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Mineral chemistry of pyroxene megacrysts from Japanese island arc: Contribution of Mn-pyroxene end-member to Island arc

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The chemical compositions of both augite (4 to 8 mm long) and enstatite (4 mm in size) megacrysts from the pyroxene-andesites, south-Yatsugatake volcano, central Japan, were determined by electron microprobe analysis (EMPA). This determination led to accurate expression of the pyroxene end-members obtained by calculation based on the assumption of charge equilibrium and the site occupancy as full as possible, represented as follows: $MgSiO_3$ (enstatite), $Fe^{2+}SiO_3$ (ferrosilite), $MnMgSi_2O_6$ (kanoite), $CaTiAl_2O_6$, $CaFe^{3+}AiSiO_6$ (esseneite), $CaSiO_3$ (wollastonite), $CaAl_2SiO_6$ (Ca-Tschermak's molecule) or $Ca_{0.5}[]_{0.5}AlSi_2O_6$ (Ca-eskolite), $NaAlSi_2O_6$ (jadeite), $NaCr^{3+}Si_2O_6$ (kosmochlor) and $Mg_{1/2}[]_{1/2}Mg_{1/2}Si_{1/2}Si_2O_6$ (a new end-member). Furthermore, calculation of the above end-members is also applicable to the chemical compositions of common pyroxenes, resulting in the determination of Fe^{2+} and Fe^{3+} contents in the analyzed pyroxenes.

Encompassment of the end-members by the pyroxene has yielded two significances in pyroxene chemistry: (1) pyroxene megacrysts from Japanese island arc are always richer in $MnMgSi_2O_6$ content than those from all the other world, and (2) a negative correlation between $NaAlSi_2O_6$ (jadeite) and $Mg_{1/2}[]_{1/2}Mg_{1/2}Si_{1/2}Si_2O_6$ contents (a new end-member) implies that the presence of the latter in pyroxene requires high-pressure conditions for the formation. Stability of jadeite at high pressure, the silicon coordinated by six oxygens contributing to its genetic environment of high-pressure (Larry et al., 1991), and the success in synthesizing high-pressure pyroxene with octahedrally coordinated silicon, $Na(Mg_{0.5}Si_{0.5})$ Si_2O_6 at 1873 K and 15 GPa (Angel et al., 1988), all support the utility behavior of a new end-member of pyroxene at high-pressure.

Most significantly, as the allanites in granitic rocks from Japanese island arc are always more enriched in Mn compared to those in the other worldwide granites, so the present pyroxene megacryst containing $MnMgSi_2O_6$ end-member is an eloquent example of "Island arc mineralogy".

Keywords: Pyroxene megacrysts, end-member expression, $MnMgSi_2O_6$, "island arc mineralogy", new emd-menber