CHEMICAL AND ISOTOPIC DIVERSITY OF ORGANIC PARTICLES IN CHONDRITES: PARENT BODY VS. NEBULAR PROCESSES. L. Remusat[1,2], Y. Guan[2] and J.M. Eiler[2]. [1] LMCM, MNHN, UMR CNRS 7202, 57 Rue Cuvier, case postale 52, 75231 Paris, France [2] GPS Division, Caltech, 1200 E. California Blvd, Pasadena, CA 91125, USA.

Introduction: Insoluble organic matter (IOM), the main organic constituent in chondrites, has been extensively studied after HF/HCl isolation techniques. Bulk isotopic compositions and elemental ratios show variations between chondrite groups, whereas they are quite homogeneous within each class [1]. Recent isotopic measurements by ion probes have revealed that IOM is heterogeneous at the sub-micron scale [2, 3]. Does this heterogeneity reflect parent body evolution or reactions in the gas phase prior to accretion? To answer this question, we have studied in situ organic matter in Orgueil (CI), Tagish Lake, Murchison (CM), Cold Bokkeveld (CM), Allende (CV), Renazzo (CR) and Chainpur (LL) by NanoSIMS imaging. We have determined D/H ratios and chemical composition (C, H and N contents) of organic particles in the matrices of these meteorites.

Results and discussion: Organic matter occurs as isolated, randomly distributed, micron size particles in the matrices of the studied chondrites [4]. The organic grains exhibit a large range in compositions. No clear trend is found between C/H, N/C and D/H ratios. Moreover, within each group, these ratios also show a large range of variations: for instance $D/H=2.55\times10^{-4}$ to 35.02×10^{-4} in Orgueil (bulk IOM $D/H=3\times10^{-4}$), C/H=0.3 to 2 for Murchison (bulk IOM C/H=1.4); this range exceeds the reported range from bulk analyses. Mixing with inorganic matrix occurs during the measurement, as shown by C/Si and C/O ratios, but it cannot explain alone the diversity of measured compositions.

Some chondrites of different groups seem to contain similar organic particles, as indicated by their elemental and isotopic ratios, whereas their IOM has a different bulk composition. Then, we have to consider that each parent body has accreted a population of organic grains rather than one unique type of organic matter. These grains may have different chemical and isotopic compositions, probably due to their pre-accretion history. Moreover, the parent body evolution did not rehomogenize the composition of the organic matter, keeping the initial heterogeneity.

Conclusion: The isotopic and elemental ratios of chondritic IOM results from the accretion of different pools of organic particles that have been subjected to and/or synthesized in different environments prior to accretion. Turbulent motion [5] of particles in the protosolar nebula could have gathered together these particles. As shown by the D/H ratio [4], some organic particles have been exposed to the outer irradiated areas of the solar system, whereas the others remained in the neutral mid-plane. Synthetic processes specific to some regions (like ion/molecule reactions in the irradiated areas) may also result in different elemental compositions. Another possibility is that the organic precursors (CH_4, HCN…) were heterogeneously distributed in the protosolar nebula, leading to the synthesis of different macromolecules depending on the location.

References: [1] Alexander C.M.O'D. et al. 2007. Geochimica et Cosmochimica Acta, 71:4380-4403. [2] Remusat L. et al. 2009. ApJ, in press. [3] Busemann et al. 2006. Science 312:727-730. [4] Remusat L. et al. 2009. 40th LPSC, abstract #1294. [5] Ciesla F. 2009. 40th LPSC, abstract #1099