EUROPEAN ACADEMIC RESEARCH
Vol. IV, Issue 7/ October 2016

ISSN 2286-4822
www.euacademic.org

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

Investigation of the Relationship between Top Soil, Bedrocks (Parent rocks) and Groundwater Salinity at Sharshar and Algaa'h Areas

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Abstract:

The aim of this study was to determine if there is any relation between groundwater salinity and the mineralogical composition of top soils and the rocks obtained during hand digging of wells in the study area. Analysis was carried for mixed top soil samples, composite rock samples and salt samples obtained by saline water evaporation. X-ray diffraction technique was used for identification of mineralogical composition of the different solid samples. The XRD analysis showed that the top soils composition in the two areas was dominated by calcite, quartz, and muscovite minerals. The salt samples were dominated by high halite content, as well as, considerable thenardite mineral and some quartz impurities. The composite rocks sample showed high quartz content, considerable muscovite and albite minerals.

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Key words: XRD, Mineralogical composition, Sharshar, Calcite, Saline water

1. INTRODUCTION

The water bearing rocks play a major role in the formation of ground water resources and their chemical content (Geological society of Africa, conference Khartoum, 1976). Ground water carries dissolved salts from under lying soil and bed rock materials through which it travels (NSW survey, 1988- 1991).

Sharshar and El-gaa'ah are small saline zones in the Northern Kurdufan state. Groundwater in the two areas is characterized by high salinity. The citizens of the area withdraw the saline ground water from hand dug wells with depths ranging from **40-70** meters. They evaporate the brine water by boiling in large drums or by solar evaporation from large plastic sheets to obtain salts. These salts are used as locally produced salt licks. The top soils in the two areas include some geophagic sites that attract domestic animals (e.g. goats and donkeys) to visit to visit this soil sites for licking. The aim of this study was to determine the characteristics of the main minerals of the top soil, the underground rocks and the locally produced salts from geochemical formation site of view. X-ray powder diffraction was used as an instrumental technique to identify various unknown/ minerals. X-ray powder diffraction is one of the best available techniques for the identification and quantification of all minerals present in clay rich rocks e.g. Clay stones, Mud-stones, and marls (Siddiqui et al, 2009). Accurate quantitative mineral analysis is important in petrological studies, engineering and industrial applications of rocks that contain clay minerals (Jan Srodon et al, 2001).

The main analytical difficulties in quantitative mineral analysis of rocks by X-ray diffraction (QXRD) are related to the chemical and structural characteristic of clay minerals such as variable chemical composition, highly variable structures involving different patterns of layers, and various defects that disturb three-dimensional periodicity (**Smith et al., 1987; Batchelder and Gressy, 1998).** In this study the purpose of analysis was mainly qualitative.

1.1 Collection of Samples

Saline soil samples were collected at depth of 20cm from Sharshar west and El-Gaa'ah. Locally produced salt samples were collected from the two zones. Rock samples obtained during well digging were collected from El-Gaa'ah area.

2. METHODS OF ANALYSIS

X-ray Diffraction System PW3040t60X'pert PRO Philips (www.Panalytical.Com) Console main supply 40, 200-240V single phase, was used for analysis of the solid samples. Each solid sample was finely grinded, packed and introduced to X-ray diffraction system. The results obtained were shown in figures (1 –8).

3. RESULTS AND DISCUSSION

Figure (1) Shows X-ray analysis results for sample (1), which, was a homogenized mixture of five soil sample from Sharshar west. The results show a high content of quartz (SiO_2) and calcite (CaCO3), indicating a sandy clay formation of the top soil. The presence of Muscovite ($KAl_2[AlSi_3O_{10}](OH)_2$ and Anorthite ($CaAl_2Si_2O_8$) as a feldspar minerals and mica group minera ls indicate that the area is igneous rock area.

Fig. 2 was a result of a single soil sample from Sharshar west (sample .2), it shows that the most available minerals composing the soil sample were quartz and calcite as well as muscovite ($KAl_2[AlSi_3O_{10}](OH)_2$), in addition it shows a significant content of albite mineral ($NaAlSi_3O_8$) instead of anorthite in figure (1).

It should be mentioned here that Ca^{2+} can easily replace Na^+ in feldsbar minerals, since the ionic radius of Ca^{2+} ion (100pm) and that of sodium ion is (102 pm). The electrical neutrality of the crystal is maintained by substituting a second element of different oxidation state in the mineral, where aluminum ion Al^{3+} (39pm) replace silicon ion Si^{+4} (42 pm). This may be enhanced by the easy leaching of sodium from soil, indicated by low sodium concentration in Sharshar soil according to (AAS) analysis of soil samples (Gibla O. A. 2007).

Sample (3) is a homogenized mixture of three soil samples from Sharshar west it shows similar mineral composition to that of sample (1), which, were quartz (SiO_2), Calcite ($CaCO_3$), muscovite ($KAl_2[AlSi_3O_{10}](OH)_2$ and anorthite (Fig. 3). But simply can be noted that the calcite peaks are less than that of sample (1) (Quantitative and qualitative).

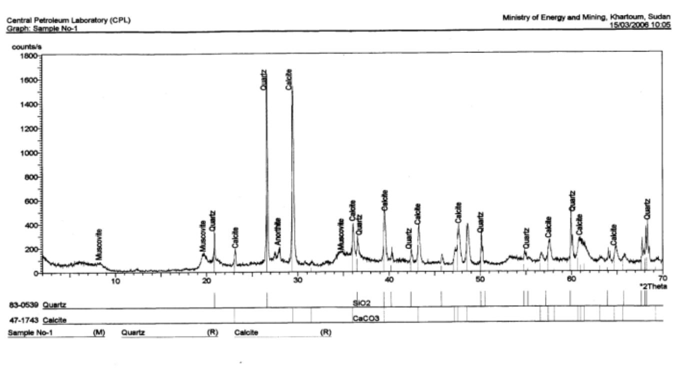

Fig.1: Soil Sample (Sharshar)

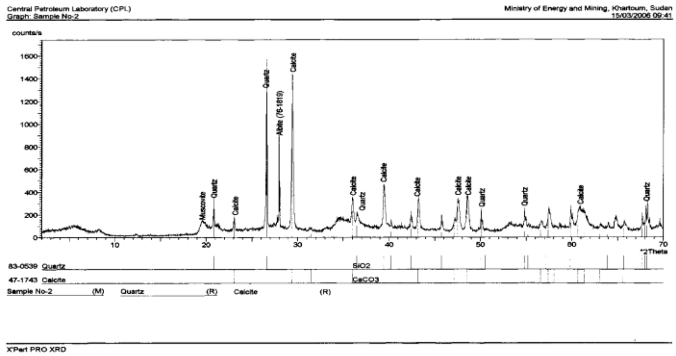

Fig.2: XRD Soil sample

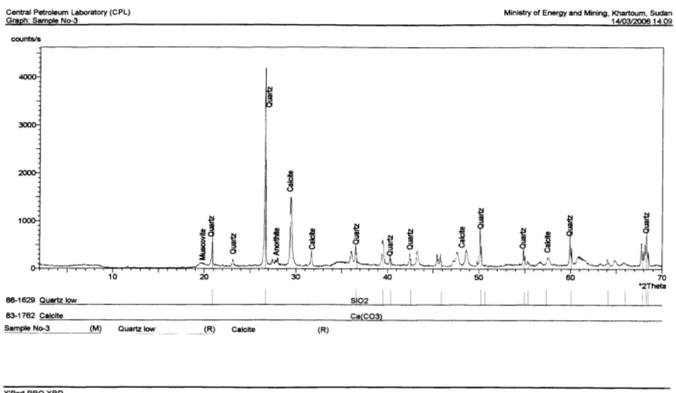

Fig.3: XRD Soil Sample

Sample No. 4 is a homogenized mixture of five soil samples from Alga'ah, shows a sandy clay formation of Alga'ah soil, with high quartz and calcite content as well as anorthite minerals (Fig. 5), but showed no Muscovite or albite compared to sharshar soils. This may be a clear difference between the two mineralization zones soil at Sharshar and Alga'ah.

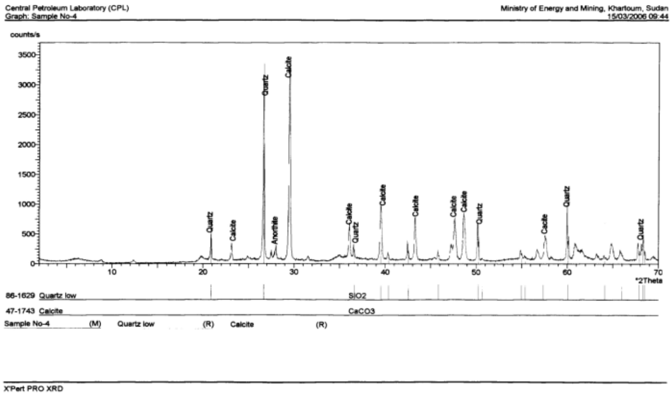

Fig.4: XRD Soil Sample

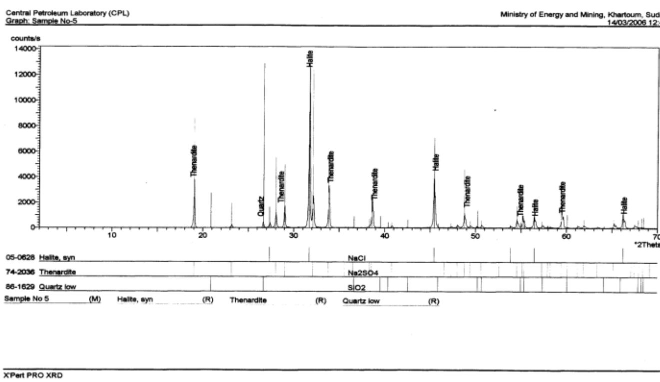

Fig. 5: XRD Salt Sample

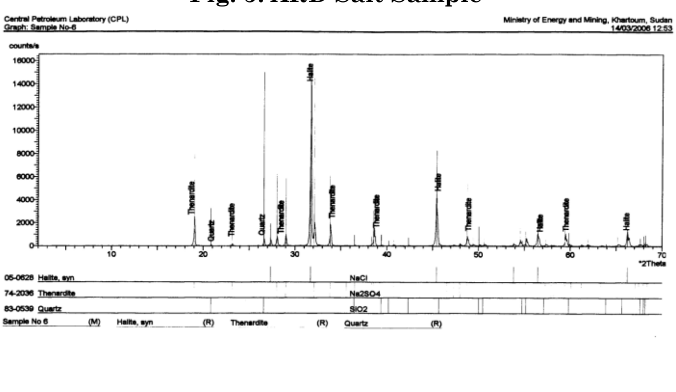

Fig 6: XRD Salt Sample

Sample (No. 5) is a mixture of five salts samples of fire evaporized saline water from Sharshar wells. Sample (No. 6) is a mixture of salts samples obtained by solar evaporation of sharshar saline water. Figures (6 and 7) may give a clear chemical composition of Sharshar locally produced salts. Sharshar salts, therefore, can be described, mainly as halite rock mineral (NaCl) with a considerable thenardite content (Na_2SO_4) and some quartz impurities.

Figure (No.7) shows XRD analysis results of sample (No.7), which was a mixture of Alga'ah salt samples. It shows a high halite content with some amount of thenardite (Na_2SO_4). In comparison with Sharshar salts samples [Fig. 5 and 6)], alga'ah salt samples show a highly pure salt composition dominated by sodium chloride.

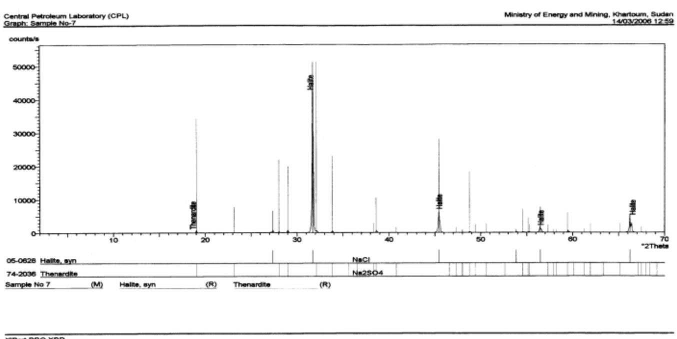

Fig.7 XRD Salt Sample

Figure (No.8) shows XRD result of rock samples mixture. The rocks sample have a high quartz content, as well as, a considerable content of muscovite ($KAl_2[AlSi_3O_{10}](OH)_2$ and albite ($NaAlSi_3O_8$) minerals. It differs from Alga'ah soils composition by showing no calcite ($CaCO_3$) or anorthite ($CaAl_2Si_2O_8$) minerals. It also differs clearly from the composition of salts obtained from alga'ah saline groundwater which were dominated by halite and thenardite minerals.

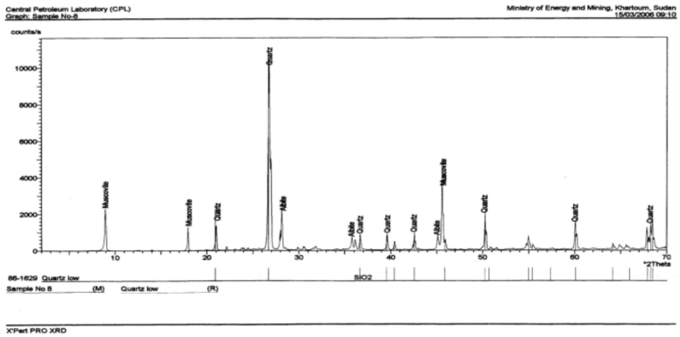

Fig. 8: XRD Mixed Rocks Sample

4. CONCLUSION

As a conclusion we may state that the X-ray diffraction analysis does not show any relationship between the top soils, the rocks obtained during wells digging and the ground water chemical composition in the two saline zones of sharshar and alga'ah areas. The high salinity of groundwater may be due to water rock interaction in more deep levels. According to groundwater specialist report (NKRDP, 2001), groundwater salinity was believed to be partly due to stagnation. Salinity in the two areas may be due to a presence of evaporites of buried sea or saline lakes. This may enhance the IFAD reports, (1993), which proposed that, the high concentrations of chloride and sulfate in the high salinity zone extends south of Greigikh to be due to the presence of a thick evaporite layer deposited under lacustrine conditions.

REFERENCES

1. Siddiqui, M. T. Shah, and I. Ahmed. (2009), X- ray Diffraction (XRD) analysis of Thar, Sonda and Meting Colifields, Sindh; *Sindh Univ. Res. Jour.* (Sci. Ser.), **41**:(1), **67-74.**

2. Jan Srodon, Victoria A. Drits, Douglas K. McCarty, Jean C. C. Hsieh and Dennis D. Eberl, (2001), Quantitative X-Ray Diffraction Analysis of Clay- Bearing rocks from random preparations, *Clays and Clay Minerals*, **49**: (6), 514-528.
3. A.R. Mukhtar G.W.S (2001). Ground water Specialist Report (16.6-31.7. 2001.) (NKRDP).
4. Omer Adam Mohammed Gibla, (2007), "Characteristics and Chemical Composition of Ground water in Bara Basin" Ph.D Thesis, Sudan University of Science and Technology.
5. Herry G. Rodis, and Abdalla Hassan lutfi Wahadan, (1963) US. Geological Survey Availability of Ground Water in Kordofan Province, Sudan, Geological Survey Department of Sudan Buletin No. 12.
6. Yee J.J.S.; Souza W.R. Denver (1987). Quality of Ground Water in Idaho. Co (USA) *Geological Survey*. p53.
7. Herry G. Rodis, and Abdulla Hassan and Lutfi Wahadan, (1964). Ground Water Geology of Kordofan, U.S Geological Survey Department, Sudan Bulletin No. 14.
8. North Kordofan Rural Development Project. Special Identification Mission Report, Annex, Water IFAD, ROME, 1993.
9. Asgher Ali Daahar Hakro, Adnan Khan and Sadaf Naseem, (2016). Mineralogical Investigation of the Bara Formation from Lakhra Anticline, Sindh Province, Pakistan, *Journal of Basic and Applied Sciences:* **12,** 1-7.
10. Asghar Ali Alias Daahar Hakro, Muhammed Atique Ahmed Baig, Syed Rafig Ul Hasan Baqri, Qamaruddin Khokhar, (2014). Clay Mineralogy of the Bara Formation exposed at Ranikot, Laakhra and in the subsurface of Thar coalfield, Sindh, Pakistan, *Int.J.econ.environ.geol:* **5**(2), 32-38.
11. Vladimir Simic and Peter Uhlik, (2006), Crystallite size distribution of clay minerals from selected Serbian clay deposits, *Annales GeologiqUES De La Peninsule Balkanique*, **67**, 109-116.

12. Batchelder M. and Cressey G. (1998), Rapid, Accurate Phase Quantification OF Clay-Bearing Samples Using A Position-Sensitive X-Ray Detector, *Clays and Clay Minerals* **46**:183–194.