I-Xe SYSTEM IN CHONDRULES FROM CR2 CHONDRITE NWA 721. O. V. Pravdivtseva[1], A. P. Meshik[1], C. M. Hohenberg[1] and A. N. Krot[2], [1]Physics Department, Laboratory for Space Sciences, Washington University, St. Louis MO 63130, USA (olga@physics.wustl.edu), [2]University of Hawai'i at Manoa, Honolulu, HI 96822, USA.

Introduction: CR carbonaceous chondrites are among the most primitive meteorites in our collections [1, 2]. Although they experienced various degrees of aqueous alteration, most of them avoided thermal and shock metamorphism, and, therefore, could have preserved primary isotopic records in their components. The previously reported ^{26}Al-^{26}Mg systematics of CR chondrules [3–5] indicate that only ~35% of them show resolvable excesses of δ^{26}Mg*. The inferred initial ^{26}Al/^{27}Al ratios [$(^{26}Al/^{27}Al)_0$] in CR chondrules range from $(1.0\pm0.4)\times10^{-6}$ to $(6.3\pm0.9)\times10^{-6}$ [3–5] which is significantly lower than $(^{26}Al/^{27}Al)_0$ in the majority of chondrules from UOCs, COs, and Acfer 094 [6, 7]. Assuming homogeneous distribution of ^{26}Al in the protoplanetary disk at the canonical level [$(^{26}Al/^{27}Al)_0 \sim 5.2\times10^{-5}$], the inferred $(^{26}Al/^{27}Al)_0$ in CR chondrules imply that they represent several generations; the majority characterized by low $(^{26}Al/^{27}Al)_0$ ($<3\times10^{-6}$) [3–5]. A weighted mean $(^{26}Al/^{27}Al)_0$ of 22 CR chondrules corresponded to a formation age of ~3.4 (+0.2, -0.1) Myr after CV CAIs [4].

Here we present I-Xe isotope systematics of 5 chondrules from the CR2 chondrite NWA 721. The I-Xe systematics is known to be affected by aqueous alteration [8], and thus can potentially provide information on the onset of aqueous alteration in the CR chondrites, which is still poorly constrained [9, 10]. Chondrules were split into fragments, thus I-Xe and Pb-Pb systematics in the same chondrule could be potentially studied in the future.

Results and Discussion: Three of the studied NWA 721 chondrules, #1, #2, and #3 (Table 1) are of the most abundant type I, (magnesium-rich, porphyritic olivine-pyroxene). Two of them are surrounded by coarse-grained igneous rims, typical for CR chondrules (Fig. 1). Two chondrules, A3 and X are anorthite-rich; they consist of low- and high-Ca pyroxenes, anorthitic plagioclase, olivine, Cr-bearing spinel, FeNi-metal, and crystalline mesostasis.

In order to convert ^{127}I into ^{128}Xe, samples were irradiated at the University of Missouri Research Reactor receiving 2×10^{19} thermal neutrons/cm^2. Xenon was extracted by step-wise pyrolysis in a low blank W-coil, and its isotopic composition was measured using Baur-Signer discrimination-free ion source mass-spectrometer.

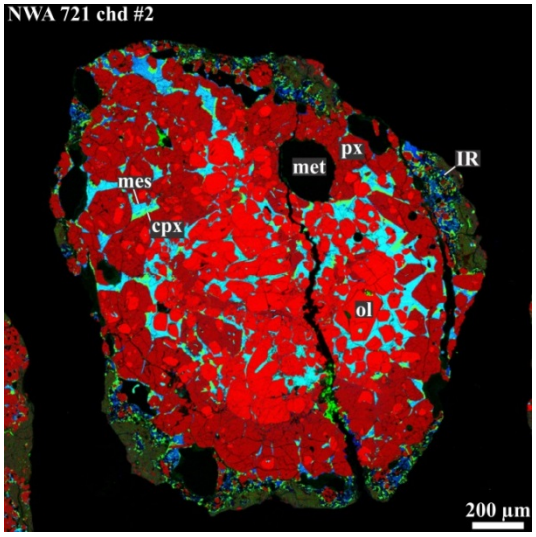


Fig. 1. Combined x-ray elemental map in Mg (red), Ca (green), Al Kα (blue) of chondrule #2 from the CR chondrite NWA 721. The chondrule consists of magnesian olivine (ol), low-Ca pyroxene (px), glassy mesostasis (mes), high-Ca pyroxene (cpx), and Fe,Ni-metal nodules (met). It is surrounded by a coarse-grained igneous rim (IR).

Table 1. Summary of data obtained from samples of 5 NWA 721 chondrules.

chd#	weight (mg)	^{129*}Xe	^{128*}Xe	^{131*}Xe	^{132}Xe	
					trapped	fission
		$\times10^{-10}$ cm^{3}STP/g				
A3	3.50	<0.001	16.15	7.93	0.44	0.22
X	5.90	<0.001	7.52	12.54	4.15	0.11
1	1.43	<0.001	8.39	65.11	31.40	0.30
2	1.73	0.007	7.71	3.18	0.19	0.10
3	8.92	<0.001	0.40	3.72	2.18	0.10

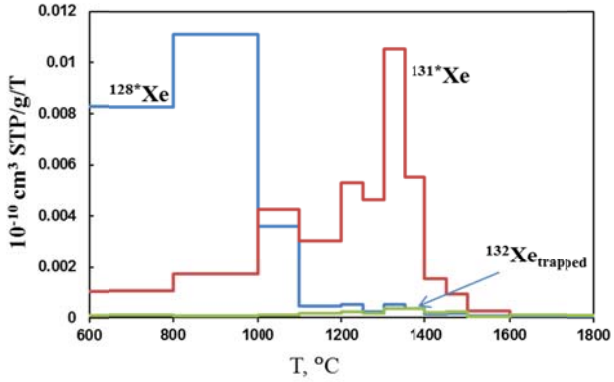
Concentrations of radiogenic ^{129*}Xe, ^{128*}Xe, ^{131*}Xe, and fission ^{132}Xe (Table 1) represent excesses over ordinary chondrites (OC) Xe trapped component. ^{129*}Xe and ^{128*}Xe are derived from iodine, ^{131*}Xe is from neutron capture on ^{130}Ba and/or ^{130}Te. Rare earth element abundances in plagioclase in a single anorthite-rich Renazzo CR chondrule were shown to be ~20 times of the CI chondrites value [1]. As a result barium appears to be the more probable parent for ^{131*}Xe. All NWA 271 chondrules contain compatible concentrations of U-fission xenon. Four of the NWA 721 chondrules studied here have no detectable ^{129*}Xe.

Only one chondrule, #2, shows slight excess of ^{129}Xe at 1500–1600°C extraction step. Similar release pattern is observed for chondrule #1, although the concentration of ^{129*}Xe in this case is even lower, within 2σ of OC-Xe value.

We usually present data as three-isotope diagrams, where ^{129}Xe/^{132}Xe is plotted versus ^{128}Xe/^{132}Xe after correction for fission Xe. Extraction steps where ^{129}Xe/^{129}Xe ratio is constant form a straight line, an isochron, that corresponds to the I-Xe system closure time. We cannot define an isochron based on one experimental point, but for the NWA 721 chondrule #2 the slope of the line drawn through the 1500–1600°C extraction and OC trapped component points suggest that I-Xe system in this chondrule may have closed at ~11 Myr after CV CAIs. This is consistent with estimation for aqueous processing at ~2–13 Myr after CAIs based on Mn-Cr ages of carbonate grains in Renazzo and GRO 95577 [10].

It is known that CR chondrites experienced various degrees of aqueous alteration at temperatures below 100–150°C [1,11]. Apparently, iodine in NWA 721 chondrules studied was nearly completely lost during aqueous alteration, for all studied chondrules more than 90% of radiogenic ^{128*}Xe was released below 1100°C (98% for chondrule #2, Fig. 2), consistent with combination of losses and superficial iodine contamination.

Fig. 2. Release profiles of radiogenic ^{128*}Xe, ^{131*}Xe and trapped OC-Xe component in NWA721 chondrule #2.



It was shown that O-isotopic composition correlates with the degree of alteration in CR chondrites [13, 14] and the anhydrous components, including FeO-poor chondrules, most likely represent primordial CR chondrite parent body, before the alteration took place. If so, the least aqueously altered CR3.0 chondrites, e.g., QUE 99177 and MET 00426 [2, 13, 14] could be more promising candidates for the I-Xe dating of chondrule ages.

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