# Two unusual carbonaceous chondrites, Asuka-9003 and Asuka 09535: Preliminary results on their classification in comparison with Yamato-82094.

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**Introduction**: Carbonaceous chondrites are classified into several groups, such as CI, CM, CO, CV, CK, CR, CB, and CH. However, some are ungrouped [1]. One of them, Yamato (Y)-82094, has features that distinguish it from the other C chondrites; 1) chondrule size is intermediate between CV and CO, 2) the matrix is low in abundance, like ordinary chondrites, and 3) a silica phase is present in many chondrules [2]. No similar C chondrite has been reported. Therefore, Y-82094 is an ungrouped C chondrite [2]. Recently, two unusual carbonaceous chondrites, Asuka (A)-9003 and A 09535, were reported [3]. Here we present our preliminary results on these chondrites, and discuss their classification, in comparison with Y-82094.

**Petrography**: A-9003 and A 09535 show typical carbonaceous chondritic texture, including abundant refractory inclusions (CAI and AOA) (7.5 and 11.3 vol.%, respectively). However, the most abundant component is chondrules (80.1 and 78.5 %), and the matrix is low in abundance (13.0 and 12.6 %). CAIs mainly consist of melilite, spinel, Ca-rich pyroxene, and anorthite with perovskite. AOAs abundantly contain CAIs within them. CAIs and AOAs often contain small amounts of the secondary alteration phases, such as nepheline. The FeO-rich rim of magnesian olivine in AOAs is usually less than 3μm in width. The average chondrule sizes of A-9003 and A 09535 are 0.29 and 0.30 mm, respectively. Type I chondrules comprise olivine, clinoenstatite, and anorthite or weakly devitrified mesostasis. Anorthite often contains thin lamellae of nepheline. A silica phase is present in the mesostasis of some Type I chondrules in A 09535, but not in A-9003. Fe-Ni metals in them consist of kamacite abundantly including fine-grained Ni-rich metal. Type II chondrules in A-9003 and A 09535 are not common (7.5 and 11.3 % among all chondrules). Matrix is dominantly FeO-rich olivine of submicron in size.

**Discussion**: The petrologic subtypes of A-9003 and A 09535 are 3.2, from the width of FeO-rich rim of AOA olivine, no plessitic metal, and abundant melilite-bearing CAIs, which are also notified in Y-82094, type 3.2 [2]. In addition to the same petrologic type, A-9003 and A 09535 have features similar to those of Y-82094, such as chondrule size (0.33 mm of Y-82094), high abundance of chondrules (78.1 vol.%), and low abundance of the matrix (11.1 %) [2]. Refractory inclusions are common in Y-82094 (8.2 %), similar to those of A-9003 and A 09535. However, they have distinct features to one another. A silica phase is common in Y-82094 and A 09535, whereas A-9003 does not contain it. Indialite is encountered in a Y-82094 chondrule [4], whereas such Al-Mg-silicate is not observed in A-9003 and A 09535. Nepheline lamellae in anorthite are common both in A-9003 and A 09535 chondrules, but not observed in Y-82094, which suggests that the secondary alteration degrees are higher in A-9003 and A 09535 than Y-82094. Type II chondrule abundance are different between these three chondrites (0.9 % in Y-82094). In spite of such difference, these chondrites have similar features and are distinguished from the other carbonaceous chondrites, especially chondrule size and matrix abundance. The sampling locations are far between them, indicating that they are not paired. Therefore, these chondrites may belong to a new grouplet.

**References:** [1] Weisberg, M.K. et al., Systematics and evaluation of meteorite classification. In Meteorites and the Early Solar System II, 19-52, 2006. [2] Kimura, M. et al., Petrology and bulk chemistry of Yamato-82094, a new type of carbonaceous chondrite. Meteoritics & Planetary Science, 49, 346-357, 2014. [3] Yamaguchi, A. et al., Meteorite Newsletter, 26, 2018. [4] Mikouchi, T. et al., Synchrotron radiation XRD analysis of indialite in Y-82094 ungrouped carbonaceous chondrite. 47th Lunar and Planetary Science Conference, #1919, 2016.