NOBLE GASES IN TWO SAMPLES OF EETA 79001 (LITH. A). S. P. Schwenzer, S. Herrmann and U. Ott, [1]Max-Planck-Institute for Chemisty, J.-J. Becher Weg 27, D-55128 Mainz, Germany; schwenze@mpch-mainz.mpg.de, ott@mpch-mainz.mpg.de.

Introduction: EETA 79001 is one of the most noted Martian meteorites with respect to noble gases, because it is the one in which Bogard in 1982 [1] and Bogard & Johnson [2] in 1983 found Martian atmospheric noble gas signatures for the first time. Since that time, various studies have been carried out on EETA 79001 [e. g. 1–8]. These efforts not only clarified the picture of the Martian atmospheric component [e. g. 3, 4, 7, 8], but also found evidence for another possible component, the so called EETV or "crush"-component [6]. In this study we add the first pyroxene data to the picture.

Brief petrology: EETA 79001 contains three lithologies with different petrological features. They are labelled A, B, and C, where A is the basaltic lithology, that makes up the main mass of the meteorite, and is basaltic, containing single and clustered xenocrystals [9]. The amount of pyroxene in lith. A is about 71 % [9]. Lithology B is a homogeneous basalt and lithology C is usually referred to as glass [9], which has been produced by an impact shock.

Sample and experiment: All five noble gases were measured in two samples of EETA 79001, lithology A: a whole rock sample (called "bulk") and a pyroxene separate. 49 mg of pulverized bulk material were measured with our "noble gases only" instrument, whereas 100 mg of hand-picked pyroxene were measured with the instrument for "nitrogen and noble gas" measurements using the procedure outlined in [10]. Gas extraction in both cases was carried out by stepped pyrolysis (at 800, 1800 and 1900 °C in a Mo crucible for the whole rock, and 400, 800, 1400, 1650, and 1700 °C in an Ir crucible for the pyroxene).

Results and discussion: Bulk concentrations of most elements (Tab. 1) agree well with the range covered by the literature data for lith. A [3, 4, 8]. For ^{4}He 40–96*10^{-8} cc STP/g, for ^{22}Ne 0.1–1.5*10^{-8} cc STP/g, with most results in the range of 1–3*10^{-9} cc STP/g have been reported [3, 4], furthermore ranges for ^{36}Ar, ^{84}Kr, and ^{132}Xe are 0.13–1.4*10^{-8}, 10.8–118*10^{-12}, and 3.2–31.1*10^{-12} cc STP/g [3, 4], respectively.

Table 1. Measured concentrations of He and Ne for bulk and pyroxene [10^{-9} cc STP/g].

		^{4}He	^{22}Ne	^{21}Ne/^{22}Ne	^{20}Ne/^{22}Ne
bulk	total	337	1.85	0.755	0.855
	±	37	0.10	0.004	0.043
pyrox-ene	total	367	1.55	0.746	0.853
	±	2	0.14	0.010	0.172

Table 2. Ar results for bulk and pyroxene. ^{36}Ar is given in 10^{-9} cc STP/g, T in °C.

	T	^{36}Ar	^{38}Ar/^{36}Ar	^{40}Ar/^{36}Ar
bulk	total	0.85	0.695	1077
±		0.04	0.032	39
pyroxene	400	0.16	0.204	398
	±	0.01	0.010	34
	800	0.17	0.525	1433
	±	0.01	0.020	121
	1000	0.05	1.592	2221
	±	0.05	0.194	266
	1400	0.24	1.577	666
	±	0.05	0.155	46

Table 3. Kr and Xe results for bulk and pyroxene. Concentrations are given in 10^{-12} cc STP/g, T in °C.

	T	^{84}Kr	^{83}Kr/^{84}Kr	^{132}Xe	^{129}Xe/^{132}Xe
bulk	total	43.64	0.208	13.61	1.062
±		2.32	0.003	0.63	0.018
pyrox-ene	400	5.44	0.202	2.14	0.982
	±	0.31	0.003	0.08	0.016
	800	1.93	0.184	1.32	1.016
	±	0.18	0.011	0.03	0.022
	1000	1.91	0.229	0.38	1.335
	±	0.32	0.006	0.12	0.086
	1400	5.19	0.212	1.24	1.206
	±	0.39	0.005	0.13	0.029
	total	14.47	0.207	5.07	1.072
	±	0.62	0.003	0.20	0.013

Abundances. Helium is released in the lowest temperature steps (≤ 800 °C) in both samples, whereas the other noble gases are primarily released at higher temperatures.

For He, Ne and Ar the elemental concentrations found in the pyroxene agree well with the bulk data. Krypton and xenon are about half as abundant in the pyroxene as compared to the bulk sample. Because our bulk sample had been pulverized in order to have a homogeneous sample for a variety of studies including noble gases and cosmogenic radionuclides [11], we need to consider its effect on the heavy noble gas inventory. This is because in previous studies it has been found that grinding of samples can introduce the heavy noble gases from the surrounding atmosphere and that these gases are possibly released at temperatures well above the first, the "cleaning"-step [12, 13], however. Close investigations of the isotopic results show that in the steps, which show Martian atmospheric signatures, the bulk also contains twice as much Xenon as the pyroxene. Therefore, we conclude that air contamination from sample preparation in temperature steps above 800 °C can be ruled out.

Components. The cumulative release plot of ^{36}Ar from pyroxene (Fig. 2) shows air ratios of $^{40}Ar/^{36}Ar$ in the first and the last three degassing steps. These ratios may indicate the release of adsorbed air or sample exhaustion, respectively. Only the 800, 1000, and 1400 °C steps show Ar-ratios different from air, where ^{36}Ar and ^{38}Ar in the 1000 and 1400 °C-T-steps are dominated by Ar from spallation, and no useful ratio of ^{40}Ar to trapped ^{36}Ar can be determined. In contrast to the Ar pattern the xenon pattern (Fig. 2) shows $^{129}Xe/^{132}Xe$ ratios clearly different from air in the 800–1400 °C steps plus in the 1700 °C step, the latter maybe due to degassing of Xe from another phase, possibly a small amount of olivine. In the 1000 °C step the isotopic ratio clearly indicates the presence of Martian atmosphere.

The presence of Martian atmosphere is further shown in the three isotope plot of $^{84}Kr/^{132}Xe$ vs. $^{129}Xe/^{132}Xe$ (Fig. 3), where the 1000 °C point falls on the mixing line between Chassigny and Martian atmosphere. However, only a small contribution of Martian atmosphere is present in both pyroxene and bulk. Most of the noble gas content in the samples comes from indigenous Martian reservoirs, spallation or is the result of radioactive decay. This is in sharp contrast to the results obtained for Lithology C [3, 4, 5, 7, 8], where the noble gas budget is dominated by the Martian atmospheric component.

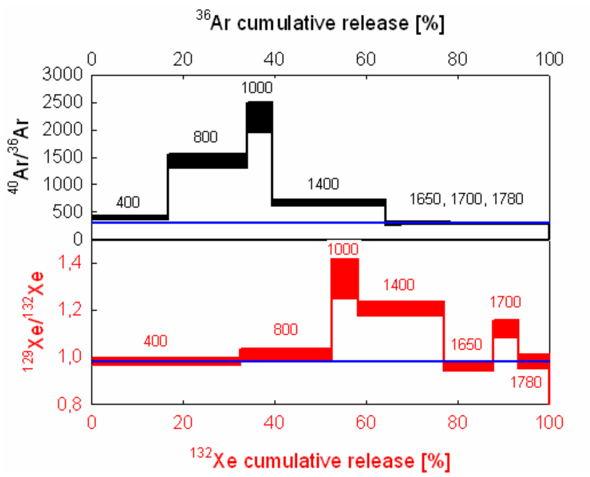

Fig. 2. Cumulative release plots of ^{36}Ar and ^{132}Xe. Blue line indicates air ratio, numbers in the graph show degassing temperatures.

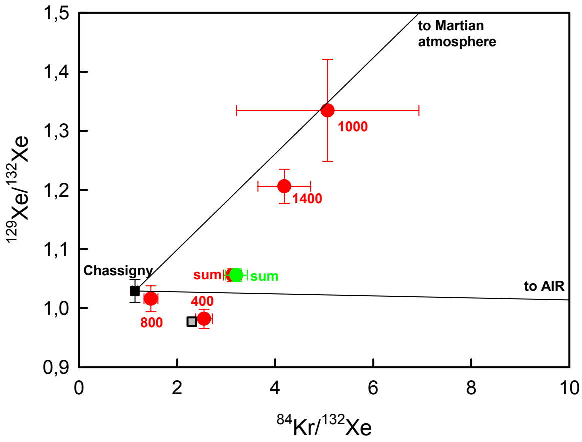

Fig. 3. Three isotope plot $^{84}Kr/^{132}Xe$ vs. $^{129}Xe/^{132}Xe$. ● pyroxene this study, ● bulk sample, this study, ■ Lithology A [4]. Numbers indicate pyrolysis temperatures. Chassigny from [14], Martian atmosphere from [7].

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