Mineralogical and petrological study of plagioclase-bearing lodranite, Yamato 981988.

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Introduction Primitive achondrites are meteorites that have both chondritic and achondritic features. Acapulcoite-lodranite clan is the second largest clan of primitive achondrites [1]. Acapulcoites and lodranites are primarily distinguished based on their grain sizes. Acapulcoites have finer-grained textures (˜0.2 mm) whereas lodranites have coarser-grained textures (˜0.5-0.7 mm) [2, 3]. Acapulcoites have chondritic modal abundances and bulk chemical compositions. Most lodranites have modal abundances depleted in plagioclase and/or troilite and fractionated bulk chemical compositions. Several transitional acapulcoite-lodranite meteorites have been found. The transitional group has larger grain sizes than acapulcoites, whereas they have modal abundances rich in plagioclase and bulk chemical compositions relatively similar to acapulcoites rather than lodranites [4, 5, 6]. The transitional group provides us with the further clues on the igneous and metamorphic processes on the parent body.

Samples and methods We investigated one polished thin section (PTS) of Y 981988. The PTS was observed by an optical microscope and a FE-SEM (JEOL JSM 7100F). Mineral compositions were obtained by using of an EPMA (JEOL JXA8200). The lattice preferred orientations (LPO) were measured by using of an EBSD detector (Oxford instruments AZtec HKL) mounted on the FE-SEM.

Results Y 981988 shows a coarse-grained texture (˜0.7 mm) mainly consisting of olivine (43 vol.%) (Fo_{93}), orthopyroxene (34 vol.%) ($Wo_{3.0}En_{88}$) plagioclase (10 vol.%) ($Or_{2.5-4.8}Ab_{78-84}$), and Fe,Ni-metal (6 vol.%). Plagioclase occurs interstitially. Some plagioclases partly or entirely enclose olivine and orthopyroxene grains. The lattice preferred orientations of plagioclase crystals are the same in wide areas up to ˜6mm width. The PTS contains a large augite crystal (˜7 mm) ($Wo_{43-46}En_{50}$-$_{53}$) that poikilitically encloses olivine and orthopyroxene chadacrysts. Minor mineral includes phosphate, schreibersite, troilite and chromite (molar Cr/(Cr+Al)x100 = 14-16, molar Fe/(Fe+Mg)x100 = 51-57). The pyroxene equilibration temperatures [7] are estimated to be ˜1120˚C from orthopyroxene and ˜1090˚C from augite. These temperatures are similar to those of other lodranites [2].

Discussion The mineral compositions are within the range of acapulcoite-lodranite meteorites. The coarse-grained texture favors that Y 981988 is a lodranite. However, modal abundance rich in plagioclase is similar to acapulcoites rather than lodranites.

McCoy et al. [3] found that plagioclase modal abundances among lodranites are correlated with Fa content of olivine, except for EET 84302. They argued that relatively large abundances of plagioclase were caused by low degree of silicate partial melting. They indicated that mafic silicate compositions or low peak temperatures caused low degree of partial melting. The modal abundance of plagioclase of Y 981988 is not correlated with olivine composition.

These observations indicate that Y 983119 suffered silicate partial melting over the solidus temperature, but probably did not experience removal of silicate melt. We suggest that Y 981988 is a transitional acapulcoite-lodranite meteorite.

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