Diverse organic compounds possibly synthesized in meteorite parent bodies with formaldehyde, ammonia and water

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Carbonaceous chondrites are known to contain a diverse suite of organic compounds including those are essential in biology [1] [2]. Aqueous environments in the asteroids likely provide favorable conditions for the organic molecule syntheses due to expected higher concentrations of reactive molecules including H_2CO and NH_3, and warm (~0 to 150ºC) and weak basic condition (pH7-12) that are favorable for organic syntheses. Sugars and sugar related compounds were identified in the Murchison meteorite, which were plausibly derived from formaldehyde via the formose reaction [3]. Organic solids similar to the insoluble organic matter (IOM) in primitive meteorites could also form from reactions that occurred in the warm wet interiors of planetesimals starting from formaldehyde [4] [5]. Recently, we focus on the formation of soluble organic matter including prebiotic organic molecules starting with formaldehyde and ammonia following the recipe of [5]. We have so far found amino acids and their precursors with similar relative abundance with those in the Murchison meteorite [6], as well as sugar related compounds, and possibly nitrogen bearing heterocyclic compounds in the reaction products [7]. Here we report detailed analyses of soluble species using an electrospray ionization time-of-flight mass spectrometry (ESI-TOF-MS; Hitachi NanoFrontier eLD). Kendrick mass defect (KMD) analyses of the reaction products revealed that numerous CHO and CHNO compounds were produced most plausibly via CH_2O addition, CH_2 addition and dehydration reactions.

[1]Pizzarello *et al*. (2006) *Meteorites and the early solar system II* (eds. Lauretta & McSween Jr.). Univ. Arizona Press, pp. 587-624. [2]Schmitt-Kopplin *et al*. (2010) *PNAS* **107,** 2763-2768. [3]Cooper *et al*. (2001) *Nature* **414**, 879-883. [4]Cody *et al*. (2011) *PNAS* **108**, 19171-19176. [5]Kebukawa *et al*. (2013) *ApJ* **771**, 19. [6]Cronin & Pizzarello (1983) *ASR* **3**, 5-18. [7]Kebukawa *et al*. (2015) LPSC abstract #1300.