Some technological developments in high temperature generation using KMA and precise melting/phase relations of minerals and rocks under deep mantle conditions

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Technological developments in stable and homogeneous high temperature generation have been made using conventional $LaCrO_3$ or Re heater for Kawai-type multianvil apparatus (KMA) with tungsten carbide (WC) and sintered diamond (SD) anvils. For WC-KMA, stable temeperature generation to ~3000 K has been achieved under the pressures up to ~27 GPa mainly for quench experiments. Temperatures of ~2000-2300 K have been produced stably for 20-180 minutes at pressures to ~65 GPa for *in situ* X-ray measurements using SD-KMA, in addition to the *ex situ* experiments.

Some experimental studies for precise determination of subsolidus and melting phase relations have successfully been made for some simple mineral systems, such as $MgSiO_3$-Al_2O_3, $MgSiO_3$-$FeSiO_3$, $MgSiO_3$-$CaSiO_3$, $CaSiO_3$-SiO_2, Al_2O_3-SiO_2, $KAlSi_3O_8$-$NaAlSi_3O_8$, Al_2SiO_5, $Ca_3Al_2Si_3O_{12}$, etc. at temperatures near and above the typical geotherm at pressures corresponding to those of the mantle transition region to the middle part of the lower mantle. These studies have provided firm experimental databases for the mineralogy of the deep mantle, and also led to findings of some new high-pressure phases stable only under the very high-temperture conditions. Melting and associated partioning of some key trace elements in more complex chemical compositions have also been conducted under the pressures of the uppermost lower manlte to constrain the differentiation and evolution of the deep mantle.

Keywords: lower mantle, multianvil apparatus, melting relations, phase relations, high pressure and high temperature experiment, technological development

