



CHEMOSTRATIGRAPHIC PROFILE OF A RESERVOIR IN WELL "X" OF FIELD "Y" OFFSHORE SOUTHERN GABON

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Article history:		Abstract:
Received:	14 th August 2023	Chemostratigraphy is a useful way to link sedimentary layers based on how the amounts of major, minor, and trace elements change over time. The chemical analysis of a cross-section of a reservoir from the offshore Gabon well "X." From ditch cuttings at depths between 2720m and 2947m, 14 samples of sandstones, siltstones, conglomerate, silty shale, and shales were taken. Eleven (11) of these samples were chosen for X-ray diffraction (XRD) and X-ray fluorescence (XRF) testing (XRF). The deeper series, which was made up of older deposits, was mostly made up of shale. The shallower part was made of sandstone, and volcanic poufs could be seen when they were looked at under a microscope. The analytical results showed the presence of minerals, which can be seen in the XRD profiles of the minerals and elements, which show how they change along the cross section of the reservoir. Elements like K, written as K ₂ O, and Mg were not found in samples taken from a shallower depth range of 2720m to 2850m. But the amount of all other elements in samples taken between 2,850 and 2,947 meters deep went up with depth. The fact that volcanic turfs were found at an altitude of 2910 meters showed that volcanic materials were released because of a tectonic event. Between 2720 and 2880 meters deep, where the volcanic event happened, the sandstone may have been heavier because of the gases that came out of it. The K ₂ O and Mg content of the cross-variable section of the reservoir is used to tell the difference between the paleoclimate and weathering. The section between 2720m and 2850m deep doesn't have any Mg and K ₂ O, but the samples from deeper down do. Compare this to things like aluminum and other elements that are heavier. K ₂ O and Mg are very mobile elements that could have been eroded away much earlier, leaving only Al and heavier elements behind. It is possible that these sandstones were exposed to chemical weathering in a warm and humid environment, which is ideal for chemical weathering.
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INTRODUCTION

Chemostratigraphy is the use of mineralogical and elemental composition to delineate the sequence of deposition of formations, this helps in establishing stratigraphic relationships (Ramkumar, 2015). This information could also be used in delineating the provenance, maturity and class of the sediments. The chemo stratigraphic profile can also be used in understanding reservoir functionality with respect to the group of minerals that may be present in reservoir sand bodies (Craigie, 2018). Scales are also important compounds but regrading flow assurance in the context of gathering etc. Provenance represents the original source of the sediments, may be continental crust or oceanic crust. The paleoclimate of the sediments expresses the weathering tendency of the sediments. This study can also be applied to generate the geochemical fingerprint of sequence of formations. The study can also be applied in establishing chemo stratigraphic zones. The study can also provide for correlation studies between reservoir sand bodies.

Geology of the Study Area

The geology of Gabon is centered on the opening of the Southern Atlantic, which gave rise to series of horst and graben which consist the Gabon basin. The Gabon basin consist of the North, Interior and the South. The sedimentary fill of the basin is divided into Pre-rift, Syn-rift and Post-rift (Brink, 1974) (Teisserenc & Villemin, 1990). The Interior basin consist mostly the Pre-rift sediments and it consist continental, fluvial and lacustrine sediments. The post rift

sediments are found in the North and South basins and are basically continental, fluvial and lagoonal. The North and South basins are mostly offshore basins. The Gabon basin has two prominent sandstone formations which are the Gamba Formation in the Offshore and the Dentale Formation in the Shallow waters.

LITERATURE REVIEW

The study of earth materials, like minerals, rocks, and fossils; soils, sediment, and dust; and water for his or her chemical makeup, is an emerging subdiscipline in geological sciences. This subject is usually known now as geochemistry. With advancements in various analytical techniques and computing, it's now possible to work out elemental and isotopic abundances precisely and accurately, even at ultra-trace levels. Until about three decades ago, geochemical tools were largely used for magmatic and metamorphic rocks (hard rock geochemistry). Realizing the potential of geochemistry and therefore the progress made in understanding processes, timing, and evolution of and sources to hard rocks, geochemical tools are being extensively applied to sedimentary systems. This has recently led to the emergence of the topic Chemostratigraphy, during which chemical signatures (elemental, radioactive–radiogenic, stable, and cosmogenic isotopes) in sediments and sedimentary rocks are wont to unravel environmental conditions of sediment production and deposition, their sources, and their evolutionary changes from sedimentary packages. This is often a big development in geology and therefore the book edited by Dr. Mu. Ramkumar has come at an appropriate time. The varied papers within the book illustrate how chemical signatures of various sorts of sedimentary rocks, formed from Paleoproterozoic to Paleogene, might be wont to infer physical/biological conditions involved in sediment production and deposition and their sources. Future generations of geoscience students will find this book very useful to start their research in soft rock geochemistry.

The results of the analysis administered by (Selegha et al, 2020), display the of log view throughout the well for V/Ni, Y/Nb, Zr/Cr, Rb/Cs, Cr/Na₂O, Na₂O/Al₂O₃, Ga/Rb, Al₂O₃/Bases and (Fe₂O₃+MgO). The shale volume indicates a sandstone formation between 1850m to 2120m, then intercalations of shale, sandstone, siltstone and carbonate rocks between 2120m to 2625m. From 2625m to 3025m, mostly carbonate rocks are observed and from 3025m to 3100m salt. While from 3100 to rock bottom, intercalation of sandstones and conglomerates. The V/Ni ratio which had been used as indicator of redox environment show a big variation, clearly the sandstones intervals like 1850m to 2120m and 2350m to 2450m show very low values which indicates that the sediments were deposited in shallow marginal marine or coastal near shore environment, while depths that have significantly high V/Ni ratios were deposited in marine environment. The depth range of 2125m to 2350m bear very high V/Ni ratios, this seemingly corresponds to Cenomanian to Turonian, which has been indicated because the best source rocks. The Y/Nb ratio Markley discriminates the sandstone rich interval from the shale rich interval, the depth range of 1850m to 2120m indicates high values of Y/Nb ratio, this corresponds to the Senonian to Maastrichtian interval, which was characterized by widespread deposition of sandstones which could be sourced from continental clastic rocks. This interval is additionally noted with renowned regression event. The depth range of 2120m to rock bottom of the well bear significantly low values, the ratio shows indication of reduction with increase in shale volume. The Al₂O₃/Bases ratio, that the bases (Na₂O, K₂O, MgO and CaO) bear very low ratios within the sandstone interval of 1850m to 2120m, and high values for interval of high shale volume. This suggests that the majority of the feldspars had been preferentially retained within the sandstone interval while clay rich minerals were preferentially retained within the shale and carbonate rich intervals. The Zr/Cr and Rb/Cs ratios bear similar profiles down the wellbore, the Zr/Cr ratio varies with organic content as portrayed by the shale volume which is modelled from gamma radiation. The profile show increase in Zr/Cr ratio for interval with high shale volume, while intervals with low shale volume and invariably high sandstone content bears near zero ratios. The Rb/Cs ratio seems more serrated, in intervals on the brink of rock bottom of the well (mostly shale), it is often wont to determine changing clay mineralogy between intervals. Ga/Rb ratio show a marked distinction between the sandstone rich interval and therefore the clay rich interval. Ga has been related to kaolinite, while Rb is with hillite, therefore the Ga/Rb ratio represents Kaolinite/hillite ratios. The Ga/Rb ratio is high within the sandstone interval of 1850m to 2125m, below to rock bottom of the wellbore, very low values were encountered. This infers that the sandstones had more kaolinite compare to other intervals, while other narrow sandstone sections bear higher hillite content. This suggests, within the context of pore morphology that the sandstones might not be an efficient producer since kaolinites are pore filling minerals and can block/prevent production, while illiterate mostly pore lining minerals and can limit/reduce production in reservoirs. The Fe₂O₃+MgO ratio show lower values for sandstones of 1850m to 2120m, relative to deeper series of mainly shale and carbonate rocks which bear higher values.

Chemical Weathering and Paleoclimate.

Weathering expresses the erosion of hydroxides and oxides of alkaline-earth metal relative to the Aluminum oxides. It also can be considered the alteration of feldspar and subsequent formation of clay-related minerals. The concept is that Ca, Na, K, Mg are released from feldspar hosting minerals, causing a preferential increase in Al, implying that the larger cations like Al are preserved within the weathering residue in contrast to the smaller cations like Na, and Ca. The weathering index during this context is represented as $WI = Al / CaO + MgO + Na_2O + K_2O$. The Al/bases ratio track indicates extremely low values with some spikes within the sandstone formation of 1850m to 2125m. This invariably means sandstone interval of 1850m to 2125m is richer in feldspar minerals relative to the Al minerals. It's been proposed that Al is usually hosted by slow–settling fine-grained sediment decreasing in abundance with increasing grain size and suspension. While Na and Ca occur mainly in faster-settling sediment. Mechanical weathering is dominant in cool and

temperate regions while chemical weathering dominates in warm and humid areas. In respect of paleoclimate, the Ga/Rb ratio which represents the kaolinite/hillite ratio may give an insight, correlating it with Al/bases ratio. This study confirmed the Ga/Rb a ratio has direct correlation with the Al/bases ratio this suggests that the formation of kaolinite increases with hydrolytic weathering, and kaolinite are formed in hot humid climates while illites are formed in drier cooler climates. Within the context of reservoir pore morphology, the preferential formation of kaolinite should indicate the occurrence of pore-filling minerals within the reservoir sandstones. This could imply that the sandstone formation of 1850m to 2125m bears poor sweep/production efficiency. While the thin sandstone formation within the deeper series bears lesser kaolinite and fewer pore-filling minerals like better production efficiency comparatively.

Provenance and Tectonic Setting

Provenance entails the relation of deposited sediments to the source area, this might be achieved via compositional distribution of element and oxide, lithology and age. Sediments are primarily sourced from its original source by weathering which might be mechanical or chemical, and therefore the weathered sediments are then transported to the location of deposition. Regular sources of sediments are normally the passive continental margins or active continental margins. they'll even be classified as mafic (Magnesium and Iron rich) or felsic (Feldspar and Silicon rich), the previous consist mostly oceanic crust while the latter is containing mostly continental crust. a plot of TiO₂ and (Fe₂O₃+MgO) for the sandstones from of 1770m to 2125m indicate that the Upper series (B) have high (Fe₂O₃+MgO) and TiO₂, this might suggest introduction of weathering products from Oceanic Crust, however most of the Lower series (A) have low (Fe₂O₃+MgO) and TiO₂ indicating contributions from Continental Crust. This might imply that in the deposition of the upper series (B) there could be a tectonic event that cause the assembly of basaltic lava which later weathered into heavy sandstone which were deposited because the upper series. Extrusions from the volcanics around the area of Dakar within the Senegal basin, might be the source of the heavy sands. which may be a plot of TiO₂ and (Fe₂O₃+MgO) for the formations transversed by the wellbore, also shows that the majority of the formation are consisted of high values of TiO₂ and (Fe₂O₃+MgO) which indicated that they were sourced from basaltic rocks from Oceanic Crust. The tectonic setting for the upper series (B) is that of the Continental Island and for the lower series (A) Passive Continental.

Lithology of Source Rock

The lithology of the source rock entails delineating the lithology from which the sandstone and other sediments were derived. Sediment are normally sourced from older rock thanks to weathering, commonest sources are mafic rocks mostly from Oceanic. While the felsic rocks are mostly sourced from Continental (Land) Crust. Intermediate rock also are found mostly in land crust. Generally, the content of rocks within the context of the silica contents has been used to classify rocks. they're all igneous rocks but are often discriminated by the lava from which they're derived. Rock with 65% silica or higher is taken into account Felsic, however those with 45% or less is Mafic while those between 45% to 65% are intermediate rock. during this study, the TiO₂-Zr binary plot has been used for discriminating potential sources of sandstone and other sediments a plot of TiO₂ and Zr for discriminating source rock lithology for 1820m-2120m sandstones indicate that the sandstones of the 1750m-2120m are sourced from intermediate rocks which are normally found on Continental Crust or Continental Arcs. Plot of TiO₂ and Zr for the entire well sections, show that each one the sediments that consist the formations transverse by the wellbore, are derived from intermediate rock which potentially are sourced from Continental Crust. The SiO₂ and Al₂O₃ has been used to understand the connection of sandstone and clay in sediments. during this study a binary plot of SiO₂ and Al₂O₃ show a linear relationship for both SiO₂ and Al₂O₃, for all the samples from the wellbore. However, majority of the samples (A) occur between 30% to 60% of silica relatively with high values of Al₂O₃. This observation is indicative of sediments that are derived from intermediate rock which are sourced mostly from Continental Arcs. Some samples (B) bear lower silica values and consequently, lower values of Al₂O₃ these represent mafic sources derived from Oceanic Crust. Selegna et al, 2020 concluded that, the V/Ni ratio indicates redox environment, the ratio indicates that the sandstone series of 1850m to 2120m and 2350m to 2450m were deposited in oxygen rich nearshore environment or shallow marine environment. While sediments of 2120m to 2330m and from 2450m to 3200m bear very high values indicating more marine environments. The Fe₂O₃+MgO parameter show that the sandstones of 1850m to 2120m have very low Fe₂O₃+MgO values, implying their source to be from Continental Crust, while the lower series of 2120m to 3200m have very high values indicating their source to be Oceanic Crust. The Al/bases ratio clearly discriminate between 1850m to 2120m sandstones which have low Al/bases ratio, implying pervasive weathering which corresponds to humid and wet climate. The TiO₂-Zr binary diagram shows that majority of the samples were derived from source with lithology which corresponds to Continental Crust and Continental Arcs. The Ga/Rb ratio which represent the kaolinite/hillite ratio indicates higher values for the sand body of 1850-2120 series, implying high pore filling minerals and poor sweep/production efficiency for reservoir functionality

Various gaps identified

In spite of the aforementioned benefits of using Chemostratigraphy as a reservoir correlation tool, numerous gaps exist at every stage of a Chemostratigraphy project. The study is probably going to fail, as an example, if the sampling strategy is insufficient, or if cuttings samples haven't been washed before analysis. An inability of the chemo stratigrapher to acknowledge poor quality data or analytical drift also are potential reasons for failure. Additionally, to

the present, variety of challenges are related to the interpretation of inorganic geochemical data and therefore the proposition of correlation schemes. it's hoped that the knowledge outlined within the following chapters will function a 'step-by-step' guide to Chemostratigraphy and encourage subsequent generation of chemo stratigraphers to further develop the technique.

Chemostratigraphic data and their advantages over previous methods

The advantages of Chemostratigraphy are that it is often applied to sediments of any lithology, any age, found in any location and deposited in any environment. additionally, to the present, it's going to be utilized on core, sidewall core, cuttings and field outcrop samples, with an equal degree of ease. Perhaps the best advantage of Chemostratigraphy, however, is that it offers a better level of resolution than most other techniques. Using ICP (Inductively Coupled Plasma) and XRF (X-Ray Fluorescence) technologies, it's possible to accumulate good quality data for around 55 and 42 elements respectively, within the range Na-U within the table. This leads to a minimum of 42 potential variables which will be used for Chemostratigraphic characterization and correlation. In fact, the amount often exceeds 250 when elemental ratios are taken under consideration. The high levels of resolution also are explained by the low limits of detection of analytical instruments. Using modern XRF spectrometers it's possible to live the abundances of most elements in concentrations of 1 ppm or less and, as long as 1wt which there's approximately like 10,000 ppm, it's obvious that minor changes in mineralogy and geochemistry are often recorded. The ICP technique offers even better levels of resolution/detection, with some trace elements and REE recorded at levels of but 1 ppb. Consequently, very subtle changes within the mineralogy, like variations within the distribution of specific heavy minerals and other accessory minerals occurring within the region of 0.1–2%, are often modeled using whole rock geochemical data.

MATERIALS AND METHOD

Sampling and Sample preparations.

Materials and method encompass the materials and methods that were employed in the course of this study, basically reservoir samples were obtained from reservoir section of well X in Field Y offshore Southern Gabon. Samples were obtained between the depths of 2720m to 2947m which were 14 (fourteen) in number, however, 11 (eleven) samples were chosen for analysis, the bases were that these were sandstones, since particular reference was to the reservoir section.

Samples were prepared by cleaning and removing the carvings then pulverized. Analysis of samples were performed using XRD and XRF for the mineral and elemental composition, the model of the X-Ray Fluorescence Spectrometer is Spectro XEPOS, produced by AMETEK, with an auto sampler with 12 situations for tests and a 50watt end window X–beam cylinder to invigorate the examples. The software for data handling is X–LabPro5.1.

RESULT AND DISCUSSION

Results.

Table 1: Elemental content of the Sandstone derived from XRF Analysis

Element	Ti (%)	Si (%)	Sr (%)	FeO (%)	Mg (%)	Al (%)	K ₂ O (%)
Depth(ft)							
2720	0.1	2.53	0.4	0.1	0	1.84	0
2820	0.02	4.62	0.51	0.21	0	2.29	0
2840	0.02	1.56	0.43	0.06	0	1.5	0
2850	0.02	4.9	0.51	0.2	0	2.1	0
2910	0.19	23.09	1.1	1.62	1.81	7.65	0.9
2925	0.18	22.06	1.42	1.56	2.36	6.57	1.03
2926	0.47	40.2	1.12	4.5	6.2	12.89	2.91
2929	0.16	44.2	1.22	4.45	5.67	13.9	3.61
2932	0.55	58.08	1.36	1.93	3.29	11.56	2.77
2939	0.54	43.53	1.43	3.98	4.56	13.16	3.61
2947	0.56	44.77	1.35	3.59	4.62	12.72	3.04

Table 2: Mineral content of the Sandstone derived from XRD Analysis.

Minerals	Halite	Fermorite	Chlorapatite	Berryite	Anhydrite	Quartz	Calcite	Dolomite	Muscovite	Lautarite	Sandine
Depth(ft)											
2720	81	10	0	0	0	0	0	0	0	0	0
2820	78	13	15	0	0	0	0	0	0	0	0
2840	72	8	0	0	0	0	0	0	0	0	0
2850	67	0	14	13	0	0	0	0	0	0	0
2910	60	0	0	0	49	42	16	0	0	0	0
2925	63	0	0	0	0	48	0	35	0	0	0
2926	0	0	0	0	0	73	0	21	22	21	0
2929	43	0	0	0	0	79	0	0	0	0	13
2932	37	0	0	0	0	77	0	0	0	0	0
2939	43	0	0	0	0	73	0	0	16	0	0
2947	0	0	0	0	0	69	0	0	0	0	0

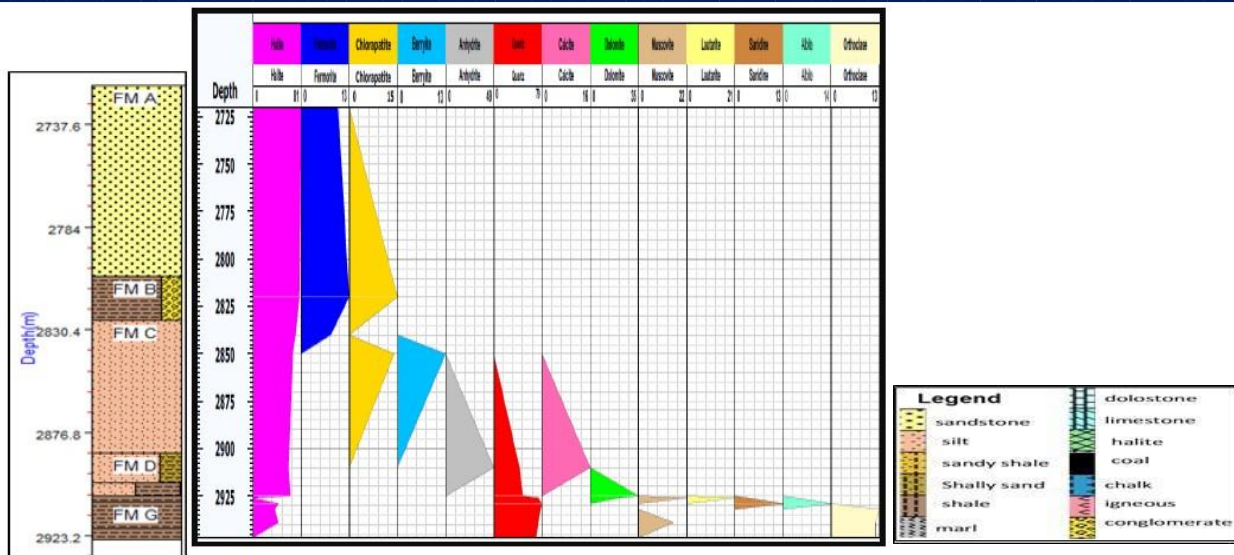


Figure 1: The Log view Mineral content of the Sandstone derived from XRD Analysis.

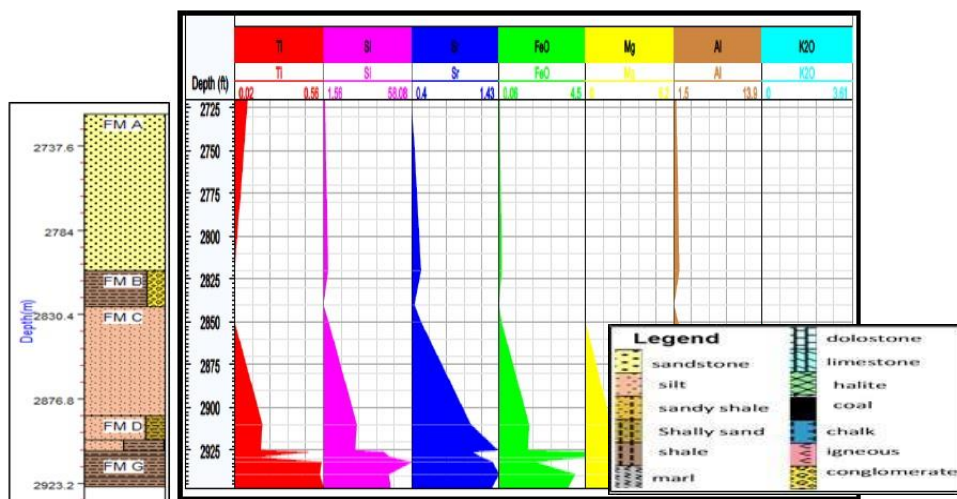


Figure 2: Log view Elemental content of the Sandstone derived from XRF Analysis

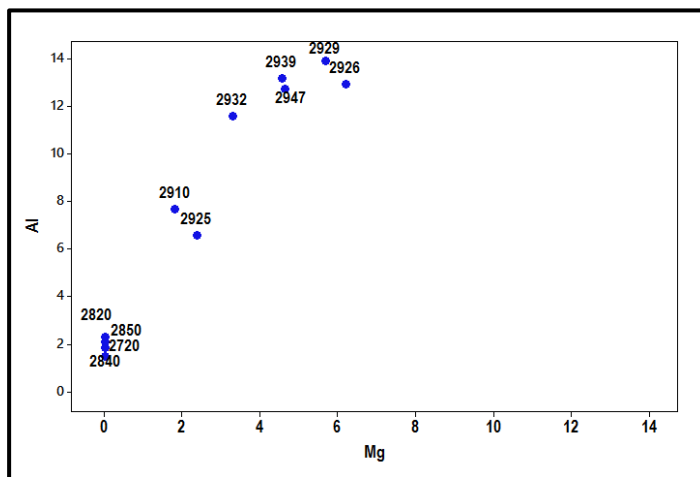


Figure 3: A bivariate plot of Al and Si

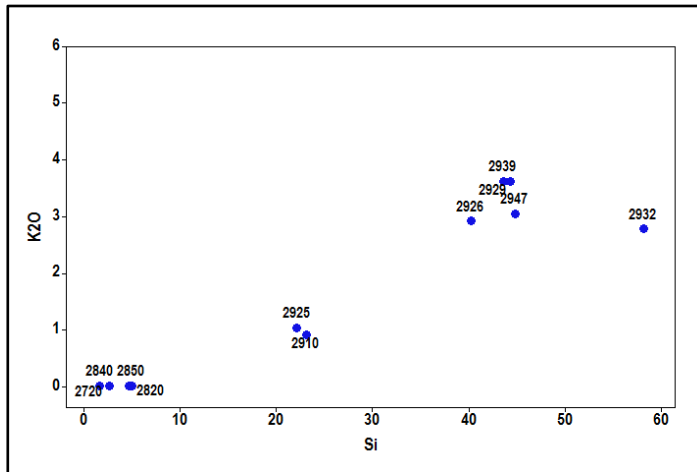


Figure 4: A bivariate plot of Al and Si

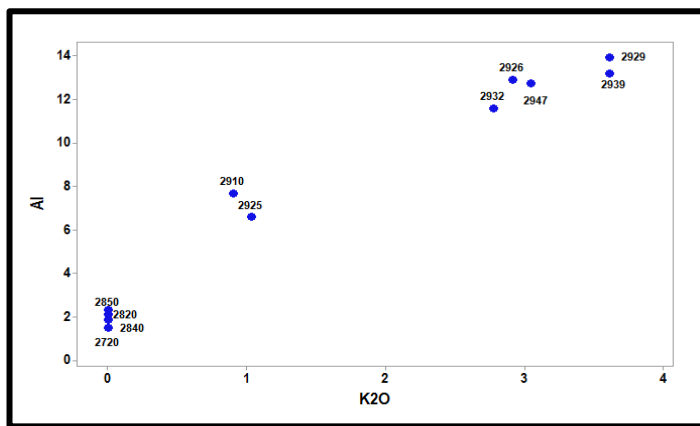


Figure 5: A bivariate plot of Al and K₂O

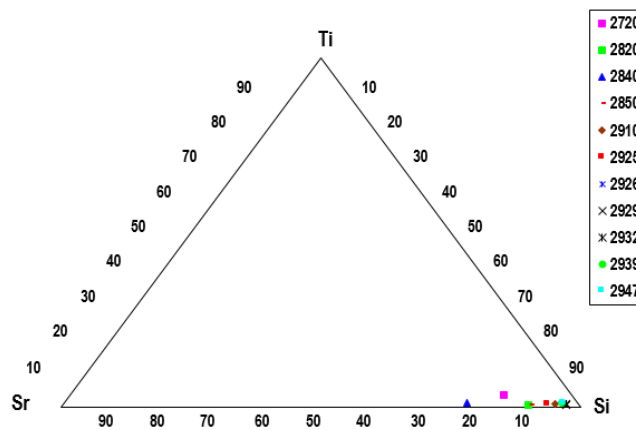


Figure 6: Ternary plot of Ti, Sr and Si

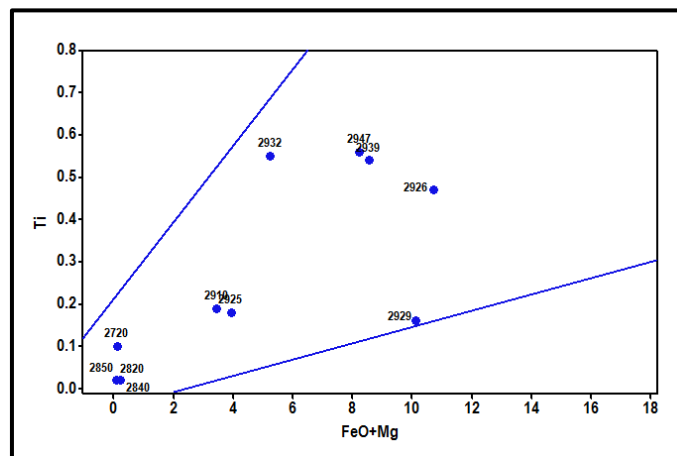


Figure 7: A bivariate plot of Ti and FeO+Mg

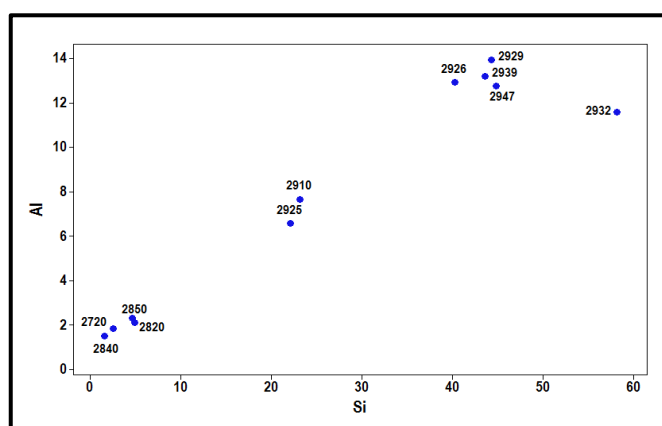


Figure 8: A bivariate plot of Al and Si

DISCUSSION

Mineral profile.

The minerals detected by the XRD analysis expressed as a logview in figure 1 using Techlog version 2007. The logview show that halite is the most abundant throughout that depth range that was studied. The halite concentration reduces down dip, the descriptive lithology which was model using Zetaware Genesis 5.4, showed that the deep range for which the halite was abundant was sandstone, while the lower region was shaly. The second most abundant mineral is femonite and it occurred within the range corresponding to the sandstones. Chlorapatite is the third most abundant mineral, occurring within the sandstone and the silt unit underlying the sandstone. Other minerals such as Anhydrite, Quartz, Calcite, dolomite, Muscovite Albite and Orthoclase were surprisingly only present in the shaly zone. The absence of these minerals in the sandstone may imply that they were dissolved/eroded away (Alexandre, 2021). That may indicate a wet paleoclimate.

Elemental Profile

Some elements determined using XRF were expressed as logview Figure 2, potassium expressed as K₂O and Mg were not present in the sandstone facies, this could represent a weathered sandstone facies (Alexandre, 2021). Other elements were shown to be present in the sandstones in the more shallow depth for the depth range that is studied. One of the prominent elements is Ti, the principal host mineral for Ti is rutile one of the polymorphs of TiO₂ including Anatase and Brookite (Craigie, 2015; Craigie, 2018). The most stable and most abundant is Rutile. It is an ultrastable heavy mineral, commonly found in Igneous and metamorphic rocks. Ti related ratios has been largely applied in the study and discrimination of sedimentary provenance. Present in rutile is also Zr. Zr (Zirconium) is exclusively link to Zircon but other elements are associated with zircon, namely U, Th, Nb etc. this has been used provenance and correlation studies. Zr has been used for provenance discrimination in North Sea sand stone reservoir.

Chemical Weathering and Paleoclimate

The chemical weathering expresses the stability of bases in the sediment overtime. The bases are referred to hydroxides and oxides of Ca, Na, K and Mg. Overtime the presence of these compound in sediment varies and are released from feldspar hosting minerals resulting in the preferential increase in Al. this observation is due to the fact that Al is made up of larger cations thus will be recalcitrant to weathering unlike Na and K with smaller cations which will be easily removed from the weathering matrix (Craigie, 2018). The profile of elements with depth show that the sandstone body in the depth range of 2725m to 2850m had no Mg and K contents in them as shown in figure 2. This could imply that Mg and K had been weathered off. Chemical weathering is dominant in warm and humid environment (Ramkumar, 2015; Sial, et al, 2019). Thus, the paleoclimate at the time of deposition of the sandstone body of 2725m to 2850m

was humid and warm and the environment of deposition is inferred to be arid. The 2850m to 2925m show gradual increase in all the elements. At 2925m and 2950m the profile shows very high content of the elements. Figure 3 shows a plot of Al and Mg show that the samples of 2720m to 2850m have low Al and Mg content while sediment of 2926m to 2949m are high content of Al and Mg. It can also be inferred that the shallower sediments which are mainly sandstone from the descriptive lithology in figure 2 experienced weathering and lost Mg ions. (Ramkumar, 2015; Sial, et al, 2019). Figure 4 showed a plot of K_2O and Si, the plot showed that sandstones within the range of 2720m to 2850m have very low content of K_2O and Si, this basically means that the sandstones have very low in K_2O content while the sandstones of the deeper series show a high value for K_2O and Si. This could imply that weathering was very prominent, and invariably means the feldspars are absent or low in content. Figure 5 is a plot of Al and K_2O . Al represents the clay fraction, while K_2O represents the Feldspar in the sandstone

Provenance and Tectonic Setting

Provenance infers the source of the sandstone body. Sediments are normally weathered and later transported to the site of deposition. The dominant sources of sediment are Passive Continental Margins or Active Continental Margins. Sediments could also be described as Mafic (magnesium and iron rich) sediment or Felsic (Feldspar and Silicon rich) sediments (Ramkumar, 2015; Sial, et al, 2019). Mafic sediments are mostly sourced from Oceanic Crust which Felsic sediment are mostly sourced from Continental Crust (Pearce et al, 1984). Figure 6 shows the Ternary plot of Ti, Si and Sr which is used in discriminating basalt from different tectonic settings was used on the data for the well section studied. Most of the samples were sited close to the Silicon axis, this implies that the samples were sourced from an Island arc basalt, which is produced at Ocean–Ocean subduction zone by partial melting due to the presence of volatiles (Alexandre, 2021). The ocean basalts are source of high density sandstones. Figure 7 shows a plot of Ti and $FeO+Mg$ is employed to discriminate the Felsic sandstones from the Mafic sandstones which are high density sandstones (Bhatia, 1983). The plots shows that sandstones are of intermediate density, they are neither felsic nor mafic. Mafic sediment is rich in Magnesium and Iron and are postulated to be from Oceanic basalts while felsic sediments are lighter and are postulated to originate from continental basalts. However, the profile of the sediments shows that shallower sandstones of 2730m to 2850m have lower to non-significant amount of $FeO+Mg$, while the deeper series have higher values of $FeO+Mg$ (Ramkumar, 2015). Mafic rocks are igneous rocks that have relatively small content of felsic minerals such as quartz and Feldspar, they have higher proportions of predominantly darkly colored minerals such as pyroxenite and peridotite.

Lithology of Source Rock

The lithology of the source rock infers understanding the descriptive lithology which served as the source of the sediment studied. Older rocks which are mostly extrusive rocks (igneous volcanic) serves as the source of recent sediments when subjected to weathering. Normally sediments that are of higher density are sourced from mafic rocks which are characteristics of Oceanic Crust, while lower density sediments are sourced from rock that have higher feldspar and Silica content and are usually origin of Continental Crust (Alexandre, 2021). In this study the Si content is used to delineate source of the sediments under study. Figure 4 shows that the content Si varies from 0% to 60%. Si content of the rocks will divide them into ultramafic ($SiO_2 < 45\%$), mafic ($45\% < SiO_2 < 52\%$), intermediate ($52\% < SiO_2 < 63\%$), and felsic ($SiO_2 > 63\%$) (Alexandre, 2021). Figure 4 shows that samples of 2720m to 2925m have Si content less than 45% which classify them as mafic and samples of 2926m to 2947m have Si content of 45% to 60% inferring the sandstones to be intermediate in origin (Alexandre, 2021). Thus, the sediments studied range between mafic and intermediate sources. In Figure 8, the plot of Al and Si bears a linear relationship. Al fairly increases with Si. Intermediate sandstones are sourced from Continental Arcs. The fact that table 2 the results of elemental analysis and figure 2 the elemental logview shows that the shallower sandstones bear no Mg and K_2O content, implies that the source is mafic like, but deeper series showed significant presence of both Mg and K_2O (Ramkumar, 2015).

SUMMARY

The Chemostratigraphic study of a reservoir cross section of a well 'X' offshore Gabon. Samples were sourced from 2720m to 2947m, the shallower portion were sandstone and volcanic poufs were microscopically identified and deeper series which were earlier deposits were mostly shaly materials.

Inbid to decipher the provenance and related paleo characteristics, the minerals present and the elements ought to be known. To this end, XRD and XRF analysis were performed to acquire the data.

The analytical result showed the presence of minerals as presented in table 2 and elements in table 1., the profile of the minerals and those of the of the elements show their variability down the reservoir cross section. Elements such as K expressed as K₂O and Mg were not present in the shallower samples of 2720m to 2850m, however all other samples from 2850m to 2947m showed increasing elemental content with increasing depth. The descriptive lithology showed the presence of volcanic turfs at 2910m, implying that a tectonic event occurred that resulted in the release volcanic materials, the emission from the volcanic event could have been the source of the heavier nature of the sandstone of 2720m to 2850m.

CONCLUSION

The paleoclimate and weathering is delineated using K₂O and Mg content of the reservoir cross section which varied, the shallower section of 2720m to 2850m have no Mg and K₂O content relative to the higher content in the deeper samples. Compare to the Al and other heavier elements. K₂O and Mg are very mobile elements and could earlier be weathered always leaving behind Al and other heavier elements. Thus, these sandstones could have undergone weathering in warm and humid environment which is most favorable for chemical weathering. The provenance of the sediment could be postulated with the silicon and feldspar content of the sediments. The silicon content of the shallower sediments of 2720m to 2850m indicate mafic like source, the present of volcanic turfs at 2910m could imply the origin of the sandstones to be emissions of the tectonic events that produced the turfs. Other sample show intermediate characters which could be source from continental arcs. The ternary plot this implies that the samples were sourced from an Island arc basalt, which is produced at Ocean–Ocean subduction zone by partial melting due to the presence of volatiles.

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