-u.ac.jp)

[2]Department of Nutritional Sciences, Yasuda Women's University, Hiroshima, Japan

**Difficulties of RNA formation**

The RNA world hypothesis is supported by the discovery of ribozyme, the simulations of RNA formation under the primitive earth environments, and *in vitro* selection of a variety of functional RNA molecules. However, there are several drawbacks regarding the formation and replication of entirely prebiotic RNA molecules. First, the efficient pathway of formation of RNA monomers under the primitive earth conditions is not yet clarified. Second, the cylization of short oligonucleotides [1], such as dinucleotides and trinucleotides, inhibits the accumulation of long RNA. This was partially solved by addition of intercalators [2]. Third, although it is true that RNA molecules preserve genetic information and enzymatic function *in vivo*, these functions are not yet elucidated for the RNA molecules formed entirely prebiotic conditions. It is known that the template-directed synthesis of oligoguanylate from activated nucleotide monomers proceeds on a polycytidylic template [3]. However, other combinations of activated nucleotide monomers on a complementary polynucleotide template proceed with very low efficeincy.

**Results and Discussion**

We have attempted screening to enhance the efficency of the template-directed formation of oligonucleotides. The screening was carried out in the presence of intercalator, polypeptides, metal ions, and naturally-occuring minerals. In addition, the template-directed reaction was carried out at temperature below 0 ºC. Although the efficieny of the template-directed reaction was slightly enhanced in the presence of intercalator, that was generally reduced in the presence of polypepetides, metal ions, and minerals. Furthermore, the influence of very low temperatures was not also deteceted. These results imply the fact that the replication of RNA moleculs consisting of entirely prebiotic materials would be very difficult.

[1] Kawamura & Ferris (1999) *OLEB* **29**, 563-591. [2] Horowitz *et al*. (2010) *PNAS* **107**, 5288-5293. [3] Inoue (1983) *Science* **219**, 859-862. [4] Sawai & Wada (2000) *OLEB* **30**, 503-511.


DOI:10.1180/minmag.2013.077.5.11