PETROLOGY OF FERROAN DIOGENITES, YAMATO 75032 TYPE, ASUKA 881839, AND DHOFAR 700.
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Introduction: The HED (howardites, eucrites, and diogenites) meteorites are the largest group of achondrites, probably derived from the Vestan crust. Eucrites are pigeonite-plagioclase basalts or gabbro, and diogenites are orthopyroxenites. Howardites are essentially mechanical mixtures of eucrites and diogenites.

Yamato (Y) 75032 type, Asuka (A) 881839, Dhofar (Dho) 700 are among the most ferroan diogenites (Mg'/= molar Mg/(Mg+Fe)) of pyroxenes = ~67-70), slightly more magnesian than Mg-rich cumulate eucrites (e.g., Binda) [1,2,3]. Thus, the study of these ferroan diogenites provides clues to understand the petrogenetic relationship with eucrites.

Samples and Analytical Techniques: Y75032 type diogenites are members of Y75032 type achondrites (Y75032 type) [4]. We petrologically studied four Y75032 type diogenites (Y75032, Y791199, Y791202, Y791422) and other Y75032 type achondrites (Y791200, Y791201, Y791439), and two ferroan diogenites, A881839 and Dho 700. For comparison, we studied cumulate eucrites, Moore County, Moama, and Y791195. Polished thin and thick sections (PTSs) of these meteorites were examined optically and with a SEM and EPMA. The bulk chemical compositions of pyroxenes were determined by averaging 5-30 analyses using a broad beam (~30 µm in diameter).

Results and discussion: Y75032 type diogenites are breccias mainly composed of angular to subrounded fragments of pyroxenes (Mg' = ~67-70, Fig. 1) with minor plagioclase (glass), tridymite (glass), and chromite, cemented by dark impact melts [1-4]. Y791200 and Y791201 are similar to Y75032 type diogenites, but contain fragments of cumulate eucrites. Y791439 is a polymict cumulate eucrite. The Mg' of pyroxenes (~70-55) are wider than those of Y75032 type diogenites [5].

Y75032 type diogenites have three types of pyroxenes: orthopyroxene and two types of inverted clinopyroxenes [1,2,4]. One type of inverted clinopyroxene is orthopyroxene with blebby augite (inverted low-Ca pigeonite, or Binda-type). The other type of inverted clinopyroxene is thin wormy augite set in orthopyroxene (inverted very low-Ca clinopyroxene). Binda-type pyroxene was formed by decomposition of pigeonite that crystallized on the pigeonite eutectoid reaction line [1,2]. Inverted very low-Ca clinopyroxene has bulk Ca compositions lower than those of Binda-type but higher than those of high Ca orthopyroxene [1,2]. These observations indicate that pyroxenes in Y75032 type diogenites crystallized as orthopyroxene and/or clinopyroxene. Plagioclase has a wide chemical variation (An79-91). Plagioclase may have crystallized from intercumulus liquid [1,2,3].

A881839 is a breccia composed of pyroxene fragments with minor amount of plagioclase. Many pyroxenes have thin augite lamellae and tiny irregular to blebby augite set in orthopyroxene matrix. Other fragments in the PTS are Binda-type inverted pigeonite. Thus, the majority of pyroxenes in A881839 crystallized as clinopyroxenes. Dho 700 is an unbrecciated rock, showing a granular texture. The granular pyroxenes have orthopyroxene cores mantled by inverted very low-Ca clinopyroxene. The major element compositions and the presence of inverted very low-Ca clinopyroxene indicate that pyroxenes in Y75032 types, A881839 and Dho 700 may have crystallized under similar conditions.

Fig. 1. Portion of pyroxene quadrilateral for Y75032 type achondrites, ferroan diogenites, A881394 and Dho 700, and cumulate eucrites (CEs), Moama, Moore County, and Y791195.

Moore County, Moama, and Y791195 are cumulate eucrites, composed of pyroxenes and plagioclase with minor phases such as tridymite, chromite, and/or ilmenite [e.g., 3,5]. Moore County and Moama are coarse-grained gabbros, whereas Y791195 is a fine-grained recrystallized rock. Moore County has pyroxenes partially inverted to orthopyroxene with fine (100) lamellae set between thick (001) augite lamellae (MC-type) [5]. Moama has completely inverted pi-
The compositions of Y75032 types are similar to those of cumulate eucrites, Moore County, Moama, and Y791195. Y75032 type diogenites fill a gap between cumulate eucrites and typical diogenites. However, the minor element compositions of pyroxenes and chromite compositions are very different. The similar TiO$_2$ and Al$_2$O$_3$ relationship and the presence of fragments of cumulate eucrites indicate that Y75032 type diogenites may have crystallized from a liquid akin to eucrite. This study provides additional evidence for multiple parent liquids for diogenites [10].