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**“Magmatism of the Earth and related strategic metal deposits”.** Proceedings of International Conference. Saint Petersburg State University, 23-23 May 2019. M.: GEOKHI RAS, 2019. 372 p. ISSN - 2618-835X.

The mineral deposits of strategic metals are vulnerable to political and economic changes, and their availability is essential for high-technology, green energy, and other applications. The most of them are related to the deep-seated alkaline magmas. This book offers a collection of papers presented at the 36th International Conference on “Magmatism of the Earth and Related Strategic Metal Deposits” held from May 23th to 26th 2019 in Saint Petersburg State University, Saint Petersburg, Russia. The conference articles are focused on the understanding of the geological processes that produce high concentrations of critical metals in geological systems such as the metal transport in the mantle and crust and enrichment processes, hydrothermal and metasomatic processes leading to the formation of such significant deposits. Papers in this book give a representative overview including mineralogy, geochemistry and origin of strategic metals deposits.

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The cover pictures – View down the Neva to the river between the Winter house of its Imperial Majesty and Academy of Sciences. G.A. Kachalov's engraving according to M.I. Makhayev's drawing (approx. 1750-1752).

# PHASES OF THE Ca-Al-O SYSTEM AT P-T PARAMETERS OF THE TRANSITION ZONE AND LOWER MANTLE: SYNTHESIS, FEATURES OF CRYSTAL STRUCTURES, ISOMORPHISM, EQUATION OF STATE

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Aluminum takes the first place among metals and the third place among the elements after oxygen and silicon by the prevalence in the Earth's crust. The concentration of aluminum in the Earth's crust, according to various researchers, reaches 16.4 wt. % (Green et al. 1979). Aluminates may be the hosts of aluminum under the conditions of the transition zone and lower mantle of the Earth (Ringwood, 1976; Irifune and Tsuchiya, 2007). There are Ca-aluminates, which may include various cations, such as Fe, Mg, Na, influencing the phase relations in the CaO-Al<sub>2</sub>O<sub>3</sub> system. To date, several intermediate compounds are known in the CaO-Al<sub>2</sub>O<sub>3</sub> system (CaAl<sub>2</sub>O<sub>4</sub>; CaAl<sub>4</sub>O<sub>7</sub>; CaAl<sub>12</sub>O<sub>19</sub>; Ca<sub>3</sub>Al<sub>2</sub>O<sub>6</sub>; Ca<sub>2</sub>Al<sub>2</sub>O<sub>5</sub>; Ca<sub>12</sub>Al<sub>14</sub>O<sub>33</sub>) (Ito et al, 1980; Lazic et al, 2006; Janakova, Salavcova, Renaudin et al, 2007; Jerebtsov and Mikhailov, 2001; Filonenko and Lavrov, 1949; Ivanova et al, 2002; Ma, Kampf et al, 2011; Mikouchi, Zolensky et al, 2009). They are stable over a wide range of pressures and temperatures.

Table 1. Crystal data for CaAl<sub>2</sub>O<sub>4</sub> and Ca<sub>2</sub>Al<sub>6</sub>O<sub>11</sub>.

	Ca <sub>2</sub> Al <sub>6</sub> O <sub>11</sub> (tetragonal)	CaAl <sub>2</sub> O <sub>4</sub> (orthorhombic)
Formula	Ca <sub>2</sub> Al <sub>6</sub> O <sub>11</sub>	CaAl <sub>2</sub> O <sub>4</sub>
Space group	<i>P4<sub>2</sub>/mm</i> (#136)	<i>Pnma</i> (#62)
Cell parameters		
<i>a</i>	11.1675(4)	8.8569(10)
<i>b</i>	11.1675(4)	2.8561(4)
<i>c</i>	2.83180(10)	10.2521(11)
<i>α</i>	90°	90°
<i>β</i>	90°	90°
<i>γ</i>	90°	90°
<i>V</i>	353.16(2)	259.34(5)
<i>Z</i>	2	8
<i>ρ</i> (g/cm <sup>3</sup> )	3.93	4.08

Experiment on synthesis of the phases in the Ca-Al-O (±Fe) system were carried out using a high pressure - high temperature 1000-t multi-anvil Sumitomo press and 1200-t multi-anvil Haymag press at Bayerisches Geoinstitute (BGI). The phases of CaAl<sub>2</sub>O<sub>4</sub>, Ca<sub>2</sub>Al<sub>6</sub>O<sub>11</sub> and Ca(Al,Fe)<sub>2</sub>O<sub>4</sub> were synthesized at 1600°C and 15, 24 GPa, respectively. Compounds of these phases were studied by different methods including optical microscopy, SEM and microprobe analysis. The method of single-crystal X-Ray diffraction allowed us to refine the structures (Table 1) and to determine the crystal chemical formulae of the phases. All studied phases with the stoichiometry AB<sub>2</sub>O<sub>4</sub> have the CaFe<sub>2</sub>O<sub>4</sub>-type structure. The structures of the synthesized phases were refined by the method of single-crystal X-Ray diffraction using synchrotron radiation. The compressibility of the Ca(Al,Fe)<sub>2</sub>O<sub>4</sub> phase was studied up to ~60 GPa. In this pressure range, no phase transformations were detected, but the spin transition for iron was registered. As one of the results of this study, it was possible to obtain the equation of state for the Ca(Al,Fe)<sub>2</sub>O<sub>4</sub> phase (Fig. 1).

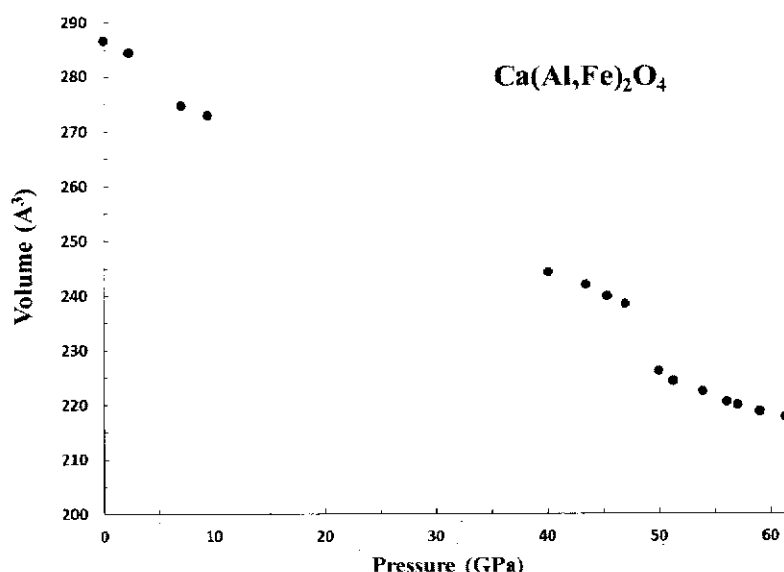


Figure 1. The diagram of the dependency for volume of the cell from the pressure for  $\text{Ca}(\text{Al,Fe})_2\text{O}_4$  phase.

The data obtained may be applied to construction of a P-T phase diagram in the  $\text{CaO-Al}_2\text{O}_3$  system (the current diagrams are limited to a pressure of 16 GPa).

The studied phases are stable in the transition zone and lower mantle of the Earth and can be considered as potential aluminum concentrators in the Earth's deep geospheres.

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