NOBLE GASES IN THE NAKHLITE GOVERNADOR VALADARES. T. D. Swindle, Lunar and Planetary Lab., U. of Arizona, Tucson, AZ; R. Nichols and C. T. Olinger, McDonnell Center for Space Sciences, Washington U., St. Louis, MO.

The nakhlite meteorites have come under increasingly close scrutiny in recent years because of the possibility that they, and the related shergottites and Chassigny (collectively, the SNC meteorites), may come from Mars. Noble gas investigations have focussed on the question of whether the elemental and isotopic compositions of the nakhlites can be attributed to simple mixtures of components previously identified in SNC meteorites. The Xe isotopic compositions of two nakhlites, Nakhla and Lafayette, are consistent with simple mixtures of components found in EETA 79001 and Chassigny (1). However, Nakhla and Lafayette data are not consistent with the trend defined by Chassigny and the shergottites on a plot of Kr/Xe vs. $^{129}Xe/^{132}Xe$ (2). We have now analyzed Ne, Ar, Kr and Xe extracted by step-wise heating of Governador Valadares, the third nakhlite. Total gas amounts and some isotopic compositions are given in Table 1.

Cosmic ray exposure ages: We can calculate exposure ages from spallation contributions to ^{21}Ne, ^{38}Ar, ^{83}Kr and ^{126}Xe. Determination of the amounts of spallogenic gas is generally straightforward, determination of production rates less so, since the chemical composition of Governador Valadares is known only for major elements (3). For Kr and Xe, where the primary targets are trace elements, we assume that Governador Valadares has the same chemical composition as Nakhla (4). Exposure ages calculated from our data and from the He, Ne and Ar data of (5) are given in Table 2. For Ne, Ar and Xe, we find exposure ages ranging from 8.2 to 9.9 Ma, in good agreement with the results of (5). The one discordant result comes from our Kr analysis, which gives an age of 21.3 Ma. We would expect our Kr-based age to be the most uncertain, both because our Kr calibration is by far the least certain (frequently uncertain by 25-50%) and because the production rate is based on a single analysis of Sr in Nakhla. Excluding the Kr-based age, the mean of the exposure ages listed in Table 2 is 9.3 ± 0.8 Ma.

Isotopic composition of trapped gas: The Ne and Ar are dominated by spallation-produced gas, but there are some observations that can be made about the Kr and Xe. First, the Xe isotopic composition is quite similar to Nakhla. The highest $^{129}Xe/^{132}Xe$ in any temperature step is 1.9, higher than any of the other SNCs other than Nakhla and EETA 79001. Because of the corrections that have to be made for spallation and fission, it is harder to extract information from the remainder of the Xe spectrum, but the data are consistent with a two-component mixture of the "martian atmospheric" Xe from EETA 79001 (6) and either terrestrial atmosphere or Chassigny Xe. The most notable feature in the Kr data is an apparent excess of about 4% at ^{80}Kr. Excess ^{80}Kr has also been found in EETA 79001 and Nakhla, although it is not clear whether the excess is part of a unique component (such as the martian atmosphere) (6) or is the result of in situ neutron capture on ^{79}Br (2).

Elemental abundances: If we add our Governador Valadares data to a plot of $^{129}Xe/^{132}Xe$ vs. $^{84}Kr/^{132}Xe$ (2), we find that it falls far to the Kr-poor side of the trend defined by Chassigny and the shergottites. Note that if our Kr calibration was in error, as suggested by the exposure age data, we may have overestimated the Kr abundance. Significantly, the only other SNCs that fall in this portion of the graph are Nakhla and Lafayette. Thus, the noble gases in Governador Valadares again seem quite similar to Nakhla.

Conclusions: The noble gases in Governador Valadares look much more similar to those in Nakhla than to those in Chassigny or any of the

shergottites. Furthermore, as is the case for Nakhla, it seems difficult to simultaneously match the Kr/Xe elemental ratio and the $^{129}Xe/^{132}Xe$ isotopic ratio by simple mixing of components previously identified in the shergottites and Chassigny, suggesting that the nakhlites may be sampling another reservoir of gas. If so, and if all the SNCs are martian, then there must either be at least three different martian reservoirs represented in our suite of eight samples. Alternatively, the nakhlites might have preferentially acquired atmospheric-like Xe. However, if that is the case, we need to identify a process that worked on nakhlites but not shergottites.

References: 1) Swindle et al. (1987) LPS XVIII 984; 2) Ott (1988) GCA **52** 1937, Met. **23** 294; 3) Burragato et al. (1975) Met. **10** 374; 3) Treiman et al. (1986) GCA **50** 1971; 5) Bogard and Husain (1977) GRL **4** 69; 6) Swindle et al. (1986) GCA **50** 1001.

Table 1: Elemental abundances ($10^{-10}cm^3STP/gm$) and isotopic composition

^{20}Ne	^{36}Ar	^{84}Kr	^{132}Xe	$^{21}Ne/^{20}Ne$	$^{22}Ne/^{20}Ne$	$^{38}Ar/^{36}Ar$	$^{40}Ar/^{36}Ar$
160	120	0.21	0.062	1.020(4)	1.201(4)	1.475(5)	791(16)

Table 1 (continued) Xenon isotopic composition (^{132}Xe=100)

^{124}Xe	^{126}Xe	^{128}Xe	^{129}Xe	^{130}Xe	^{131}Xe	^{134}Xe	^{136}Xe
6.4(2)	10.9(2)	22.9(4)	153.6(1.0)	24.7(3)	99.2(7)	36.0(4)	31.5(4)

Table 2: Cosmic ray exposure ages in Ma

Reference	He	Ne	Ar	Kr	Xe
This study	-	8.2	9.1	21.3	9.9
Bogard and Husain (4) mean	8.9	10.6	9.2	-	-

Production rate equations from Cressy and Bogard (1976) GCA **40** 749; Schultz and Freundel (1985) Isotopic ratios in the solar system, 27; Freundel et al. (1986) GCA **50** 2663; Regnier et al. (1979) Proc. LPSC 10th 1565; Hohenberg et al. (1981) **45** 1909.

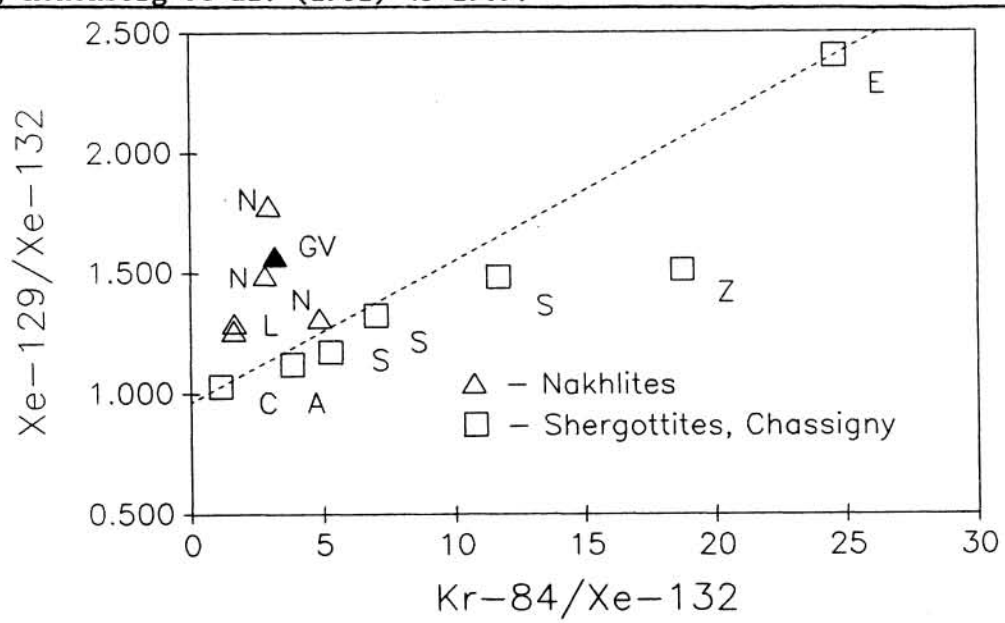

Fig. 1: Trapped noble gas data for high-temperature extractions from SNC meteorites. Other than Governador Valadares (filled triangle), data are from (2) and (6). All data have been corrected for spallation. Meteorites denoted by the first letter of their name (e.g. S=Shergotty).