FINAL PROOF OF THE DEPTH DEPENDENCE OF THE Xe-131/Xe-126 - RATIO AS DEDUCED FROM "THICK TARGET"- EXPERIMENTS EXECUTED FOR ANALOGY CONSIDERATIONS OF THE SITUATION ON THE LUNAR SURFACE, W.A.Kaiser, K.P.Roesner, W.Herr, Institut für Kernchemie der Universität zu Köln.

After having established the fact that Ba-130 caused the depth dependent Xe-131 anomaly we saw a definite chance to use this effect for estimating actual burial depths of extra-terrestrial samples presuming we were able to find a suitable calibration scale. The only way accessible was a simulation experiment.

A large amount (200 kg) of artificial lunar soil was bombarded with 600 MeV protons at the CERN synchro-cyclotron in order to simulate effects due to cosmic ray bombardment on Ba-targets on the moon. The material was filled in 7 Al-boxes (each 300 x 300 x 200 mm) which were assembled one after the other towards the beam. Preliminary results of that study were already presented at the Fourth Lunar Science Conference. However, it turned out that the geometrical dimensions of this particular set up were not sufficient to ensure a comprehensive insight into the complexity of the nuclear reactions leading to the isotopes in question. Conditioned by that, especially the data of the nuclides produced by neutron capture like Ba-131 and Au-198 were concerned. Therefore, we found it necessary to do an improved irradiation experiment. In order to minimize the leakage of neutrons additional material e.g.natural basalt etc. was added (total weight of the experimental arrangement $\sim$2500 kg). The p-flux ($\psi = 3.25 \times 10^{11}$ p/sec) was measured by Al-foils, via the reaction Al-27(p,3p3n)Na-22. The total dose was 1.64×10^{16} p. Thus, it was possible to record especially those nuclear processes occuring in the depth region of 170-210 g/cm^2 more distinctly which in comparison to the former experiment had not been unambiguously judged. The knowledge of the energy and spatial distribution of the neutron cloud proved to be of utmost importance for attempting to convert the "Thick Target" data to the actual case: the 2π geometry of cosmic ray irradiation on the moon.

The isotopic composition of Xe produced in 200 natural baryt samples was measured. Gold wires served as neutron monitors. Whereas Au-198 is entirely produced by the (n,γ)reaction, the Xe-isotopes are formed by spallation as well as by neutron capture. At first the ratio of the radio-isotopes Ba-131/Xe-127 was determined by γ-counting. Since the Ba-131-activity contains all of the Xe-131 which is due to neutron capture on Ba-130, the ratio Ba-131/Xe-127 can already be regarded (at least in the first approximation) as a measure for the more informative ratio Xe-131/Xe-126.

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Since Xe-126 and also Xe-127 are predominantly formed by spallation (their ratio is near unity) the more easily available radionuclide Xe-127 can replace the Xe-126 in our considerations. Noteworthy will be the fact that the spallogenic part of Xe-131 is not represented by the Ba-131 activity. Consequently, the actual Ba-131/Xe-127-ratio is somewhat lower than the ratio Xe-131/Xe-126.

However, since the spallogenic part of the latter ratio will be rather insensitive to depth (a fact which follows from yield-calculations using the Rudstam formula and Xe-measurements on "Estherville" samples) the Ba-131/Xe-127-activity ratio should indeed reproduce the relative changes of the Xe-131/Xe-126 ratio with depth.

The experimental results showed clearly that the above ratio can be used to determine burial depths of individual samples assuming undisturbed structures of the respective parent bodies.