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WEATHERING OF A TASSILI SILURIAN SANDSTONE, CENTRAL SAHARA

Preliminary report

Partial results of the investigations carried out in various regions of Central Sahara (Paleozoic and Precambrian area — Tassili and Hoggar) are presented. Special attention has been given to geological and geomorphological section across the Tassili-N'ajjer Mts. (in SSW—NNE direction) — 24°30′—24°15′N; 9°30′—9°50′E.

Explanations to the adjoining figure are as follows:

M — migmatites with migmatitic gneiss (paragneiss)
m — microgranite
md — microdolerite
γ — intrusive granites
alt — alternation of cataclastic granite (depth till 10 m); it was observed the decomposition of following minerals: lime plagioclase, lime soda plagioclase, orthoclase, biotite, muscovite, etc.
S_2 — Silurian "Tassili" sandstones
δ — tectonic disturbance (with structural wall — w)
eQ — aeolian sands
fQ — fluviatile gravels (alluvial zone)
pD — playa depression — bolson plains (fluvial-aeolian zone with finer psefitic and psamitic sediments); the average surface color in playa depression as determined with the Munsell notation ("Munsell soil color chart", 1954) is very pale brown — 10YR 8/2—4, but the hue, value and chroma may shift to gray and brownish-yellow; it is a result of re-sedimentation from peripediment material
b — bornhards ("inselbergs") as residual hills resulting from scarp retreat and pediplanation
bP — bottom level of peripediment area (suballuvial bench) with transitions to bolsonplain
pP — supposed main prequaternary peripediment level (relics of 50—90 m erosional niveau) with stone desert pavement (a dark red-brown coating)
Ps — a vast plateau of Tassili sandstones — peneplain structural level of Tassili-N'ajjer Mts. at absolute heights of 1500—2000 m

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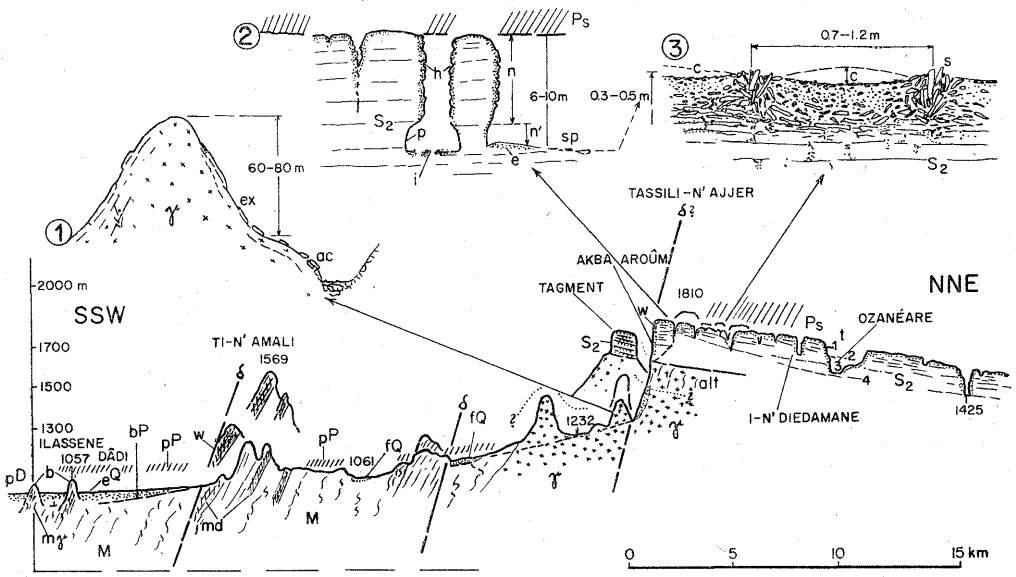

t_{1-4} — relics of structural fluviatile terraces joint to NNE in gigantic canyons, deep gorges, "stone forest", "sandstone towns", etc.

w — structural wall — in the upper part there are highly conspicuous honeycomb forms

1. Section across a structural "domed inselberg"

γ — cataclastic intrusive granite

l — latent conformity of "hypogenic joints"

ex — exfoliation of granite and aeolian weathering

ac — accumulation of exfoliation plates

The form of "inselberg" and processes of exfoliation result here from geological and exodynamical factors: concentric cooling of the magma, internal pressure by the removal of load by erosion, expansion of joint conformity due to chemical changes, expansion and contraction of the rock's surface (alternate changes of temperatures), etc.

2. Typical sculpture of a Tassili sandstone — stone towers, cupolas, etc.

Ps — peneplaine, structural level — in the summit part can be seen typical black-red-brown colouring ($Fe_2O_3+MnO_2$ will produce "ferricrete" and manganese crusts, respectively SiO_2 will produce "microsilicrete" on the Silurian sandstone surface — dark reddish grey (10/R 3/1 — very dusky red 7.5R 2/2), aeolian weathering, ventifacts, rill-like forms, exfoliation slabs and honeycomb forms in a polycyclic development

n — depth of cutting corresponding to the erosian level of terraces, t_{1-2} (3?)

n′ — concave abris walls mainly modelled by separation in polygenic development (correspond to t_{2-4} erosion level); efflorescence deposits were not observed

h — highly conspicuous honeycomb forms
sp — deflation surfaces of stone pavements
e — aeolian psamitic to pellitic material
p — wall painting of prehistoric civilisation, covered with "loess" material — very fine product (in size from 0.01 to 0.08 mm) of wind corrasion-deflation was transported and accumulated in wall-abris and also on prehistoric painting; fine powder material is pale yellow (2.5Y 8/4), but the hue, value and chroma may shift to yellow and light grey
i — prehistoric implements (silex industry)

3. Section through "frost-cryo-segregated polygonal structures" in regosol (situation on December, 28, 1974)

c — segregation centres of fine "Tassili sandstone" debris and psamitic components; with degraded surface by deflation process
s — segregated debris fragments of sandstone (max. 0.5 m ø) predominantly with vertical orientation; surfaces of stone fragments at the top part of polygons have a drab patina, microhoneycomb forms, aeolian polished surfaces, etc. (after "Munsell notation" weak red colouring — 10R 5/2—4)

The wide diurnal variation of temperature, typical of warm deserts, release expansion and contraction forces in rocks, which may cause disintegration and, under conditions of temporary soil humidity and frost occurrence, cryo-sorting of debris in regosol.

According to the stations of Tamanraset (1376 m) and Asekrem (2700 m) the following data may be supposed for soil temperatures in summit parts of the Tassili-N'ajjer Mts.:

min. absol. temperatures:
January — —13°C— —15°C
July — 9°C—10°C

mean daily soil temperatures (°C):
January — at 7^h: —1° —2°, 13^h: 40°—45°, 18^h: 15° —25°
July — at 7^h: 30° —35°, 13^h: 50° —60°, 18^h: 32° —37°

Rainfall:
Djanet: 20 mm
Tamanraset: 40 mm
Asekrem: 80 mm (approximate 20—60 days with rain)

Development of frost-cryogenic segregation polygonal structures must have been associated with the last Pleistocene cold climatic oscillation. It corresponds with nivational stationary moraines of the Upper Pleistocene in the highest parts of the Hoggar Mts. (2200—2500 m above sea level).

Especially, patination and coatings on a surface of different micro- and macroforms are very helpful tool in desert geochronology (see different changes of colouring in the Munsell notation).