CRYS TALIZATION EXPERIMENT OF LOS ANGELES BASALTIC SHERGOTTITE: IMPLICATIONS FOR THE CRYSTALIZATION OF LOS ANGELES AND DHOFAR 378. E. Koizumi, T. Mikouchi, J. Chokai, M. Miyamoto, Department of Earth and Planetary Science, Graduate School of Science, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan, E-mail: koi@eps.s.u-tokyo.ac.jp

Introduction: Los Angeles (LA) is a coarse-grained basaltic shergottite composed of pyroxene and maskelynite [1] (Fig. 1). Pyroxenes in this meteorite are pigeonite and augite, and both pyroxenes are extensively zoned from relatively Mg-rich cores to Fe-rich rims (Fig. 2). The Ca zoning pattern is complex and pigeonite and augite are irregularly distributed unlike other basaltic shergottites [1-3]. Previous study interpreted this irregular zoning as the result of exsolution at low temperature [3]. Because LA has high plagioclase abundance similar to QUE94201, there is a possibility that the LA bulk composition represents a parent melt composition [4]. However, these two shergottites show distinct pyroxene zoning patterns although their compositions are generally similar. In this study, we performed a crystallization experiment using the LA bulk composition to investigate the crystallization history of LA. We also compared LA mineralogy with that of Dhofar 378 (DHO) which shows a lot of mineralogical characteristics similar to LA, and applied the experimental result to explain the differences between LA and DHO.

Crystallization experiment: We performed crystallization experiments by using a wire loop technique [5]. We prepared starting material having the bulk composition of LA [1]. The pellets were homogenized slightly above the liquidus temperature (1155 °C) for 48 hours and then cooled down to 800 °C at various cooling rates (0.5, 1, 2.5, and 5 °C/hour) under the oxygen fugacity of QFM-1.3 (estimated fO2 of LA). So far we could obtain the phase compositions of the LA bulk composition to investigate the crystallization at low temperature [3]. Because LA seems to be a fractionated sample. We calculated the equilibrium mineral assemblages by using the MELTS program [7] with the bulk composition of LA under QFM-1.3. According to the calculation results, the liquidus phase of this bulk composition is chromite and plagioclase (An80) at 1128 °C. This plagioclase composition is more Ca-rich than that of LA (An84). Then, pigeonite (En47Fs38Wo15) started crystallizing at 1110 °C. This composition is similar to the core composition of pigeonite in LA (En47Fs38Wo15) although Ca content of the pyroxene core in LA is slightly lower. Immediately after the onset of pigeonite crystallization, augite (En38Fs32Wo30: also similar to the core composition of LA augite (En38Fs32Wo30)) started crystallizing, and then both pigeonite and augite became Fe-rich with constant Ca contents. Whitlockite appeared at 1068 °C and Fe-Ti oxides at 870 °C. The crystallization ended at around 830 °C, and the compositions of pigeonite and augite at this temperature were En26Fs71Wo9 and En24Fs72Wo9, respectively.

Experimental result and crystallization of LA: Our crystallization experiment shows that pyroxene started crystallizing before the onset of plagioclase crystallization unlike the MELTS calculation result (Fig. 3). The run product consists of pyroxene, plagioclase, Fe-rich olivine, and Fe-Ti oxides. The possible reason that the pyroxene crystallized earlier than plagioclase could be the nucleation difficulty of plagioclase due to fairly fast cooling rate (2.5 °C/hr) of the experiment. Synthetic pyroxene is zoned from the Mg-rich augite core to the Fe-rich rim with lower Ca content, although hedenbergite formed at the pyroxene edges (Fig. 2). The texture of the run product suggests the following crystallization sequence. (1) Mg-rich augite core crystallized. (2) Plagioclase started crystallizing with the Fe-rich pyroxene rim. (3) After the end of pyroxene crystallization, fayalitic olivine (Fa90) began to crystallize. Synthetic pyroxenes are all high-Ca pyroxenes, and there is no Mg-rich pigeonite that was present in LA. However, the zoning sequence shows a similar trend between synthetic and natural LA pyroxenes (Fig. 2). When the charge could have been cooled more slowly, plagioclase crystallized first and then low-Ca pyroxene might have crystallized as is the MELTS result. Otherwise, the parent melt of LA is more Mg-rich and Ca-poor than the bulk LA composition because LA seems to be a fractionated sample. We prefer the latter scenario because (1) LA should have cooled fast enough to preserve chemical zoning of pyroxenes, (2) the LA plagioclase is clearly more Ca-poor than the calculated plagioclase composition as the liquidus phase of the LA bulk composition. Probably, plagioclase in LA crystallized after the onset of augite crystallization.

Implications for the recrystallization of DHO: DHO is composed of subequal amounts of pyroxene and maskelynite, and shows mineralogical characteristics similar to LA (Fig. 4). Both pigeonite and augite...
are zoned from the Mg-rich cores to the Fe-rich rims, and their compositions are similar to those of LA (Fig. 5). In addition to the pyroxene composition, DHO resembles LA in lithology, grain size, and mineral assemblage [8]. However, a complex mixture of hedenbergite, fayalite and silica abundant in LA is absent in DHO in spite of their striking mineralogical similarities. Such a texture is interpreted as a breakdown product of pyroxferroite [1,9]. Because DHO contains abundant vesicles that are not seen in LA, DHO must have experienced a higher shock degree than LA. Probably, higher shock degree of DHO melted these phases although they were originally present as seen in LA. Some areas in DHO include euhedral fayalite with Fe-rich pyroxene and the mesostasis. These areas are considered as originally pyroxferroite breakdown products that melted by shock and subsequently recrystallized [9]. Because the pyroxene compositions of LA and DHO are similar, the slower cooling also may be able to reproduce the pyroxene in DHO. However, our 2.5 °C/hr cooling run could be comparable to the cooling rate for recrystallization of DHO from shock melt, although this cooling rate was too fast to reproduce the original igneous texture and mineralogy of LA. The run product crystallizes euhedral fayalite with Fe-rich pyroxene at their last crystallization stage. The chemical composition of synthetic fayalite is similar to that in DHO (Fa~85). Therefore, we believe that the recrystallization of Fe-rich phases from the shock melt of DHO was reproduced at the last stage of our 2.5 °C/hr cooling experiment.

The coming results of slower cooling experiments will tell more about the crystallization of LA and DHO.