Fe/Mg-Fe/Mn SYSTEMATICS OF CHONDRULES AND THEIR HOST CHONDRITES: CLUES FOR THEIR EVOLUTION. J.P.Das*, Institute of Earth Sciences, Academia Sinica, 128 Academia Road, Sec. 2, Nankang, Taipei 11529, Taiwan, ROC, e-mail: jpdas06@gmail.com

Introduction: Composition of chondrites on Fe-Mg-Mn diagram show distinct patterns that result from nebular processes like volatility-controlled Mn-Mg fractionation, metal/silicate fractionation under reducing conditions and subsequent oxidation leading to variations in FeO/MgO ratio [1]. As chondrules are the major constituent of chondrites (except CI) their effect on bulk chemical compositions of chondrites cannot be neglected. On the other hand, very little is known about chondrule formation mechanism and their precursors [2]. Generally individual chondrules show wide range of chemical properties compared to their host chondrites which can be related to heterogeneous chondrule precursors, variable effect of chondrule forming event(s) and surrounding environment during chondrule formation [2]. Processes (e.g. evaporation and condensation, metal/silicate fractionation) during high temperature chondrule forming event and low temperature secondary events (e.g. igneous fractionation) on parent body both can be responsible for the variation in chemical composition of chondrules. A comparison of individual chondrules and their host chondrites on Fe-Mg-Mn diagram can be useful in understanding both nebular stage (condensation and accretion) and the planetary stage (igneous differentiation) of chondrules and their final effect on bulk composition of chondrites. In this work, on Fe-Mg-Mn diagram, relation between individual chondrules in Semarkona (LL3.0), Chainpur (LL3.4), Allende (CV3), Renazzo (CR2) and Qingzhen (EH3) chondrites and their respective bulk is investigated.

Method: Chemical compositions of chondrules and their respective host chondrites were obtained from various reported results. Sources of data are listed in the figure caption. Molar abundance of Fe, Mg and Mn is used to calculate the Fe/Mg and Fe/Mn ratios.

Results and discussion: Fig.1a shows Fe/Mn *vs.* Fe/Mg in chondrules of Semarkona and Chainpur chondrites. Most chondrules show lower Fe compared to their bulk with significant range. Semarkona chondrules roughly follow a constant Mn/Mg ratio close to CI line. However, few Semarkona chondrules, mainly with lower Fe content show evidence of Mn loss which can be due to volatility controlled fractionation. Chainpur chondrules reveals larger variation compared to Semarkona chondrules. Some chondrules in Semarkona and Chainpur chondrites with lower (sub-chondritic) Mg/Mn ratio suggest fractionation of Mn relative to Mg.

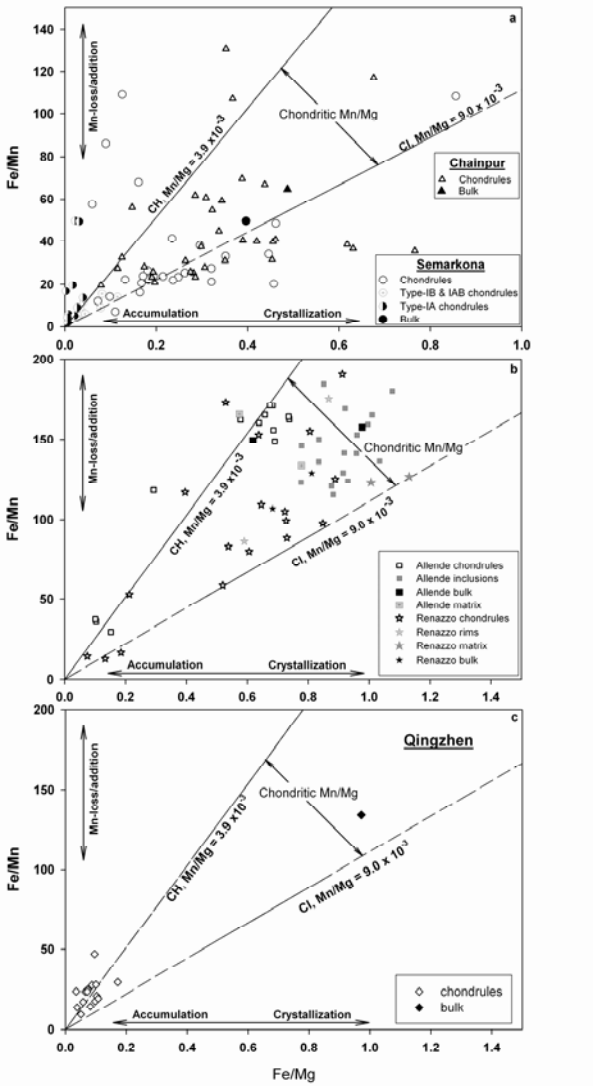

Fig. 1 Molar Fe/Mg vs. Fe/Mn for chondrules from different chondrites. Sources of data: Chainpur chondrules and bulk – [3], Semarkona chondrules – [4], Semarkona Bulk – [5], Allende chondrules, matrix, bulk and inclusions – [6, 7], Renazzo chondrules, rims, bulk and matrix – [8], Qingzhen chondrules and bulk – [9].

Large variation of Fe is evident for Renazzo chondrules mostly depleted in Fe when compared to matrix or bulk (Fig. 1b). CAIs in Allende chondrite show spread in Fe/Mg and Fe/Mn ratios but fall in chondritic range. These inclusions show lesser variation in Fe compared to chondrules. Chondrules and CAIs show

distinct trends on Fe/Mg vs. Fe/Mn plot. Relative to CI, among chondrules and CAIs, chondrules are more depleted in Mn relative to Mg. This is understood as chondrules have experienced longer duration of heating, resulting in higher fractionation of Mn.

Fig. 1c shows Fe/Mn *vs.* Fe/Mg in chondrules of Qingzhen. Chondrules are highly depleted in Fe content compared to the host chondrites as well as show smaller variation in ratios compared to chondrules from other chondrites.

On Fe-Mg-Mn diagram chondrules from ordinary and carbonaceous chondrites occupy different places. Chondrules in Semarkona and Chainpur chondrites are depleted in Fe content compared to their host unlike the case of Renazzo and Allende chondrules. This indicates that precursors of chondrules in ordinary chondrites were different than that of chondrules in carbonaceous chondrites.

Relative to CI, all the carbonaceous and ordinary chondrite groups show depletion of Mn relative to Mg and degree of fractionation increases in the order CI→OC, R→CM→CR→CO→CV, CK→CH [2]. However, it can be clearly seen from this work that chondrules do not show such kind of trend and instead show large variation in Fe/Mg and Fe/Mn ratios. This indicates that precursors of chondrules were compositionally heterogeneous but mostly within the chondritic range.

Study of noble gases and stable isotopes (e.g. O, C, N and S) in individual chondrules with respect to their composition can help in understanding the nature of chondrule precursors.

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