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CHARACTERIZATION OF LITHOLOGIC/ WEATHERING PROFILE OF OUAGADOUGOU AREA (BURKINA-FASO)

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Introduction

Most of the hard consolidated rocks exposed on the earth's surface are deeply weathered either by mechanical or chemical agents resulting in a mantle of the residual material. This superficial material furnishes pore space for groundwater storage.

In Burkina-Faso, most of the basement made up crystalline rocks (about 80% of the territory) is usually covered by a weathered zone. The character and the thickness of this zone is related to the type of rock, climatic conditions, and intensity of fracture. The fractured zone and its weathered zone form a two layer aquifer with 30 – 50m thickness in Ouagadougou area. The weathered zone stores about 90% of the volume of water available in this aquifer system.

Our present paper reports on the mineralogical composition and one physical property (magnetic susceptibility) of each layer making up the weathering profile with a view to characterize the weathering zone of Ouagadougou area and to understand its hydraulic rule in the aquifer system.

Origin and Geology of the samples

Our samples were collected from one borehole drilled by Down Hole Hammer technique for the water supply purpose in Ouagadougou area. This area belongs to North Sudanian climate characterized by annual rainfall between 600 – 1000mm with mean annual temperature between 24 – 28°c.

The mean depth of borehole is about 40 m. The borehole penetrated the bedrock constituted by two types of rock (according to petrographic description of the thin section of sample got from surface outcrop): one have **basic migmatite** made up by Plagioclase, Biotite, Hornblende, Chlorite, Epitote and Sphene and **tonalite** made up by Quartz, Potassium feldspars, Plagioclase, Biotite, Hornblende and Sphene. These rocks were dated from **PRECAMBRIAN D** and are called **ANTEBIRRIMIAN** formations.

Methods of investigation

All samples were analysed by means of X-ray diffractometry (XRD) in an untreated condition. For each sample, ordinary dry-powder mounts with random (or nealy random) orientation were X-rayed.

The susceptibility measurements were carried out using a magnetic susceptibility meter (MS2) connecting to a sensor (MS2B). The samples put in plastic bottle (10 cm^3 or 15 cm^3) were placed within the sensor cavity using a simple insertion mechanism. The values measured were displayed directly in SI (10) unit.

Results and discussion

Quartz, Kaolinite (Kao), Goethite (Goe), Hematite (He), Illite, Smectite (Smec), mixed layer (m-l), Potassium Feldspar (P-K), Plagioclase (Plag), Amphibole (Amph) and Biotite (Biot) are the minerals determined by means of XRD (fig. 1).

Iron minerals represented by Goethite and Hematite are dominant in the first layers and the clay minerals (Illite, Smectite and mixed layers) are dominant in medium layers apart Kaolinite which is present in all layers. The lower layers of the profile contains the original minerals of the rock basement (Potassium Feldspar, Plagioclase, Amphibole and Biotite) and a small amount of clay minerals.

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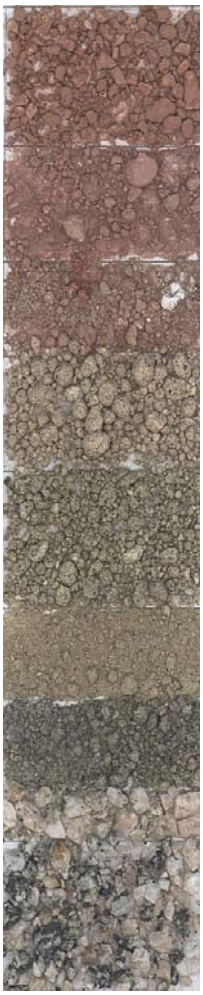

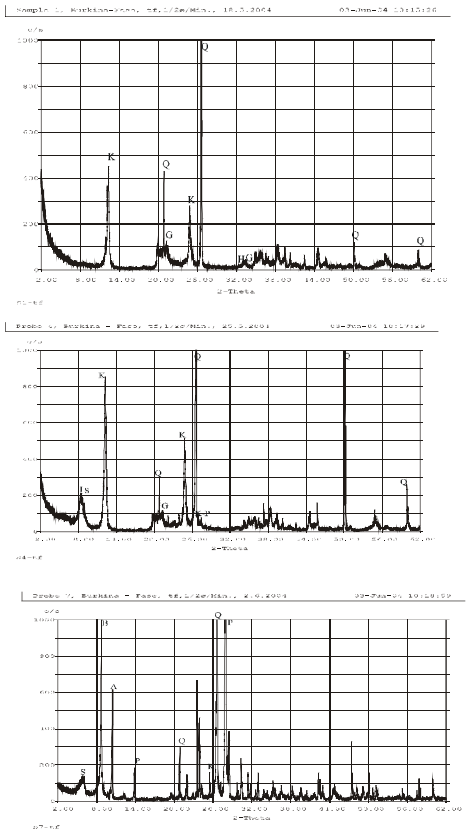

Layers 1 and 2

Layers 3, 4, 5

Layers 6 and 7

Fig. 1: Lithologic Profile and X-ray diffraction patterns of sample
Q= Quartz (Qz),
G= Goethite (Goe),
H= Hematite (Hem),
I= Illite,
S= Smectite (Smec),
m-l= mixed layers,
F-K= Potassium Feldspar (Ortho),
P= Plagioclase (Plag),
A= Amphibole (Amph),
B= Biotite (Biot)

Table 1 summarizes the main results. The magnetic susceptibility measured is influenced by those minerals: In the upper layers the value magnetic susceptibility is mainly influenced by iron minerals, the value of magnetic susceptibility decreases with the depth corresponding to the decrease of iron minerals content. In the medium layers this value is influenced by clay minerals. In low layers , we have an increase of magnetic susceptibility due mainly to the presence of dark minerals such Amphibole, Biotite, Plagioclase and a small amount of clay minerals.

Layer	Depth in m	Goe	Hem	Kao	Illite	Smec	m-l	Qz	Ortho	Plag	Amph	Biot	K	Aquifer
1	0...6												21	1
2	6...11												17	
3	11...15												12	
4	15 ... 20												21	
5	20 ... 26												19	
6	26 ... 30												25	2
7	30..34												17	

Table 1: Minerals content and magnetic susceptibility (K)

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Conclusion

A relatively complete weathering profile in Ouagadougou area is made up of three parts, each part is characterized by its mineralogical composition:

- The upper part contains iron minerals such as goethite and hematite and the decrease of these minerals is characterised by the decrease of magnetic susceptibility. This part forms the shallow aquifer or superficial aquifer.
- The medium part is characterized by the high content of clay minerals (illite, smectite and mixed layer). The magnetic susceptibility is influenced mainly by clay minerals. This part forms an impermeable zone and separates the two main aquifers.
- The lower part is made up of original minerals making up the rock basement. This part shows a high value of magnetic susceptibility due to the dark minerals (plagioclase, amphibole and biotite) and a small amount of clay minerals and forms a deep aquifer connected with a fractured zone.

These results give fundamentals for a zonation of profiles based on indication from geophysical measurements (magnetic and nuclear logs).

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