THE KAIDUN BRECCIA MATERIAL VARIETY: NEW CLASTS AND UPDATED HYPOTHESIS ON A SPACE TRAWL ORIGIN

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Introduction: The Kaidun meteorite is a breccia containing a wide variety of different material types [1- 5]. It contains lithologies of CI, CM1 and CM2, CR chondrites [6], CAIs of Types A and B [7, 8], enstatite chondrite materials (EH and EL) [3, 4], including altered enstatite clasts [9], ordinary chondrites [10], and possible R chondrite material [11] as well as glass fragments and altered shock melt veins [4]. It also contains different achondritic clasts (including alkaline rocks) with unusual oxygen isotopic compositions representing unknown differentiated parent bodies [2, 12]. Based on Fe/Mn and Fe/Mg ratios these clasts correspond to the SNC and HED meteorites and confirm their origin from differentiated parent bodies that experienced impact events and aqueous alteration, and not represented by known meteorites. We continue studying Kaidun and report results on investigation of newly discovered objects and discuss processes of their formation, and the origin of the Kaidun microbreccia as a whole.

Results and Discussion: Clast #d7.2-68 was found in Kaidun section #7.2d. It consists of pyroxene and SiO_2-phases. Pyroxene is pigeonite (Fs_{63-67}, Wo_{10-14}, Fe/Mn – 40.1) with augite lamellae (Fs_{44-57}, Wo_{20-34}, Fe/Mn – 40.4) (up to 10 μm width). Equilibrium temperature of coexisting pyroxenes is close to 900°C at 5 Kbar [13]. The observed smooth shape of the CaO profile across the pyroxene lamellae could correspond to mild metamorphism after exsolution. On a plot of Fe/Mn vs. Fe/Mg, the clast falls at the far Fe-rich end of the HED pyroxenes cluster. The SiO_2-phase is enriched in Al_2O_3 and FeO and possibly is tridymite. The exsolution textures of pyroxenes require annealing for a long period of time and are typical features of achondrites, especially eucrites. This clast could represent a fragment of differentiated material of a body size of which is similar to the HED parent body.

Clast #d5-3 from section #d5 consists of zoned olivine grains (Fa_{34-42}) embedded in mesostasis consisting of two components with a clear boundary. One component is a Na-Ca glass. The second component contains crystals whose composition is similar to that of unusual crystals and coatings from cavities of the clasts #d3A and #d3-5 [4, 14]. Based on Fe/Mn and Fe/Mg ratios the clast is in the range of lunar basalts. We studied unusual striped crystals using EBSD. Chemical compositions of crystals and coatings in cavities of #d3A, #d3-5 and in clast #d5-3 are variable in FeO, MgO and Al_2O_3 and enriched in Cl (1.1 wt%). These phases probably belong to the quintinite group with a trigonal structure. They are $Mg_4Al_2(OH)_{12}Cl_2$-xH_2O-$Mg_4Al_2(OH)_{12}(OH_2)$-xH_2O or $Mg_4Al_2(OH)_{12}(CO_3)$-xH_2O, and $Fe_4Al_2(OH)_{12}(CO_3)$-xH_2O or $Fe_4Al_2(OH)_{12}(OH_2)$-xH_2O. $Mg_4Al_2(OH)_{12}Cl_2$-3H_2O is chlormagmaluminite; $Fe_4Al_2(OH)_{12}(CO_3)$-3H_2O is caresite. It was impossible to determine CO_3 in these tiny phases. Among them $Mg_4Al_2(OH)_{12}(OH_2)$-xH_2O, $Mg_4Al_2(OH)_{12}(CO_3)$-xH_2O, and $Fe_4Al_2(OH)_{12}(OH_2)$-xH_2O are potential new minerals. Formation of crystals in the cavities in clasts of different origin indicate the same source of the fluid circulated in the Kaidun parent body after its accretion.

Given Kaidun's highly diverse assemblage of extremely different rock types, a space-trawl hypothesis has been advanced [15] to best explain the lithological diversity of the microbreccia. A celestial body which orbits the Sun along a highly eccentric orbit with distant aphelion could pass like a trawl through different regions of the solar system, collecting samples of different material on the way. It should be massive enough to survive numerous collisions during the travel voyage, and need to be porous enough to absorb and preserve more or less friable samples of different origin encountered on the way. Examples could be a nucleus of an extinct comet which had lost most of volatiles, C-type asteroid material, a porous asteroid resident for a time at a Lagrange Point, etc.

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