SPALLATION AND NEUTRON CAPTURE REACTIONS IN A THICK TARGET OF LUNAR SOIL COMPOSITION, W.A.Kaiser, W.Herr, K.Bär, U.Herpers, H.Kulus, R.Michel, P.Rösner, K.Thiel and H.Weigel.
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At present, there is a lack of quantitative data of nuclear production rates in lunar soil. Therefore, a thick target experiment (dimensions 30 x 30 x 140 cm, weight 150 kg) of a chemical composition identical with lunar soil at the Apollo 11 landing site (1) was performed exposing the target to the 600 MeV proton beam of the synchro-cyclotron at CERN (Genève). Purpose of the experiment was to simulate the cosmic ray bombardment and the determination of production rates of special isotopes in dependence of their spatial distribution. Initially, the spallation reactions from Ba to Xe and the n-capture reaction Ba-130(n,γ)Ba-131 $\xrightarrow{\varepsilon}$ Cs-131 $\xrightarrow{\varepsilon}$ Xe-131 as a function of depth and energy were of top interest in order to correlate the Xe-131/Xe-126 ratio (Xe-126 is purely spallogenic, whereas Xe-131 is produced eitherway) to an actual depth (Kaiser and Rösner). The result will be of high actuality for burial depth and neutron history of lunar samples (2-6). The measurement of the Xe-mass spectra is delayed due to instrumental modifications; however, γ-spectrometry of the Ba-13lactivities gives already valuable information concerning the epithermal neutron distribution in the body.

The thick target experiment offered also the possibility to measure the thermoluminescence (TL) and a large number of spallogenic and neutron produced radioisotopes.

The TL depth profile of calciumfluoride and plagioclase (see fig.1) is strikingly similar to that of the p-dose, except at the beam-exposed surface, where the spatial intensity of the TL is lowered due to a leakage of radiation. Yet, in a depth greater than $\sim$170 g per square cm the TL is reduced by a factor $>$100 (Bär).

The production rates of Be-7, Na-22, Na-24, Ti-44, Sc-44, Sc-46, Sc-48, V-48, Cr-51, Mn-53, Mn-54, Co-56, Co-57, Co-58 and Fe-59 as a function of depth were measured. Targets were the "artificial moon" and pure Fe, Ni, Co, Si, and Al foils. Regarding the behaviour of the neutrons, the following processes besides the above mentioned Ba-130(n,γ)...Xe-131 reaction were studied: W-186(n,γ)W-187 $\xrightarrow{\beta}$ Re-187; Ir-191(n,γ)Ir-192; Au-197(n,γ)Au-198; Co-59(n,γ)Co-60; Cu-63 (n,γ)Cu-64; Co-59(n,2n)Co-58; Co-59(n,3n)Co-57. (Herpers, Kulus, Michel and Weigel.)

Finally, the spatial neutron field has been investigated by means of particle tracks in Uranium glass standards of known U-concentration. The glasses, of different U-235/U-238 isotopic

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composition (including a pure U-238 glass standard) supplied additional informations of the thermal and fast neutron energy region. Furthermore, rock forming minerals were used to record the depth profile of p-recoil tracks (Thiel).

The total dose of protons was $1.3 \pm 0.2 \times 10$ to the power 16 based on the Na-22 activity of purest Al foil (99.9999 %). The spatial distribution of the proton beam within the body was determined by induced Na-22 and by γ-autoradiography of Na-24 (see fig.1).

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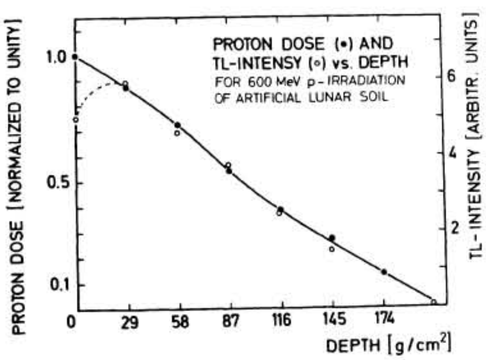

Fig.1