ARAGUAINHA IMPACT STRUCTURE,BRAZIL: SHOCKED ROCKS OF THE CENTRAL UPLIFT, W.v.Engelhardt, Mineralogical Institute Univ.of Tuebingen, Germany, St.Matthäi,Austral.Nat.Univ. Res.School Earth Sci,Canberra, Australia, J.Walzebuck, Assen, Netherlands.

The central uplift of the 40 km wide Araguainha impact structure ($16^0$52'S,$52^0$45'W), Mato Grosso, Brazil (Engelhardt et al.1985), is formed by a ring of uplifted blocks of Devonian Furnas sandstone, 9 km in diameter which surround an elliptical basin, 4.5 * 3.0 km in size, occupied by uplifted granite and several impact formations. We report on results of petrographical and chemical investigations of the rocks of this central area of the uplift.
We distinguished four lithogical units in the area for which an inventory is given in Table 1: (1) Alkali-feldspar granite occupies the largest part of the basin. Coexistence of pure K-feldspar with albite indicates that the granite crystallized at pressures above 4.2 kbar. Its Rb/Sr age is 449+-9 MA (Deutsch et al.1990). According to deformation features in quartz and other minerals the granite was shocked at pressures between 20 and 25 GPa. It is permeated by red dikes, filled with shocked granitic material, including some melt, and thinner gray cataclastic veins.
(2) Impact Breccia with Melt Matrix, overlies the granite in the center and forms hills, surrounding the basin in the S and SW. It is chemically identical with the granite and contains shocked and thermally altered granitic clasts in a granitic impact melt, recrystallized at >700^0C.
(3) Unsorted and unstratified Polymict Impact Breccias form hills, surrounding the basin in the N and NW, comprising a Lower and an Upper Unit. Components of the Lower Unit are unshocked, shocked and shock-melted sandstone, shocked granite and crystalline melt rocks, derived from granitic impact melt, altered by two successive reactions: (a) exchange of K by Na and removal of Rb; (b) replacement of feldspar by quartz. Crystallization age of two impact melt rock samples is 240-250 MA ($^{39}Ar/^{40}A$: 250 +- 50 MA, Hammerschmidt in Engelhardt et al.1985; $^{87}Rb/^{86}Sr$: 243 +- 19 MA, Deutsch et al.1990). Components of the Upper Unit are shocked granite, sandstones with shatter cones, unshocked, shocked and shock melted sandstones, some of them recrystallized, indicating a subsequent heating by the ambient hot breccia mass.
(4) Monomict Impact Breccias from sandstones, forming hills which border the central basin in the SE and consist of quartz sandstones and breccias in various stages of shock metamorphism, up to complete melting.

Conclusions: (1) Superposition order of impact formations in the central area: uplifted shocked granite - granitic impact breccia with melt matrix - polymict and monomict impact breccias.

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(2) Observed stages of shock metamorphism: IV = complete melting (granite,quartz sandstone); III = partial melting (granite, sandstone); II = isotropization (granite ?); I = deformation structures (granite, sandstone); shatter cones. (3) Observed polystage deformation structures in the granite are assigned to compressional and extensional deformation time intervals during crater formation. (4) Impact formations at the present surface were originally covered by breccias, removed by erosion. (4) The impact occurred 240-250 MA ago, in Upper Permian times, during the deposition of the shallow marine Passa Dois formation. (5) Exchange of K by Na and removal of Rb point to reactions of the granitic impact melt with sea water and indicate that the impact occurred under submarine conditions. (6) Polymict breccias underwent diagenetic silification.

References

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Table 1:

Rock Type	Main Shock Effects				Chemical Modification	Post Impact Modification
	Shatter Cones	Fractured Grains	PLE	Melt		
Granite		●	●			quartz & hematite precipitation
Red Dikes		●	●	●	hydrothermal alteration	
Grey Veins		●	●			
IBM		●	●	●	chemical & thermal interaction of melt and clasts	
Poly. Breccia (Upper Unit)	●	●	●			silification
Poly. Breccia (Lower Unit)		●	●	●	metasomatic reaction (with sea water)	silification
Mono. Breccia		●	●			

PLE = shock induced planar elements in quartz

SIMULATION OF GALACTIC COSMIC RAY INTERACTIONS WITH 'MARTIAN SOIL': IMPLICATIONS FOR COSMOGENIC NUCLIDE STUDIES AND PLANETARY GAMMA RAY SPECTROSCOPY II. Peter A.J. Englert, Lennox J. Harris, and S. George Bobias, Nuclear Science Facility, San Jose State University, San Jose, CA; Darrell M. Drake, Edward R. Shunk, Manfred Drosg[1], and Robert C. Reedy, Los Alamos National Laboratory, Los Alamos, NM; Martin Körfer, Max-Planck-Institut fuer Chemie, Mainz, FRG.
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The Mars Observer Mission of NASA will have on its payload an instrument that is able to measure both neutrons and gamma-rays emitted from the Martian surface [1]. To study the relation between bombarding galactic cosmic ray particles and the emitted radiations quantitatively two thick targets bombardments of artificial martian soil that measured both the secondary particle cascade inside the thick targets and surface neutron fluxes and spectra were performed at the Los Alamos Meson Physics Facility's Weapons Neutron Research laboratory.

In the first experiment during September 1989, [2], a thick target in form of a cylinder with a diameter of 67.5 cm and a depth of 93 cm was filled with powder of a chemical composition close to that from the Viking lander analysis of the Martian soil. The artificial regolith was mixed using industrially pure chemicals and local sand, resulting in a density of 1.8 g cm^{-3} and a total water content of 3.05 %. In the second experiment, during July 1990, the cylinder had a diameter of 91 cm and a depth of 121 cm. The powder was mixed from crushed local basalt (Totavi basalt) and industrial purity chemicals. The achieved match with the Viking lander composition was better. The density was again 1.8 g cm^{-3} but the water content was 1.8%, i.e. lower than that of the first experiment. An 800 MeV proton beam was sent through the (center) symmetry axis of the cylinders. The target containers were made of steel with an Aluminum window at the front side to let neutrons escape almost undisturbed. For the neutron measurements and the exposure of cosmogenic nuclide target materials both assemblies were irradiated with 800 MeV protons at currents of 1 - 2 nA for extended periods. For a detailed study of secondary particle fluxes inside the target both assemblies were irradiated with 3.1×10^{15} and 1.66×10^{15} protons in less than 12 hours, respectively. Residual radioactive product nuclides were measured at Los Alamos with conventional gamma-ray spectrometry not earlier than 48 hours after the end of irradiation.

Figures 1 and 2 show results of residual ^{198}Au produced in exposed gold foils by neutron capture reactions. Figure 1 shows the ^{198}Au activities measured in the center cores of the first and second targets. The activities are normalized to the number of incident protons. In both simulation experiments the low energy neutron distribution as represented by ^{198}Au shows a broad maximum between 30 - 70 cm and 30 - 90 cm respectively. Though the water concentration differed by about 1%, no significantly deeper maximum was observed for the second irradiation. The depth of the maximum is comparable to that observed by Michel et al [3] in a 600 MeV proton bombardment and by Englert et al [4] in a 800 MeV/nucleon alpha particle bombardment of a thick target. The maxima are all much shallower than that observed by Englert et al [4] in a 2.1 GeV proton bombardment.

Remarkable, however, is that the absolute ^{198}Au activities are throughout higher in the second target. Differences in composition of the target material including moderators are not significant. The volume of the second target is with 0.794m^3 more than two times larger than that of the first irradiation (0.333m^3).

Consequently more neutrons were kept inside the target (see also [4]). This effect was observed on smaller spherical targets by Michel et al. (1986) [5].

Figure 2 describes the lateral distribution of ^{198}Au inside the targets. In addition to Figure 1, the result confirms the higher neutron retention inside the second and larger target. ^{198}Au activities of the second irradiation are generally higher at a given depth; they do not decrease as fast as those of the first target when moving radially outwards from the center.

After a significant cooling time long-lived cosmogenic nuclides will be studied in samples exposed inside the two thick target assemblies.

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Figure 1

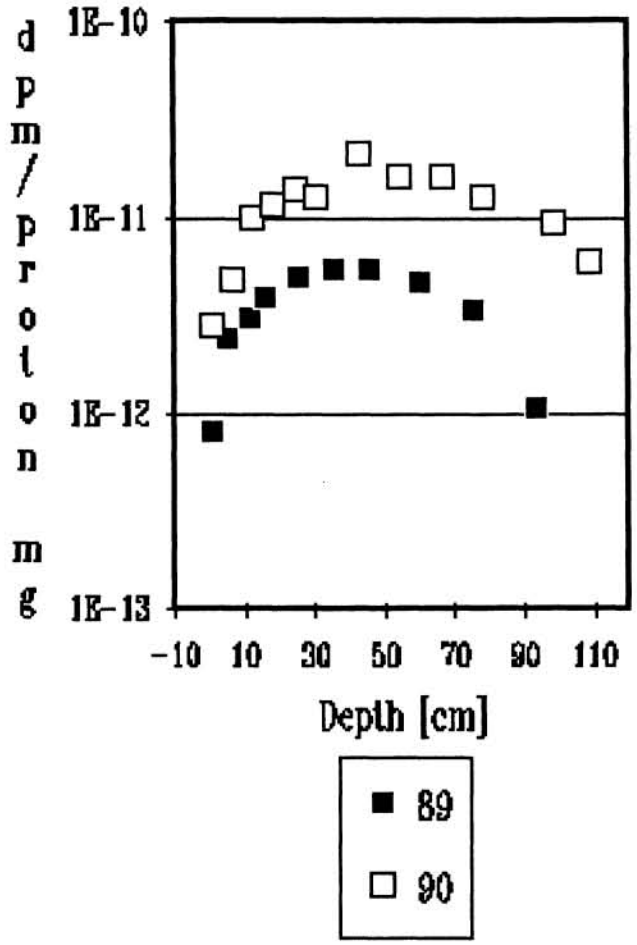

Figure 2