

NITROGEN AND NOBLE GASES IN MARTIAN METEORITE TISSINT. R. R. Mahajan¹ and A. Basu Sarbadhikari¹, ¹Physical Research Laboratory, Ahmedabad, Gujarat, 380009, India (e-mail: ramakant@prl.res.in).

Introduction: The Martian meteorite, Tissint, an olivine-phyric shergottite, has generated great excitement for its pristine nature and its scientific potential for understanding Mars [1-4]. Here we report results of nitrogen and noble gas isotopic study to understand the contribution from different reservoirs to make up Tissint.

Nitrogen and noble gas data from Martian meteorites define signature of modern Martian atmosphere, ancient Martian atmosphere and Martian interior. Chassignite host interior components, while shergottites and nakhlites contains both interior and atmosphere components.

Measurements: Nitrogen and noble gas isotopic measurements were carried out at Physical Research Laboratory (PRL) on newly developed ‘Noblesse’ noble gas mass spectrometer facility [5]. Sample was wrapped in aluminum foil, loaded in the furnace storage volume and preheated in UHV for 48h at 150°C. Gases were extracted by heating the sample at 800°C and 1750°C, separated into two fractions (NG and N), which were analyzed using the standard protocols [5]. Measured data is presented in Table 1.

Nitrogen: Nitrogen in our studied sample of Tissint is 2.13 ppm, the isotopic composition varies from 11.74 ± 0.50 ‰ to 19.72 ± 0.74 ‰ in the temperature steps.

We corrected the total $\delta^{15}\text{N}$ value for cosmogenic contribution by using cosmogenic ^{21}Ne following [6]. We obtained the trapped nitrogen, $\delta^{15}\text{N}_t$ of 17.99 ± 1.93 ‰ for Tissint.

Noble gases: Neon is purely cosmogenic. Low $^{40}\text{Ar}/^{36}\text{Ar}$, $^{129}\text{Xe}/^{132}\text{Xe}$ observed in the 800°C temperature step suggest the presence of a Martian mantle component in this meteorite. While the signatures in the 1750°C step point to small contributions from Martian atmosphere.

Discussion: Nitrogen isotope ratio in our sample is alike earlier reported for groundmass by [1], but lower than the aggregate samples measured by [8].

Kr isotopes, $^{83}\text{Kr}/^{84}\text{Kr}$ and $^{86}\text{Kr}/^{84}\text{Kr}$ (Table 1, not shown here) indicates the gases in Tissint are mixture of Martian atmosphere, solar wind and cosmogenic components. Contribution to ^{82}Kr from (n, γ) reactions on Br is present in Tissint [9].

In Ar-Xe and Kr-Xe plot (Fig. 1), Tissint bulk sample falls near the interior component, defined by Chassigny [7], indicating a contribution from the Martian interior. This is consistent with the observation by [10].

Table 1. Noble gas and nitrogen data

Isotope	800°C	1750°C	Total
^{22}Ne , 10^{-8} cm ³ STP/g	0.018	0.376	0.394
$^{20}\text{Ne}/^{22}\text{Ne}$	0.860 ± 0.021	0.925 ± 0.002	0.922 ± 0.003
$^{21}\text{Ne}/^{22}\text{Ne}$	0.743 ± 0.003	0.805 ± 0.001	0.802 ± 0.001
^{36}Ar , 10^{-8} cm ³ STP/g	0.022	0.175	0.197
$^{38}\text{Ar}/^{36}\text{Ar}$	0.210 ± 0.001	0.607 ± 0.001	0.562 ± 0.001
$^{40}\text{Ar}/^{36}\text{Ar}$	579 ± 1	1348 ± 1	1261 ± 1
^{84}Kr , 10^{-10} cm ³ STP/g	0.107	0.588	0.695
$^{82}\text{Kr}/^{84}\text{Kr}$	0.206 ± 0.001	0.211 ± 0.001	0.211 ± 0.001
$^{83}\text{Kr}/^{84}\text{Kr}$	0.203 ± 0.001	0.210 ± 0.001	0.210 ± 0.001
$^{86}\text{Kr}/^{84}\text{Kr}$	0.304 ± 0.001	0.300 ± 0.001	0.300 ± 0.001
^{132}Xe , 10^{-10} cm ³ STP/g	0.022	0.120	0.142
$^{128}\text{Xe}/^{132}\text{Xe}$	0.074 ± 0.005	0.073 ± 0.003	0.074 ± 0.003
$^{129}\text{Xe}/^{132}\text{Xe}$	0.994 ± 0.001	1.167 ± 0.004	1.140 ± 0.003
$^{130}\text{Xe}/^{132}\text{Xe}$	0.154 ± 0.001	0.154 ± 0.001	0.154 ± 0.001
$^{131}\text{Xe}/^{132}\text{Xe}$	0.785 ± 0.001	0.798 ± 0.001	0.796 ± 0.001
$^{134}\text{Xe}/^{132}\text{Xe}$	0.390 ± 0.001	0.388 ± 0.001	0.388 ± 0.001
$^{136}\text{Xe}/^{132}\text{Xe}$	0.326 ± 0.003	0.330 ± 0.003	0.329 ± 0.003
N_2 ppm	0.17	1.99	2.16
$\delta^{15}\text{N}$ ‰	11.74 ± 0.50	19.72 ± 0.74	19.11 ± 0.72

Summary: We presented nitrogen and noble gas isotopic data on sample of Tissint, Martian meteorite of

the olivine-phyric shergottite, in order to understand the trapped components. Nitrogen and noble gases show the presence of interior components in Tissint. It also exhibits presence of atmospheric gas, similar to other shergottites and nakhlites.

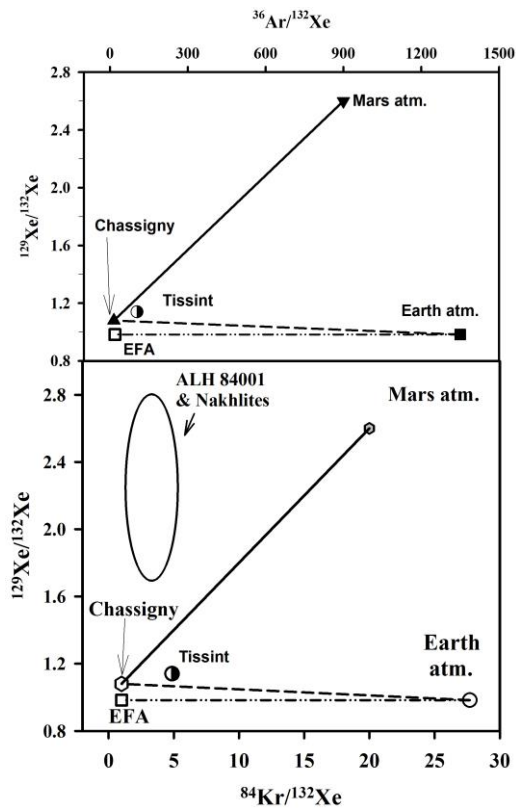


Fig. 1. Ar-Kr-Xe diagram showing the data for Tissint sample measured here. EFA is elementally fractionated air.

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