CARBONATE MINERALOGY OF THE C1 CLASTS IN KAIDUN METEORITE. K. Ogiya[1,2], T. Mikouchi[2,1], M. E. Zolensky[3], [1]Dept. of Earth and Planet. Sci., University of Tokyo, Hongo, Tokyo 113-0033, Japan, [2]University Museum, University of Tokyo, Hongo, Tokyo 113-0033, Japan, [3]ARES, NASA Johnson Space Center, Houston, TX 77058, USA, E-mail: ogiya-kenei886@g.ecc.u-tokyo.ac.jp.

Introduction: The Kaidun meteorite is a polymict microbreccia weighing approximately 850 g that fell in the People's Republic of South Yemen on December 3, 1980. Although the host material is CR chondrite, it is unique in that it contains many clasts of various chondritic and achondritic materials. Chondritic clasts include EH3-5, EL3, C1, C2, CM1, CM2, CV3, and ordinary chondrite-related materials. Achondrites include a high-Ca primitive achondrite, fragments of alkali-rich differentiated materials, and an aubrite-like clasts [1]. In this study, we focused on C1 materials. There is plenty of evidence that aqueous alteration in the carbonaceous chondrite clasts in Kaidun occurred primarily on their parent bodies before accumulation to a Kaidun body/ Therefore, observations of the C1 materials, which are highly aqueously altered, can provide quantitative constraints on the geologic history of their asteroid parent bodies. In addition, although the lack of petrological features can make the classification of C1 material more difficult, recent studies and analysis of new meteorite fall and returned samples continue to emphasize the diversity of C1 materials [2].

Since Kaidun has unprecedentedly diverse clasts of different origin, it is expected to contain unknown C1 materials, including ungrouped C1, which will lead to further diversity in C1 materials. Therefore, this study aims to systematically understand C1 materials by comparing C1 materials in Kaidun with known C1 materials such as CI1.

This study mainly focused on carbonate mineralogy of the Kaidun C1 materials. Since carbonates are minor but ubiquitous constituents of CI chondrites, carbonate composition has been analyzed in CI1 chondrites [3, 4]. They are often coarser than phyllosilicates, which is the most dominant constituent of C1 materials, and can be analyzed by electron microbeam techniques. Therefore, carbonates provide a valuable opportunity to constraint the physical and chemical conditions of C1 materials alteration processes. Since such an analysis of the C1 material in the Kaidun meteorite has not yet been fully performed, we analyzed the chemical composition of carbonates in the C1 materials of the Kaidun meteorite.

Samples and analytical methods: Six thin section samples used in this study. Each sample is named 58.06.2, 01.3.10h, 01.3.13g, 01.3.19, 58.06.1, and #4, and we have now analyzed the first three samples. Analytical data for the remaining three samples will be added at the meeting. FE-EPMA (JEOL JXA-8530F at Dept. of Earth and Planet. Sci., Univ. of Tokyo) was employed for observation and chemical composition analysis of the carbonate minerals.

Results and Discussions: Three thin sections of six samples from Kaidun were observed and 122 dolomites from 15 clasts were analyzed. Most of the clasts had a texture similar to those of CI1 chondrites. Two of the clasts coexisting with Ca carbonates and dolomites and 19 Ca carbonates were analyzed. There were also clasts containing only Ca carbonates, but since it also contained anhydrous silicates, it was considered to be C1/2 and C2 material and was excluded from this study. In addition, no magnesite was observed.

Dolomites are commonly dispersed in the matrix as isolated grains, up to less than 100 μm in size, and often coexisting with magnetite. Calcium carbonates are dispersed in the matrix as round-shaped micrometer grains.

The chemical composition of dolomite analyzed in this study is shown in Fig. 1. Compared to the previous studies of CI and CM dolomites, it tends to be more enriched in Ca and Fe-Mn components. Ca-rich tendency is a more common feature of CM dolomites compared to CI, and it is noteworthy that such a tendency appeared even though most C1 clasts in this study has a similar texture to the CI chondrite matrix [3].

The overall Fe enrichment was also suggested. Fig. 2 shows a plot of Fe versus Mg, showing a higher Fe and lower Mg component than that of CI dolomites [3]. This is inconsistent with the characteristics of CI dolomites, which has low Fe content and high Mg. Therefore, most of the clasts cannot be classified as CI1 based on the chemical composition of the carbonates. In fact, Zolensky & Ivanov [5] found that the C1 clasts in Kaidun are closer to CM and CR than to CI based on their bulk compositions and O isotopic analysis. Thus, the carbonate mineralogy of Kaidun C1 materials analyzed in this study is consistent with these characteristics.

Conclusions: The carbonate analysis of C1 materials in Kaidun performed in this study revealed that many of the grains are more enriched in Ca and Fe components than typical CI1, although there are some overlapping regions with CI and CM dolomites. In other words, even though the clasts have a matrix texture similar to CI1, they have a different carbonate composition from CI1. These observations are consistent with the hypothesis that the C1 materials in Kaidun consists of a near continuum encompassing CM, CR, and CI meteorites [1].

However, although the dolomites analyzed in this study is closer in composition to CM dolomite than to CI, it shows a wider compositional distribution and may be different from the carbonates of C1 materials already known. Therefore, it is conclusive that Kaidun contains C1 materials that are not bound by the existing framework of CI and CM, and we intend to conduct a detailed mineralogical description of the unknown C1 materials, including analysis of other minerals, to systematically understand C1 materials.

References: [1] MacPherson G. J. et al. (2009) *Geochimica et Cosmochimica Acta* 73.18, 5493-5511. [2] Russell S. S. et al. (2022) *Meteoritics & Planetary Science* 57, 277-301. [3] Johnson C. A. and Martin P. (1993) *Geochimica et Cosmochimica Acta* 57, 2843-2852. [4] Endreß M. and Bischoff A. (1996) *Geochimica et Cosmochimica Acta* 60, 489-507. [5] Zolensky M. and Ivanov A. (2003) *Geochemistry* 63, 185-246.

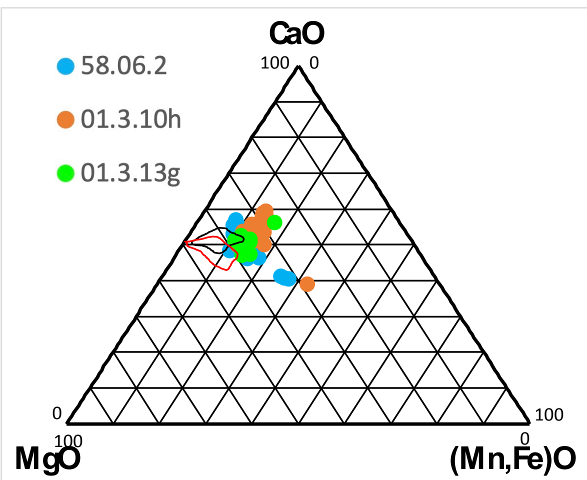

Fig.1 Dolomite compositions of C1 materials in the Kaidun meteorite (mol%). The area circled by the red line is the compositional region of dolomites in CI chondrites and the area circled by the black line is the compositional region of CM dolomites, respectively (Data from [3]).