KRYPTON AND XENON ISOTOPES IN INDIVIDUAL CHONDRULES OF PARSA (EH3) AND CHAINPUR (LL3.4) CHONDRITES.

R. R. Mahajan[1], [1]Physical Research Laboratory, Ahmedabad, Gujarat, 380009, India (email: ramakant@prl.res.in).

Introduction: Chondrules are present in each chondrite group in distinct chemical and/or physical population. The high abundance of chondrules in some chondrites suggests that they formed by one of the most ubiquitous and energetic process. Our current understanding of their origin provides a wealth of detailed information about processes that occurred in early solar system. Noble gases and cosmic ray effects on chondrules were discussed in detailed in literature [1-7]. Nitrogen isotope ratios in Dhajala chondrules shows large variations [8]. Xenon isotopes in bunch of chondrules from various chondrites were discussed in [9-13]. Kr and Xe isotopic ratios in individual chondrules were discussed in [14-15] and [14], respectively.

Chondrules were formed as molten objects. Noble gases dissolved in them during their formation are termed as nebular trapped gases. Isotopic ratios of trapped noble gases in chondrules are imprints of gas in the nebular environment. The question of what is the isotopic composition of trapped noble gases in chondrules remains unanswered. This work in in continuation of the study [4-8]. In present work, Kr and Xe isotopic composition of individual Parsa (EH3) and Chainpur (LL3.4) chondrules are discussed, while He, Ne, Ar and nitrogen were presented earlier [6-7]. Both Parsa and Chainpur chondrites are from 3 petrographic type and are falls in India. Chondrites of type 3 petrographic grade are thought to be least aqueous/thermal altered meteorites. Enstatite chondrites are a small clan of chondrites with unique mineral inventory indicating formation in highly reducing conditions. Their materials are typically thought to be formed near the Sun. Ordinary chondrites are the largest clan of chondrites falling on Earth [16]. They also formed near the Sun, but slightly away from the formation location than that of enstatite chondrites. Parsa chondrules are named as PR1, PR2, PR3A and PR3B. PR1 and PR2 are individual chondrules. PR3A and PR3B are aliquots of single chondrule. Chainpur chondrules are named as CH1A, CH1B, CH2 and CH3. CH1A, CH1B are splits of single chondrule. CH2 and CH3 are individual chondrules. The measured Kr and Xe isotopic ratios in the chondrules are given in Table 1.

Results and discussion: The most important observation in this study is that Parsa and Chainpur chondrules shows trapped Kr and Xe composition similar to Q-phase. Figure 1 [a] & [b] depicts the isotopic ratios $^{82}Kr/^{84}Kr$ and $^{86}Kr/^{84}Kr$ as a function of $^{83}Kr/^{84}Kr$ for the studied chondrules. Also shown are the isotope ratios for Q in [1a] and [1b] and air and solar wind (SW) in [1b]. The Parsa chondrules show excesses of ^{82}Kr and ^{83}Kr normalized to ^{84}Kr. The ^{82}Kr excesses can be explained by neutron capture on ^{81}Br. Chainpur chondrules data plot near to Q-GCR mixing line as compared to Parsa chondrules (Fig.1).

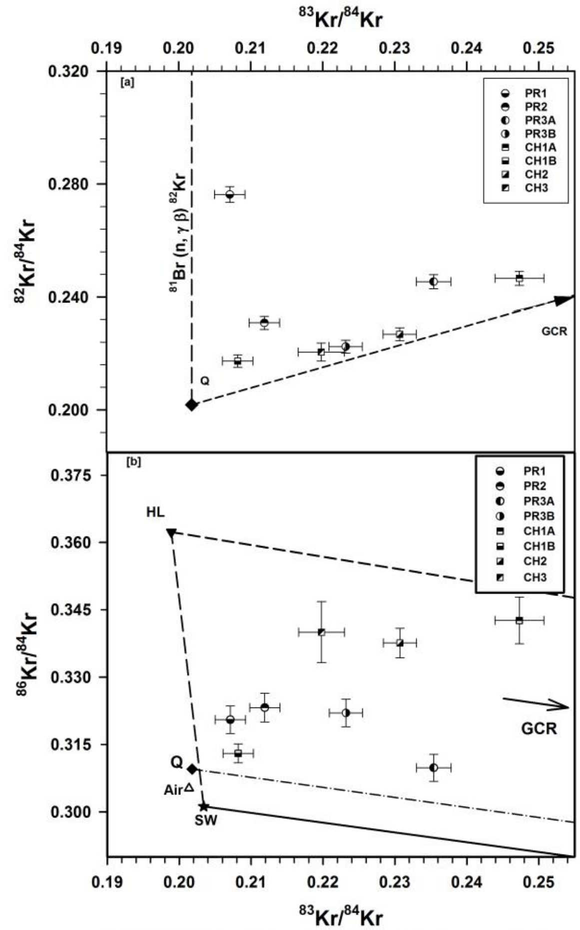

Fig.1 [a] & [b] Kr three isotope plot showing isotopic composition in Parsa and Chainpur chondrules.

Figure 2 depicts the $^{130}Xe/^{132}Xe$ ratios as a function of $^{136}Xe/^{132}Xe$. Also shown the isotopic ratios for Q, SW, and air. The thick line indicates the direction towards HL-Xe. All the measured data plot above the Q-HL mixing line. Contribution of cosmogenic ^{130}Xe is observed in the chondrules. Excess ^{128}Xe in observed in Parsa chondrules (Table 1). The excess

^{128}Xe could be from spallation reaction or from neutron capture on iodine.

The trapped components of Kr and Xe in the studied chondrules are primordial (Q and/or HL) in composition. The Kr and Xe records of all three chondrules are dominated by Q component. Kr and Xe from SW are not observed in the studied chondrules.

Chondrules formed from freely floating molten droplets and hence acquisition of Kr and Xe may thus be from the gas surrounding them in the nebular reservoir.

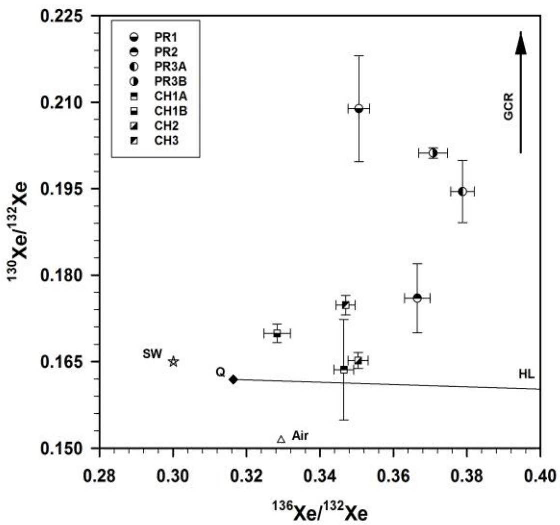

Fig. 2. Xenon three isotope plot showing xenon isotopic composition in Parsa and Chainpur chondrules.

Summary: In conclusion trapped noble gases, Kr and Xe in Parsa and Chainpur chondrules are mixture of primitive components, Q and HL. SW Kr and Xe is absent in the studied chondrules.

Acknowledgments: The author thanks Department of Space, Government of India for fund to carry out this study.

References: [1] Roth A. S. G. and I. Leya (2018) *Meteoritics & Planet. Sci.*, 53, 2644-2651. [2] Beyersdorf-Kuis U., U. Ott and M. Trieloff (2015) EPSL, 423, 13-23. [3] Riebe M. E. I. et al. (2017) GCA, 213, 618-634. [4] Mahajan R. R. and S. V. S. Murty (2003) *Proc. Indi. Acad. Sci. (Earth Planet. Sci.)*, 112, 113-127. [5] Mahajan R. R. (2020) *Meteoritics & Planet. Sci.*, 55, 2141-2156. [6] Das J. P. and S. V. S. Murty (2009) *JGR* 114, E01008. [7] Das J. P. and S. V. S. Murty (2009) *Meteoritics & Planet. Sci.*, 44, 1797-1818. [8] Murty S. V. S and R. R. Mahajan (2003) *Meteoritics & Planet. Sci., 38, Nr. 7*, A20. [9] Alexander E. C. and O. K. Manuel (1969) *GCA* 33, 298-301. [10] Fireman E. L., J. Defelice and E. Norton (1970) *GCA* 34, 873-881. [11] Merrihue C. M. (1963) *JGR* 68, 325-330. [12] Polnau et al. (2001) *GCA* 65, 1849-1866. [13] Rowe M. W. (1968) *GCA* 32, 1317-1326. [14] Miura Y. N., K. Nagao and M. Kimura (2014) *Meteoritics & Planet. Sci.*, 49, 1037-1056. [15] Strashnov I. and J. D. Gilmour (2013) *Meteoritics & Planet. Sci.*, 48, 2430-2440. [16] Mahajan R. R. (2017) *LPSC XLVIII*, #1762.pdf.

Table 1. Measured Kr and Xe in Parsa and Chainpur chondrules, concentrations in cm^{3}STP/g. Error in concentrations is 10%. Wt. = weight in mg

Sample and wt.	^{84}Kr x 10^{-10}	^{82}Kr/^{84}Kr	^{83}Kr/^{84}Kr	^{86}Kr/^{84}Kr	^{132}Xe x 10^{-10}	^{128}Xe/^{132}Xe	^{129}Xe/^{132}Xe	^{130}Xe/^{132}Xe	^{131}Xe/^{132}Xe	^{134}Xe/^{132}Xe	^{136}Xe/^{132}Xe
PR1 1.827	5.135	0.2763 ±0.0028	0.2071 ±0.0021	0.3205 ±0.0031	3.662	0.1594 ±0.0067	2.057 ±0.039	0.2089 ±0.0092	0.8370 ±0.0033	0.4108 ±0.0018	0.3506 ±0.0029
PR2 4.022	15.7	0.2308 ±0.0023	0.2119 ±0.0021	0.3232 ±0.0032	2.689	0.1065 ±0.0045	4.572 ±0.032	0.1760 ±0.0060	0.8064 ±0.0064	0.4118 ±0.0026	0.3665 ±0.0035
PR3A 4.402	9.23	0.2454 ±0.0025	0.2354 ±0.0024	0.3098 ±0.0030	2.690	0.1237 ±0.0022	2.801 ±0.019	0.1945 ±0.0054	0.8057 ±0.0016	0.4512 ±0.0030	0.3788 ±0.0032
PR3B 4.856	20.53	0.2224 ±0.0023	0.2232 ±0.0023	0.3220 ±0.0031	1.697	0.0953 ±0.0030	4.237 ±0.050	0.2012 ±0.0009	0.7959 ±0.0025	0.4604 ±0.0090	0.3708 ±0.0039
CH1A 6.602	7.149	0.2466 ±0.0025	0.3073 ±0.0034	0.3426 ±0.0052	4.608	0.1033 ±0.0047	1.034 ±0.010	0.1636 ±0.0087	0.8475 ±0.0057	0.4065 ±0.0018	0.3465 ±0.0027
CH1B 5.898	105.9	0.2173 ±0.0022	0.2082 ±0.0021	0.3130 ±0.0021	46.06	0.0886 ±0.0018	1.136 ±0.008	0.1699 ±0.0016	0.8081 ±0.0075	0.3963 ±0.0021	0.3283 ±0.0036
CH2 2.356	22.7	0.2268 ±0.0023	0.2307 ±0.0023	0.3376 ±0.0033	10.90	0.1002 ±0.0038	2.343 ±0.066	0.1652 ±0.0014	0.8677 ±0.0037	0.3933 ±0.0067	0.3504 ±0.0027
CH3 0.798	27.7	0.2205 ±0.0032	0.2198 ±0.0032	0.3400 ±0.0068	35.60	0.0968 ±0.0009	1.138 ±0.009	0.1748 ±0.0017	0.8346 ±0.0070	0.3974 ±0.0027	0.3470 ±0.0026