Viking Mars Labeled Release Results

Levin, G.V. and P.A. Straat
Nature, **277**, 326, January 1979.

The labeled release (LR) Mars experiment[1,2] yielded a positive response from Mars soil when a radioactive organic solution was added and a negative response when the soil was heated to sterilization temperature. After storage of the soil at 10ºC for two to three months in the spacecraft, there was almost no response on addition of radioactive nutrient[3].

Nussinov *et al.*[4] proposed that LR Mars life-detection response arose from water-induced outgassing of CO_2 from Mars surface fines. They state that the kinetics of outgassing in LR and GEX are similar and that the characteristic time of the yield of O_2 in GEX and CO_2 in LR are also similar.

We are surprised that they ignored the fact that the CO_2 released by the LR is radioactive and, therefore, must have arisen from the radioactive nutrient added to the soil sample. Further, we do not agree that the reaction kinetics in GEX and LR are similar. GEX outgassed all of the measured O_2 in ~2 h whereas the half-time for the LR production of radioactive CO_2 was ~8 h, after which production tapered off, but continued slowly, for the duration of the particular experiment (up to 90 Sol).

Although we are not yet certain whether the LR response was biological or chemical, we are sure that it cannot be explained by the outgassing of CO_2 trapped in Mars surface fines.

GILBERT V. LEVIN
PATRICIA A. STRAAT

Biospherics Incorporated,
4928 Wyaconda Road,
Rockville, Maryland 20852

1. Levin, G.V. & Straat, P.A. *Science* **194**, 1322-1329 (1976).
2. Levin, G.V. & Straat, P.A. *J. geophys. Res.* **82**, 4663-4667 (1977).
3. Levin, G.V. & Straat, P.A. *20th COSPAR Meet.*, Tel Aviv (1977), *21st COSPAR Meet.*, Innsbruck (1978).
4. Nussinov, M.D., Chernyak, Y.B. & Ettinger, J.L., *Nature* **274**, 859-861 (1978).

NUSSINOV *ET AL.* REPLY¾We should like to correct a false impression that our paper[1] contained a conclusion about registration in the LR experiment of 'CO_2 trapped in Mars surface fines'. We assumed that due to the radioactivity of the $^{14}CO_2$, such a conclusion could never be drawn either by us or by readers. No conclusion as such can be made about the origination mechanism of the registered gases on the basis of the GEX and LR kinetics. It is only natural to think that $^{14}CO_2$ resulted from interaction between nutrient and O_2, the latter developing from the soil's reaction with water. The time trend of the count curve is typically filtrational which means that the formation of O_2 was rapid as compared with its transport. From a classical physical viewpoint, their kinetics implies quantitative similarity only of GEX and LR curve shapes, itself implying identity of the power dependence ($\sim t^{1/4}$ at small t) and exponential saturation ($t \to \infty$). Qualitative differences are easily explained by the fact that the very designs of GEX and LR were incorrect from the physical standpoint, namely: (1) shapes (and masses) of the GEX and LR samples were not identical; (2) specific quantity of nutrient differed in the experiments; (3) the most informative initial segments of the kinetic curves were not registered. These are the reasons that it was impossible to expect a better than order of magnitude agreement. Therefore the similarity of the GEX and LR kinetics should undoubtedly be considered as fact.

Note that the data by Levin and Straat on 'almost no response upon addition of radioactive nutrient' after storage of the soil at 10ºC for two to three months, are readily explained by our model. Indeed, O_2 physically adsorbed within the micropores at elevated temperatures can be converted to a chemisorbed state, thereby losing its reactability. At low Martian temperatures the chemisorption of O_2 is inhibited[1].

M.D. NUSSINOV

Space Research Institute

Y.B. CHERNYAK

Zatonnaya str. 10-1-178,
115407 Moscow, USSR

J.L. ETTINGER

Space Research Institute,
Academy of Sciences, USSR,
Profsojusnaja, 88,
117810 Moscow, USSR

1. Nussinov, M.D., Chernyak, Y.B. & Ettinger, J.L. *Nature* **274**, 859-861; **275**, 19-21 (1978).