COSMOGENIC RECORDS IN EFREMOVKA CV3 METEORITE, **S. V. S. Murty[1], K. Nishiizumi[2], and J. N. Goswami[1]**, [1]Physical Research Laboratory, Ahmedabad 380009, India, [2]University of California, Berkeley, Berkeley, California 94720, USA.

Cosmic ray produced noble gas, radionuclide and nuclear track records have been studied in the CV3 meteorite Efremovka. A ^{21}Ne exposure age of 11.4±1.7 Ma and a pre-atmospheric radius of 20 cm are obtained. Saturation activities of ^{10}Be, ^{26}Al and ^{36}Cl are similar to chondritic values and consistent with the deduced size and a simple cosmic ray exposure of Efremovka meteorite. The measured ^{36}Cl activity of 11.5 dpm/kg can at best have ~20% contribution from *in situ* neutron produced ^{36}Cl and suggest that the neutron fluence experienced by Efremovka is almost an order of magnitude less than that by Allende.

Introduction. The CV3 meteorite Efremovka is a find with a recovered mass of 21 kg. Petrologic and chemical studies suggest Efremovka to be the most pristine member of CV3 class, with very little secondary alteration of its matrix and CAIs [1]. Signatures of the short-lived isotopes ^{26}Al, ^{41}Ca and ^{36}Cl [2-4] found in this meteorite clearly attest to its pristine nature. The objective of the present study is to decipher the cosmogenic records in Efremovka and derive its exposure age, pre-atmospheric radius and the neutron fluence experienced by it.

Experimental. Separate samples of bulk Efremovka (adjacent to the CAIs studied for ^{41}Ca) have been used for neuclear track, noble gas and cosmogenic nuclide studies. Olivine grains, hand picked from a disagregated bulk piece, were used for nuclear track studies following standard procedures [5]. Accelarator mass spectrometry has been employed for the determination of the activities of ^{10}Be, ^{26}Al and ^{36}Cl [6]. Standard noble gas mass spectrometric procedures have been employed in the study of Ne, Kr, Xe, as detailed in [7].

Results: *Noble gases*: Two bulk samples and fragments of two CAIs (E40, E42) have been studied for noble gases. A trapped Ne composition of 20/22=10.1±0.1 can be derived from the Ne three isotope plot of the data for the different temperature fractions of these four samples. Data for both the bulk samples yield $(22/21)_c$=1.11±0.01 and exposure ages of 12.7 and 10.1 Ma, respectively using production rates from [8]. We adopt an average exposure age T_{21}=11.4±1.7 Ma, which includes uncertainities in concentration of Ne as well in the production rate. This value is better than the previously reported value of 9Ma [4] which was based on a assumed value of 8.4 for trapped 20/22. Independent calculation of cosmogenic ^{38}Ar is not possible due to the presence of excess ^{36}Ar [4], while large amounts of trapped gases make cosmogenic effects barely detectable in Kr and Xe isotope data.

Nuclear Tracks: The measured track density of ~$3x10^5/cm^2$ in olivine grains correspond to a track production rate of ~$2.6x10^4$ tracks/cm^2/Ma for an exposure age of 11.4Ma. A maximum shielding depth of 9 cm for the analysed sample can be deduced from the track data. Considering the recovered mass of 21Kg, we can estimate a preatmospheric radius of ≤20cm for the Efremovka meteorite. The small size of Efremovka meteorite is also supported by the radionuclide data.

***Radionuclides*:** The activities of ^{36}Cl, ^{26}Al and ^{10}Be in bulk samples of Efremovka are 11.52±0.28, 59.9±0.28 and 18.47±0.23 dpm/kg, respectively and are similar to saturation activity level seen in samples of normal-sized chondritic meteorites. The radionuclide data and the cosmogenic neon (22/21) ratio, both support the small shielding depth of the analysed sample deduced from the track data. The radionuclide data are also consistent with the small preatmospheric size of Efremovka and suggest a simple cosmic ray exposure history for this meteorite. The ^{36}Cl activity of Efremovka is much less than the maximum value of 54±2 dpm/kg found in Allende [9] for which the presence of a significant contribution from neutron induced production has been well established. If we use a spallation production ratio of P36(Ca)/P36(Fe)=8, and appropriate chemical composition, the expected spallation ^{36}Cl in Efremovka turns out to be 9.6±1.3 dpm/kg. This suggests that we can attribute at the most ~2 dpm/kg of ^{36}Cl activity in Efremovka as due to secondary neutron induced production. If we consider the Cl concentration in Efremovka and Allende to be similar and take into account the lower cosmic ray exposure age of 5Ma for Allende [10], the neutron fluence experienced by Efremovka during its cosmic ray exposure turns out to be almost ten times lower than by Allende. This is in agreement with the results reported by us earlier based on the data for neutron produced ^{80}Kr and ^{128}Xe in Efremovka samples [4]. These results also show that the neutron produced component cannot account for more than a few percent of the observed excess of ^{41}K in Efremovka CAIs [3].

References : [1] Sylvester, P.J. et al. (1993), ***GCA* 57**, 3763-3784. [2] Goswami J.N. et al.(1994) ***GCA* 58**, 431-447. [3] Srinivasan, G et al, (1994) ***Ap.J.* 431,** L67-70. [4] Murty, S.V.S. et al. (1995) ***Meteoritics* 30,** 555. [5] Krishnaswami, S. et al. (1971), ***Science,* 147,** 287-291. [6] Nishiizumi, K, et al (1986) ***LPSC,* 17,** 619-620. [7] Murty, S.V.S. and Goswami, J.N. (1992), ***PLPSC,* 22,** 225-237. [8] Eugster, O. (1988) ***GCA,* 52,** 1649-1662. [9] Mabuchi, H et al (1975), ***Meteoritics,* 10,** 449. [10] Fireman E.L. and Gobel R. (1970) ***JGR,* 75**, 2115-2124.