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# Hydrothermal experiment of melilite and plagioclase: Implication for formation of nepheline in meteorite parent bodies

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Nepheline ($NaAlSiO_4$) in Ca-Al-rich inclusions (CAIs) and chondrule mesostasis of carbonaceous chondrite is believed to be a secondary altered mineral replacing melilite or plagioclase. Recent studies reported that the nepheline formation is correlated with hydro-thermal process on their parent body, but its detailed condition is not yet established.

To understand the formation process of nepheline in chondrite parent bodies, we conducted hydrothermal alteration experiments. As starting material, we prepared synthetic pure Ca-rich melilite (gehlenite, $Ca_2Al_2SiO_7$), mixture of gehlenite and $SiO_2$, Mg-contained melilite ($Ca_2AlMg_{0.5}Si_{1.5}O_7$), and plagioclase ($Na_{0.5}Ca_{0.5}Al_{1.5}Si_{2.5}O_8$). Hydrothermal alteration experiments were performed with a teflon reaction cell. The experiments were carried out at temperature of 200 $^oC$ for run duration of 168 hours, with different pH condition (0, 7, 13, 14) and different water/rock ratios. Na+ concentration in all solution is maintained at 1 mol/l. Run products were identified by powder X-ray diffraction (XRD) and scanning electron microscopy (SEM).

Under pH 14 condition, nepheline hydrate ($NaAlSiO_4H_2O$) and analcime ($NaAlSi_2O_6H_2O$) were observrd in gehlenite-$SiO_2$ system. Under pH 13-7 conditions, analcime formed by replacing gehlenite or plagioclase. Under pH 0 condition, no crystalline phase was formed from gehlenite and plagioclase. In addition, these alterations proseed under relatively low water/rock ratio condition.

The results indicate that the alteration process of gehlenite and plagioclase strongly depends on pH and water/rock ratio, suggesting that in carbonaceous chondrite parent body aqueous alteration of gehlenite and plagioclase occurred under high pH and lower water/rock ration.

Keywords: nepheline, aqueous alteration, hydrothermal experiments, carbonaceous chondrites