I-Xe AND ^{40}Ar-^{39}Ar AGES OF CHAINPUR CHONDRULES; T. D. Swindle, M. W. Caffee and C. M. Hohenberg, McDonnell Center for Space Sciences and Dept. of Physics, Washington University, St. Louis, MO 63130.

Iodine-xenon studies of individual chondrules from Bjurbole [1] and Allende [2] have demonstrated that it is possible to determine precise I-Xe structure on small (<5mg) samples. We report here analyses of 13 chondrules from Chainpur. After thin sections were made (for analysis by G. J. Taylor), the chondrules were irradiated with neutrons and the University of Missouri Research Reactor for our I-Xe and ^{40}Ar-^{39}Ar analysis and for neutron activation analysis by M. M. Lindstrom. Results of a comparison of interior (rim-free) and exterior samples of two chondrules with a sample of matrix have previously been reported [3]. Comparison of I-Xe structure with chemical composition is not complete.

I-Xe chronology: Many of the chondrules give fairly well-defined I-Xe isochrons, with radiogenic ^{129}Xe (produced by decay of now-extinct ^{129}I) correlated with iodine-derived ^{128}Xe (from neutron capture on ^{127}I) at higher temperatures. Unlike the Bjurbole chondrules [1], in which the initial ^{129}I/^{127}I ratios (**R**) were all within a few percent of that of Bjurbole whole rock, the **R**'s in the Chainpur chondrules vary by a factor of four. If **R** is interpreted as a chronometer, this corresponds to a difference in xenon closure time of about 35 m.y. (see Table 1). The highest **R**'s are comparable to that of Bjurbole. The spread in **R**'s suggests that they do not represent formation times, but could be dating some later event(s).

Trapped Xe compositions: A convincing isochron is that of chondrule 12 (Fig. 1), where the eight highest-temperature points are consistent with a single line. The slope corresponds to a formation time 6.1±2.7 m.y. after Bjurbole. We can also calculate the ^{129}Xe/^{132}Xe ratio in the trapped xenon component of this sample by taking the intercept of the correlation line with a nominal (AVCC) ^{128}Xe/^{132}Xe ratio of 0.082. For this sample, we get a value of 0.92±0.05, somewhat lower than the values determined for most meteorites [4,5]. Chondrules 4, 8, 10 and 13, which have less well-defined isochrons, also seem to have trapped ^{129}Xe/^{132}Xe ratios of 1.0 or less. An alternative interpretation for some of these chondrules is that the trapped composition is really more like that of Bjurbole [1], 1.045, but there is a pattern of increasing apparent **R** with increasing extraction temperature. Such a pattern is commonly seen in I-Xe studies of inclusions and chondrules from Allende [2,6,7], where it has been interpreted as slow cooling or slow relaxation of thermal metamorphism. Moreover, in one Chainpur chondrule (C6) where no isochron is observed, there is a pattern of increasing apparent **R** with increasing extraction temperature (Fig. 2).

Many chondrules have a cluster of intermediate temperature points with ^{129}Xe/^{132}Xe ratios of 1.05 to 1.10. This could be the result of evolution of the I-Xe system followed by closed-system re-equilibration among the lower temperature sites. In some chondrules (3, 5 and 18) the highest-temperature extractions are not any more radiogenic, suggesting re-equilibration may have been complete.

Are textural type and I-Xe structure correlated? Some interpretations of the I-Xe system would

Table 1: I-Xe, ^{40}Ar-^{39}Ar ages

Sample	Type[1]	No.[2]	$(^{129}I/^{127}I)_0$ x 10^{-4}	I-Xe age[3] (m.y.)	$(^{129}Xe/^{132}Xe)_t$ [4]	K-Ar "age"[5] (g.y.)
1	P	7	1.29±0.02	-4.0±0.3	0.92±0.04	4.31±0.06
2[6]	P	5	0.87±0.02	5.7±2.5	1.20±0.20	–[7]
3[6]	P		–[8]		1.05±0.01	–[7]
4	P	8	0.88±0.02	5.5±0.7	1.00±0.01	4.29±0.03
5	P		–[8]		1.04±0.01	4.45±0.04
6	P	10[9]	.25-.75	9.3-36.0		4.24±0.01
7	NP	6	0.50±0.06	19.6±2.7	0.97±0.03	4.35±0.01
8	P	5	1.16±0.12	-1.3±2.3	0.96±0.03	4.34±0.02
10	NP	6	1.14±0.07	-1.0±1.4	0.93±0.03	4.30±0.02
12	P	8	0.85±0.10	6.1±2.6	0.92±0.05	4.19±0.01
13	NP	7	0.29±0.02	32.5±1.5	1.01±0.01	4.19±0.02
16	NP	4	1.17±0.32	-1.6±0.5	0.92±0.07	4.38±0.19
18	NP		–[8]		1.11±0.08	4.14±0.23

Notes:

[1] Textural type: P=Porphyritic, NP=Non-Porphyritic.

[2] Number of points defining I-Xe isochron.

[3] Time (after Bjurbole) of xenon isotopic closure; larger numbers are later.

[4] Trapped ^{129}Xe/^{132}Xe ratio determined by intercept of correlation line with AVCC ^{128}Xe/^{132}Xe ratio (.082) on plots such as Figs. 1 and 2.

[5] Total ^{40}Ar-^{39}Ar age; no plateaus were observed. This "age" is the true age only if no argon loss or contamination has occurred.

[6] Interior (rim-free) sample.

[7] Argon not analyzed.

[8] No isochron observed because there are no extractions enriched in ^{129}Xe. Trapped ratio is approximately equal to total ^{129}Xe/^{132}Xe ratio.

[9] Although several points are radiogenic, no isochron is observed. Range in apparent initial ^{129}I/^{127}I ratios and I-Xe ages is listed, assuming trapped ^{129}Xe/^{132}Xe ratio is that of Bjurbole [1].

seem to predict a relationship between textural type and **R**. For example, Crabb et al. [4] have argued that large differences in **R** could be produced by differential mixing of iodine from two reservoirs (gas and dust) with different iodine isotopic compositions. Oxygen isotope structure in meteorites has also been attributed to gas and dust with different isotopic compositions, and the fact that the oxygen isotopic composition of chondrules clearly varies with textural type has been taken as evidence in favor of that model [8]. Among the nine chondrules with well-defined isochrons, we see no clear relationship between I-Xe structure and textural type (although the two chondrules with the lowest **R**'s (7 and 13) are non-porphyritic, while the one with the highest (1) is porphyritic), nor do we see the correlation between **R** and iodine content that Crabb et al. observed in carbonaceous chondrites.

^{40}Ar-^{39}Ar dating: As in previous studies of Chainpur chondrules [5,9], the K-Ar system shows evidence of recoil effects or non-thermal disturbance; no plateaus are observed. Some of the chondrules show regular patterns that may be approaching plateaus, with the higher-temperature extractions giving apparent ^{40}Ar-^{39}Ar ages comparable to those of most primitive meteorites (4.5 g.y.) Total extraction (K-Ar) "ages" for all of them fall in the range between 4.15 and 4.45 g.y.

References: 1. M.W. Caffee et al. (1982) *Proc. LPSC 13th*, in *JGR*, **87**, A303-A317; 2. T.D. Swindle et al. (1983) *GCA*, **47**, 2157-2177; 3. T.D. Swindle et al. (1985) *Meteoritics*, **20**, in press; 4. J. Crabb et al. (1982) *GCA*, **46**, 2511-2526; 5. F.A. Podosek (1970) *GCA*, **34**, 341-365; 6. C.M. Hohenberg et al. (1983) *Meteoritics*, **18**, 313; 7. A. Zaikowski (1980) *EPSL*, **47**, 211-222; 8. R.N. Clayton et al. (1983) In *Chondrules and their Origins*, 37-43; 9. I. Herrwerth et al. (1983) *Meteoritics*, **18**, 311.

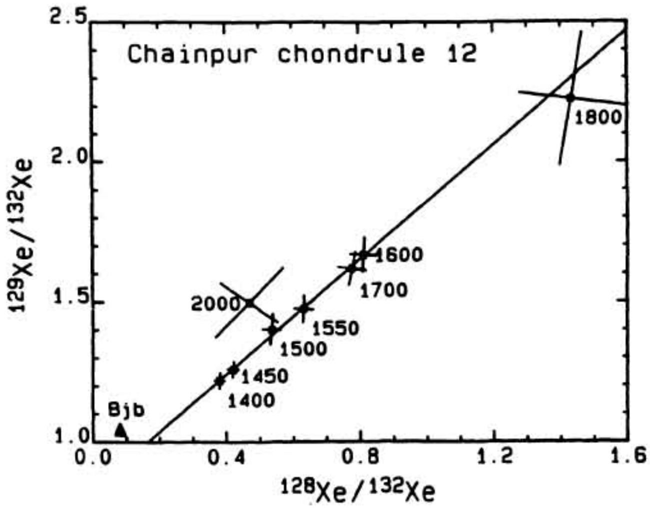

Fig. 1: Three-isotope I-Xe plot for Chainpur chondrule 12. Note that the points shown are all consistent with a single line, indicating a well-defined ^{129}I/^{127}I ratio at time of xenon isotopic closure. Numbers next to points represent coil temperatures in ^{0}C (due to the open design of the coil, they probably overestimate the sample temperature by 100-200^{0}C). Point labeled "Bjb" represent trapped xenon composition of Bjurbole whole rock [1].

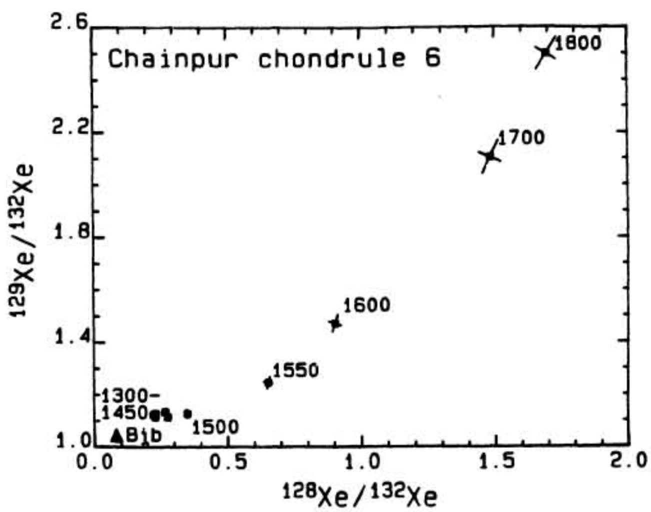

Fig. 2: Three-isotope I-Xe plot for chondrule 6. Note the pattern of increasing apparent ^{129}Xe/^{128}Xe ratio with increasing extraction temperature.