THE CHONDRITIC ASSEMBLAGE. B. Zanda[1,2] P.-M. Zanetta[1,3], H. Leroux[3], C. Le Guillou[3], É. Lewin[4], S. Pont[2], D. Deldicque[5] and R. H. Hewins[2,1], [1]IMPMC – MNHN, UPMC & CNRS, 61 rue Buffon, 75005 Paris, France (brigitte.zanda@mnhn.fr); [2]Dept. of Earth & Planetary Sciences, Rutgers University, 610 Taylor Rd., Piscataway, NJ; [3]UMET, University of Lille & CNRS, F-59655 Villeneuve d'Ascq, France; [4]ISTerre (OSUG : Univ. Grenoble-Alpes & INSU-CNRS), Grenoble, France; [5]École Normale Supérieure, UMR 8538, 75231 Paris CEDEX 5, France.

Introduction: Chondritic meteorites comprise components formed or processed at high temperature embedded in a volatile-rich fine-grained matrix. The origin of matrix and its relationship with other chondritic components are poorly understood. It is highly susceptible to parent-body processes and hence better studied in the most pristine chondrites (type≈3.0), in which it has been shown to be a complex assemblage of hydrous and anhydrous silicates, amorphous material, opaque minerals, presolar grains and organics. Presolar grains have been inherited from the interstellar medium and possibly other components of the matrix, but others may be the product of nebular condensation or high temperature processing and recycling.

Understanding the links between chondritic components is critical to our vision of the protoplanetary disk (PPD) as a chondrule-matrix genetic relationship would indicate accretion to have taken place shortly after these components formed and thus preclude their transport within the disk. Chondrules and matrix may have formed independently [1]. However, the discovery of chemical relations between chondrules and matrix within a given chondrite has led several authors [2-4] to suggest they actually formed simultaneously from the same reservoirs, the compositions of which would be chondritic (CI) in terms of major elements such as Si and Mg [2,4] and more or less depleted in volatile elements depending on the chondrite group [3]. Because obtaining a reliable bulk composition of chondrules within a chondrite is difficult, most arguments developed by these authors are based on comparing matrix composition to that of the bulk rock.

Complementarity in volatile elements. [3] compared bulk and matrix compositions in carbonaceous chondrites (CCs) and showed them to mimic one another: if the bulk is highly depleted in volatiles (CVs), so is the matrix, but to a lesser extent. In contrast, when the bulk is less depleted (CMs), then matrix is even less so. [3] concluded this pattern indicated that these rock components had formed simultaneously from the same reservoir.

Complementarity in major elements [4] and subsequent work by this group argue that all CCs exhibit CI chondritic ratios of the major elements Si, Mg (Fe…), but that each group has a specific matrix composition, with a lower Mg/Si ratio than that of the bulk. This would imply that in each CC group, the composition and proportion of chondrules are exactly suited to those of their embedding matrix to reach a chondritic bulk. They make the case that /Si distribution cannot result from parent body processes, and hence that chondrules and matrix must have been formed simultaneously from a reservoir of CI composition.

Results and discussion: In [5], we showed that the similarity in volatile depletion patterns for matrix and bulk in CCs might be explained by parent-body alteration in the course of which the matrix, originally CI in composition, would have lost some of its volatiles to the chondrules. In the cases where the matrix comprises most of the rock (CMs) the resulting volatile depletion of the matrix would have been slight, whereas in the cases where matrix is significantly less abundant than chondrules (CVs and COs) its volatile depletion would have been much more important.

Here we discuss the case of the major elements and contend that [4] and most of the work arguing for complementarity between matrix and chondrules is based on matrix analyses performed by EMP, a method that may be precise but not necessarily accurate because the beam has to analyze a mixture comprising crystals of varying density. In fact, matrix analyses performed by LA-ICP-MS [3] yield chondritic Mg/Si ratios. Such published data are however rare in the literature and we feel that they should be confirmed and supplemented. We are currently developing a new method for sample analysis adapted from techniques of multiple component analysis in order to obtain an improved estimate of the bulk chemistry of the matrix. Our technique is based on coupling X-ray maps obtained at low voltage on a FESEM with an EMP calibration. Preliminary results will be presented at the meeting.

Conclusion: Complementarity between the high-T and the low-T fractions of the chondritic assemblage would have important implications for our undertanding of the PPD. There is an obvious need for new accurate analyses of the matrices of primitive chondrites.

References: [1] Anders, E. (1964) *Space Sci. Rev. 3,* 583-714. [2] Wood (1985) *Protostars and Planets II,* p. 687. [3] Bland P. et al. 2005 *PNAS 102*, 13755–13760. [4] Hezel D. and Palme H. 2010 *EPSL 294,* 85-93. [5] Zanda B. et al. (2012) *LPS XLIII,* 2413.pdf.