TOTAL NITROGEN IN LUNA-24 SAMPLES

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(*Received 24 March 1979*)

Total nitrogen has been measured by neutron activation in three Luna-24 soils. The nitrogen abundances are found to vary from 46 ppm to 65 ppm with no significant variation with stratification. From the low nitrogen content of these soils, it is concluded that the Luna-24 soils studied in this work are immature.

INTRODUCTION

As a part of that general programme of N and Li measurements in lunar samples (Goel & Kothari, 1972; Kothari & Goel, 1973; Goel *et al.*, 1974, 1975; Shukla & Goel, 1974; Shukla, 1977), the present authors report in this paper the total N contents of three Luna-24 soils analysed in this laboratory. Lithium results are described separately.

EXPERIMENTAL

The experimental technique used is radiochemical neutron activation analysis, details of which are described elsewhere (Shukla *et al.*, 1978).

RESULTS AND DISCUSSION

The Luna-24 samples analysed in this work are : 24123, 24148, and 24190. Nitrogen contents for these soils are given in Table I. As can be seen, there does not appear any appreciable change in N contents with the depth indicating that all the soils were exposed to the solar wind irradiation for about the same time. This conclusion is derived from the fact that most of the N (and other species like carbon and rare gases) in lunar soils are mainly solar wind derived (Goel *et al.*, 1975 and references cited therein).

In Table II, the N results of these soils are compared with the soils from other missions. It is evident that N values for these Luna-24 soils lie towards the lower side of the range observed for other lunar soils. From earlier studies on lunar samples, it has been observed that N content of a soil is a good indicator of its maturity as N values for various soils are found to correlate with maturity parameters like agglutinate content (Goel *et al.*, 1975), excess reducing capacity (Shukla, 1977), and FMR intensity normalised to total iron content (Morris, 1976). Based on these observations it could be concluded that the Luna-24 soils analysed by us are immature ones and shall have low value for other maturity parameters mentioned above. In fact the agglutinate content studies (Barsukov *et al.*, 1977; Ryder *et al.*, 1977 & McKay *et al.*, 1977) for Luna-24 soils suggest these soils to be immature to submature. Our three samples fall within the depth classified as immature by McKay

TABLE I

*N contents in Luna-24 samples**

Sample No.	Depth cm	Weight mg	N content ppm	
24123-13	122–123	5·5	56	Av. = 55
24148-11	147–148	8.0	65	
24190-14	189–190	7.5	46	

*(Error ± 10%) Av.—Average.

TABLE II

*Nitrogen contents in lunar samples analysed in our laboratory**

Sample	No. analysed	Range (ppm)	Average N /ppm)
Soils	23	60–242	110
Luna–24 soilds	3	46–65	55
Basalts	3	18–21	20
Breccia	7	16–30	24

*(Error ± 10%)

et al. (1977) (from 110 cms and below) from agglutinate content and by Morris (1977) from FMR studies. Other solar wind species like ^{36}Ar, ^{132}Xe (Bogard & Hirsch, 1977) are also low in the region studied by us. To our knowledge, the only contrary report about the maturity of these soils has been the track analyses work by Goswami (1978), who finds that, with the exception of the soils 24190 and 24163, other soils (24087, 24123, 24148) are almost mature. Blanford and Wood (1977) from their particle track measurements on plagioclase bearing grains in six Luna–24 soils (24077, 24109, 24149, 24174, 24182 and 24210) find the upper four samples to be mature and, in order to account for the observed submature to immature behaviour of these four soils based on other studies (McKay *et al.*, 1977; Morris, 1977), suggest that Luna–24 soils are a mixture of soils in which the feldspathic component is mostly mature. Nitrogen content and track data for various lunar soils are being examined to find the possible causes for such discrepancies.

From the almost uniform low value of N observed for the soils studied in this work it may be suggested that the Luna–24 regolith is either formed from a previously younger surfacial material in a single ejecta event or its accumulation rate is quite fast. The first possibility has been found to be unlikely by Ryder *et al.* (1977) in view of the maturity of lower most sample (24210) studied by them. It might be that the latter possibility has prevailed in the depth region studied by us.

ACKNOWLEDGEMENTS

The authors are grateful to the U.S.S.R. Academy of Sciences for making available to the Indian National Science Academy samples of the valuable lunar material. Thanks are also due to Professor D. Lal, F.N.A., F.A.A.S., and Professor N. Bhandari for their efforts in sample procurement and distribution. This research was partially supported by a grant from the Department of Space, Bangalore.

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