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Sediments analysis of eastern makran coast line area of Pakistan by X-Ray diffraction

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Key words: Mineral, X-Ray Diffraction, Makran Coastal area.

Abstract

Sediment are mechanically and/or chemically weathered rocks, they are unconsolidated materials. Present Research investigation conducted on the sediment of Coast line area of Markran. Six major areas selected for the collection of sediment sample which are Sur Bandar, Koh Mehdi, Ganz, Pishukan, Gwader and Jiwani. Total sediment sample stations are eighteen, out of which one station on the Sur Bandar, one station on Koh Mehdi, Three stations on Ganz, Three stations on Pishukan, Three stations on Gwader East Bay, Five stations on Gwader West Bay and Two stations on Jiwani. Latest scientific instrument and technique X-Ray Diffraction (XRD) used in this time for investigation of Minerals. Quartz, Kaolinites, Calcite are the common mineral found during this study. Calcite and Quartz are found throughout the targeted area of the coastal belt and a major area has Kaolinites during this research. Baratovite found in some places. These types of mineral into sediment are normally due to the weathering of pre-existing rock and transport by running water in rivers, Ocean currents. Other less common factors uses for transportation of sediments are wind, glaciers and landslides. River sediments originate by the erosion process of near surface, exposed igneous, metamorphic or sedimentary rock. The sediments are then deposited and form sedimentary rock.

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Introduction

Mineral Sand is actually loose aggregate of unlithified mineral or rock particle where gain sizes of sand vary between 20 to 2000 µm. Physically they are unconsolidated or slidely consolidated sedimentary deposit. They are the result of weathering of soil and rock or in aquatic system. Mineral deposition in beach area depended on a number of factor, for example Climate condition of the area, mechanism of sediment transportation from host rock and deposition condition of the area (Borreswar, 1957).

The settlement of Sediment that reached to sea from the river will be depend on the waves and current action with respect to size, shape and densities of sediment(Kumar and Wang, 1984).The mineral concentration directed by hydrodynamic condition such as sediment velocity, wave energy in flux. Here littoral transport depends on wind spread and long shore current. These factors also control the sorting and deposition of mineral in proper location (Rao *et. al.*, 2001).

Sediment has dominantly a specific form of Silica which is called quartz- (Fe, 1976). It is observed that 95 % of mineral has a small portion of quartz, feldspar and micas minerals (Grim, 1968). Kaolinite is most commonly mineral in soil or sediments. It is commonly occurring in all clay mineral (Smith, 1957). Quartz is one of the highly siliceous mineral for formation of Soil. Eluvial horizons are the places of storing of quartz. In the highly weathered oxisols (Kim, 1978) condition, Quartz may not be present. The present research carried with the aim of investigation on the sediment of coast line area of Markran, Pakistan

Materials and methods

Study Area

Southern portion of Baluchistan is the Makran coast which has 600 Km length from Dasht River near the Iranian border to Hub River (Delisle *et- al.*, 2002).

The coast of this region has narrow Continental shelf with sharp declined and rock bottom area- (Rad *et. al.,* 2000). The study area was stretched between the Sur Bandar to Jiwani along Makran coast of Pakistan (Fig. 1).

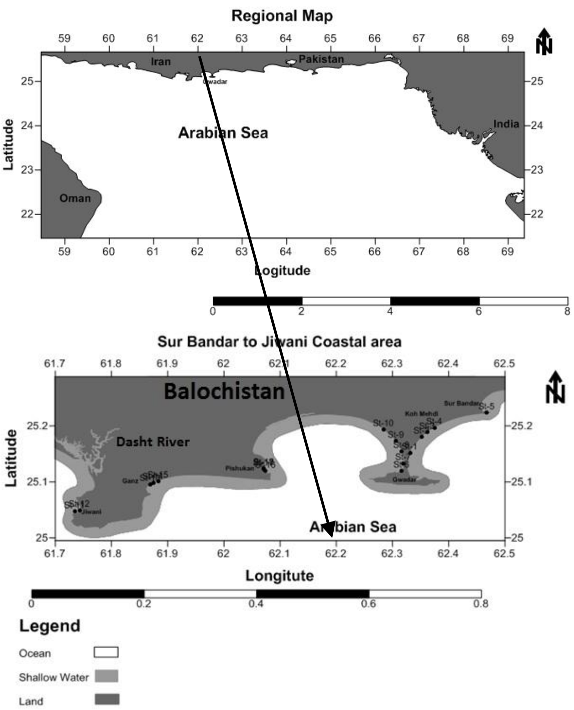

Fig. 1. Showing study area.

Sampling Techniques

Sandy beaches are common along Balochistan's shores. Rocky shores and cliffs are prevalent in Balochistan (Baloch *et. al.*, 2014). They are generally composed of conglomerates of soft mudstone and sandstone, which are highly susceptible to erosion (Akhtar *et- al.*, 2013). Headlands are prominent in Jiwani, Pishukan, Gwadar Rasjidi and Ormara, and are intervened by low-lying places comprised of alluvial deposits.

Six major areas selected for the collection of sediment sample which are Sur Bandar, Koh Mehdi, Ganz, Pishukan, Gwader and Jiwani (Fig. 2 & 3). Augur used for the collection of samples. There were eighteen sample stations in the six sampling sites. The sample collected from a depth of one meter.

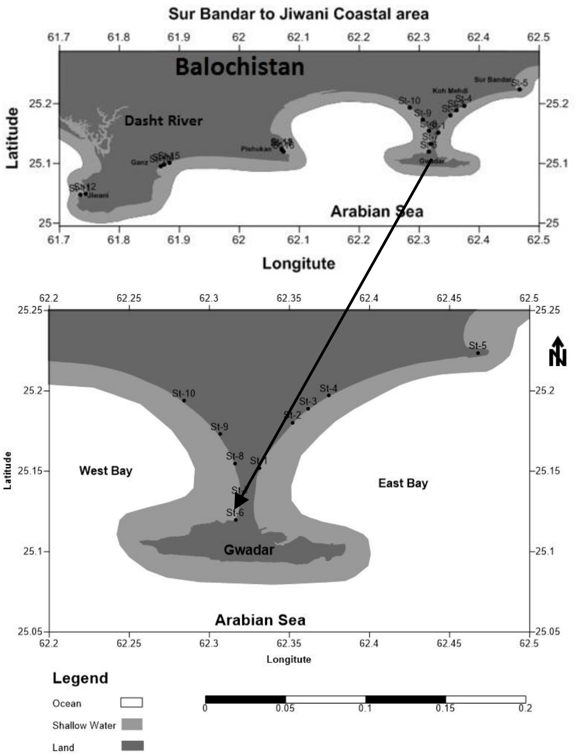

Fig. 2. Showing sampling points ST-01 to ST-10.

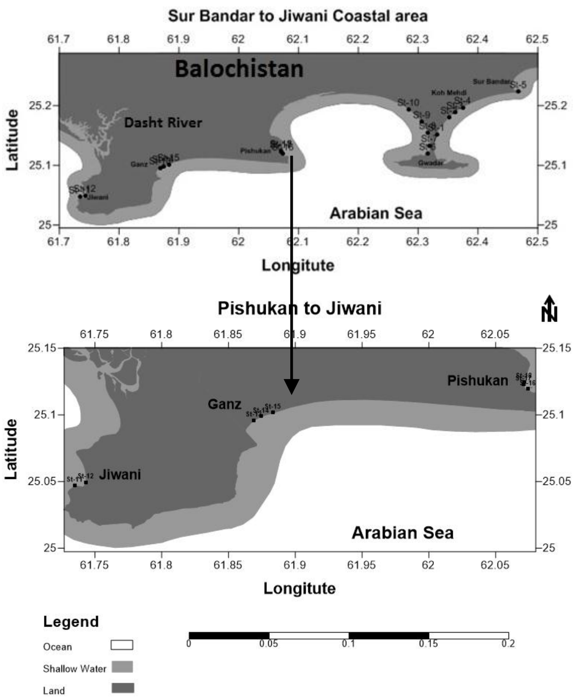

Fig. 3. Sampling points ST-11 to ST-18.

The collected sample were washed by distil water and were transferred into plastic bag. These packets transported to National Institute of Oceanography, Karachi, Pakistan. NIO bring these packets in the Geology and Geophysical laboratory and leaved under the sunlight for 7th hours. These samples put in the Oven at the 250°C where they were air dried and stored in moisture free environment. The sample carried out at "Center for pure and Applied Geology Sindh University Jamshoro" for the sediments mineralogy evaluations.

Preparation of Sediment sampling for X-Ray Diffraction (XRD)

The Centre for Pure and Applied Geology Sindh University Jamshoro is equipped with D8 ADVANCE X-Ray Diffractometer of Bruker-AXS, Germany. The instrument is fully controlled by DIFFRAC software. The sample preparation is fast and easy. First of all, the sample is grinded to make fine powder less than 63 micron meter. Afterwards, this sample is carefully inserted into the plastic sample holder and the holder is fixed into sample holder. The parameters are set for the analysis. Once a raw file is created then it is evaluated with the help of EVA software.

Results

During the Present study following results of Sediment samples obtained by the XRD analysis in Table 1. The XRD diffractograms are being presented in Fig.4-10.

X-Ray Diffraction (XRD)

The XRD result of sediments samples of Gwadar indicates that the dominant minerals are Quartz and calcite etc at East Bay and west Bay of Gwader were found.

Koh Mehdi has minerals Quartz, calcite and Baratovite while Sur Bandar has dominant minerals Quartz and calcite. Sediment samples of Pishukan and Ganz shows that the dominant minerals are Quartz, calcite and kaolinite. Prominent minerals from Jiwani which is near the Irani border are Quartz and Calcite.

Table 1. General Characteristics and mineral observed by XRD analysis along the coast line from the Sur Bandar to Jiwani sediments.

Sample No.	Site of Sample Collection	Sample Depth	Main Mineral Observed
1,2,3	Gwader East Bay	Depth-1m	Quartz, Calcite
6,7,8,9,10	Gwader West Bay	Depth-1m	Quartz, Calcite
4	Koh Mehdi	Depth-1m	Quartz, Calcite, Baratovite
5	Sur Bandar	Depth-1m	Quartz, Calcite, Kaolinite
16,17,18	Pishukan	Depth-1m	Quartz, Calcite, Kaolinite
13,14,15,	Ganz	Depth-1m	Quartz, Calcite, Kaolinite
11,12	Jiwani	Depth-1m	Quartz, Calcite

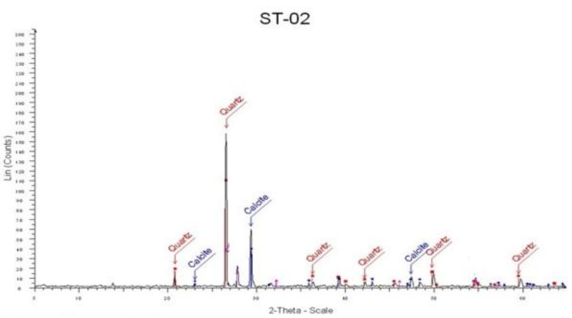

Fig. 4. XRD of Station 02.

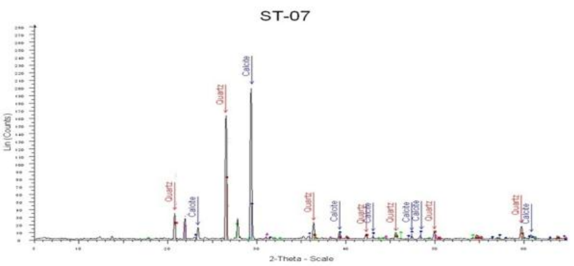

Fig. 5. XRD of Station 07.

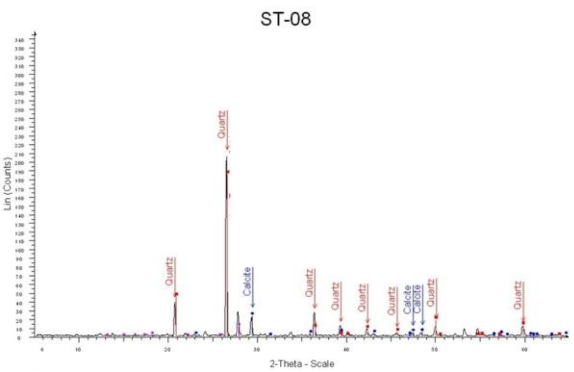

Fig. 6. XRD of Station 08.

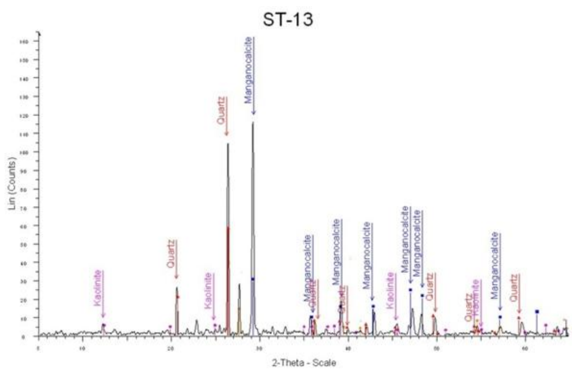

Fig. 7. XRD of Station 13.

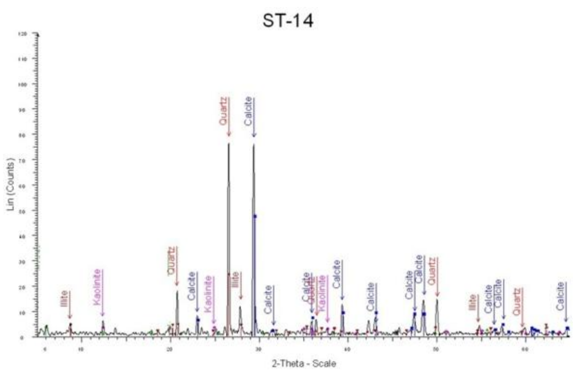

Fig. 8. XRD of Station 14.

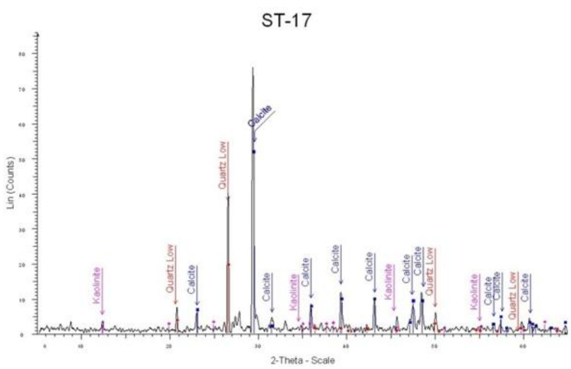

Fig. 9. XRD of Station 17.

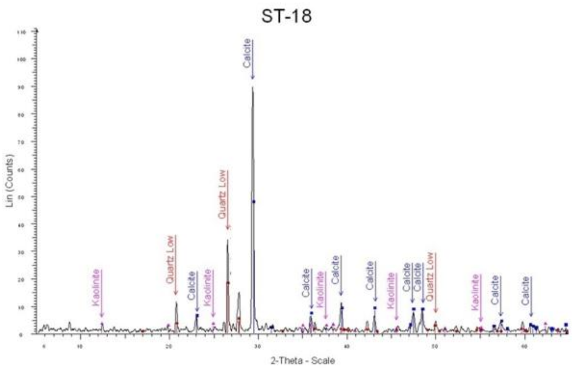

Fig. 10. XRD of Station 18.

X-ray diffraction (peak) from ST-01 of Gwadar East Bay at 2=20.8° correspond to the Quartz minerals. The second order diffraction is at 2=26.6° characteristic to Quartz while calcite recognized at 2=23° and second order diffraction is at 2=29.4° corresponds to the Calcite.

ST-02 of Gwadar East Bay in the Fig. 4 exhibit characteristic diffraction at an angle 2=20.9° corresponds to a d spacing which suggest the presence of Quartz. The Second order diffraction is at 2=26.5° characteristic to Quartz. X-ray diffraction at 2=23° recognized as calcite and second order diffraction is at 2=29.3°.

Third sediment sample of Gwadar East Bay is ST-03. X-ray diffractogram peak of ST-03 at 2=20.8° correspond to the Quartz and Second order diffraction at 2=26.5° may suggesting the presence of Quartz. They X-ray diffraction peak 2=29.5° correspond to the Calcite.

X-ray diffractogram of Koh mehdi in the ST-04 exhibit characteristic diffraction at an angle 2=21° which corresponds to quartz and second order diffraction is at 2=26.5° corresponding to quartz. Calcite in ST-04 (Diffractogram) exhibit characteristic diffraction at an angle 2=23.1°. The second order diffraction is at 2=29.5°.

X-ray diffractogram in ST-05 of Sur Bandar exhibited characteristic diffraction at an angle 2=20.8° which correspond to Quartz . The Second order diffraction pattern at 2=26.5°. X-ray diffraction pattern at 2=8.6° corresponds to Illite and at 2=12.5° corresponds to Kaolinite. X-ray diffraction peak at 2θ =29.5° corresponds to Calcite and second order diffraction is at 2=29.5°.

ST-06 is on the Gwadar west bay showed X-ray diffraction peak at 2=20.9° value corresponds to the quartz and second order diffraction is at 2=26.5° which is the diagnostic peak for quartz. X-ray diffraction pattern at 2=23° Corresponds to Calcite and Second order diffraction is at 2=29.5° which is correspond to Calcite.

ST-07 is the second sediment sample of Gwadar west bay showed in Fig. 5. Here X-ray diffraction peak in Fig. 5 at 2=20.9° is corresponds to quartz and second order diffraction is at 2=26.5° which corresponds to Quartz. X-ray diffraction peak at 2=23.3° Corresponds to calcite and second order diffraction is at 2=29.5° correspond to Calcite.

Third sediment sample collected from the Gwadar west bay is ST-08 and it is show in Fig. 6. Here X-ray diffraction peak in Fig. 6 at 2=20.9° correspond to Quartz and second order diffraction is at 2=26.5° correspond to quartz.

Forth Sediment sample collected from the Gwadar west bay is ST-09. Here X-ray diffraction peak at 2=20.9° correspond to Quartz second order diffraction is at 2=26.5° corresponds to quartz X-ray diffraction peak 2=29.5° correspond to Calcite.

Fifth Sediment sample collected from the Gwadar west bay is ST-10. Here X-ray diffraction peak at 2=20.9° which corresponds to quartz and second order diffraction is at 2=26.5° corresponds to quartz. X-ray diffraction peak at 2=29.4° corresponds to Calcite.

X-ray diffractogram from ST-11 of Jiwani exhibit characteristic diffraction at an angle 2=20.8° corresponds to

Quartz and Second order diffraction at angle 2=26.5° corresponds to Quartz. X-ray diffraction peak at an angle 2=23° corresponds to Calcite and Second order diffraction peak at an angle 2=29.9° corresponds to Calcite.

X-ray diffractogram of Second Sediment sample from the Jiwani is ST-12, exhibit characteristic diffraction at an angle 2=20.8° corresponds to Quartz and Second order diffraction at an angle 2=26.5° corresponds to Quartz. X-ray diffraction at an angle 2=29.2° corresponds to Calcite.

X-ray diffractogram from first sediment sample (ST-13) in Fig. 7 of Ganz exhibit characteristic diffraction at an angle 2=20.5° correspond to Quartz and Second order diffraction is at 2=26.4° correspond to Quartz. X-ray diffraction peak exhibit characteristic diffraction at an angle 2=29.2° correspond to Manganocalcite and second order diffraction is at 2=36° correspond to Manganocalcite.

X-ray diffractogram of ST-14 from Ganz in Fig. 8 exhibit characteristic diffraction at an angle 2=20.8° corresponds to quartz and second order diffraction is at an angle 2 =26.5 corresponds to quartz. X-ray (diffractogram) exhibit characteristic diffraction at an angle 2=23° correspond to Calcite and Second order diffraction is angle 2=29.8° correspond to Calcite.

X-ray (Diffractogram) from third sediment sample from Ganz is ST -15, shows exhibit characteristic diffraction at an angle 2=20.8° correspond to Quartz and Second order diffraction is at angle 2=26.5° corresponds to Quartz low. X-ray (Diffractogram) exhibit characteristic diffraction at an angle 2=23° correspond to Calcite and second order diffraction is at an angle 2=29.2° correspond to Calcite.

X-ray (Diffraction) of ST-16 belong to Pishukan exhibit characteristic diffraction at an angle 2=20.8° correspond to Quartz and second order diffraction is at an angle 2=27° correspond to Quartz. X-ray diffraction peak at 2=23° correspond to Calcite and Second order diffraction is at 2=29.5° which corresponds to Calcite.

X-ray (Diffraction) of Second Sediment sample (ST-17) from Pishukan in Fig. 9 exhibit characteristic diffraction at an angle 2=20.8° correspond to quartz and second order diffraction is at an angle 2=26.5° correspond to Quartz. X-ray diffraction peak at 2=23° correspond to Calcite and Second order diffraction is at 2=29.5° which correspond to Calcite.

ST-18 is the third sediment sample belong the Pishukan in Fig. 10 and X-ray (Diffractogram) exhibit characteristic diffraction at an angle 2=20.8° correspond to Quartz low and Second order diffraction is at an angle 2=26.5° correspond to Quartz. X-ray diffraction peak at 2=23° correspond to Calcite and second order diffraction is at 2=29.5° which correspond to Calcite.

Kaolinite present in ST-05 diffractogram exhibit characteristic diffraction at an angle 2=12.5° and second order diffraction is at 2=45.5°.Kaolinite in Fig. 7 of ST-13 diffractogram exhibit characteristic diffraction at an angle 2=12.2°. The Second order diffraction is at 2=25°. Kaolinite in Fig. 8 of ST-14 diffractogram exhibit characteristic diffraction at an angle 2=12.5°. The second order diffraction is at 2=24.9°. Kaolinite in ST-15 (Diffractogram) exhibit characteristic diffraction at an angle 2=12.5°. The Second order diffraction is at 2=19.8° and third order diffraction is at 2=24.8°. Kaolinite in ST-16 (Diffractogram) exhibit characteristic diffraction at an angle 2=12.5°. The second order diffraction is at 2=25°. Kaolinite in Fig. 9 of ST-17 (Diffractogram) exhibit characteristic diffraction at an angle 2=12.5°. The Second order diffraction is at 2=35°. Kaolinite in Fig. 10 of ST-18 (Diffractogram) exhibit characteristic diffraction at an angle 2=12.5°. The second order diffraction is at angle 2=25°.

Sediment sample collected along the coast of Balochistan region in six areas which are contained in eighteen sample stations.

The XRD analysis of sediments sample collected from Station no 1 to 12 were clearly presence of Quartz and Calcite minerals and from Station no. 05, 13 to 18 were disclosed Kaolinite along with the Quartz and Calcite minerals.

Table 2. Stratigraphic succession of the Makran belt [modified after Hunting Survey Corporation (1961; Cheema *et- al*., 1977; Kassi *et- al*. 2007].

Age	Group	Formation	Lithology
Pleistocene to Holocene	Makran group	Haro formation	Shelly and reefoid limestone, Sandstone, and conglomerate
Upper Pliocene		Unconformity Ormara Formation	Soft and poorly consolidated Mudstone with minor sandstone
Lower Pliocene		Unconformity Chatti Formation	Calcareous shale and marl
Upper Miocene		Hinglaj Formation	Cyclic succession of sandstone And shale
Lower Miocene		Parkini Mudstone	Mudstone with occasional Thin sandstone
Oligocene-Miocene	Turbat group	Panjgur Formation	Sandstone interbedded With shale
Upper Eocene-Lower Oligocene		Hoshab Shale	Shale with occasional thin Bedded sandstone
Eocene		Thrust Wakai Limestone	Highly fossiliferous to reefoid Limestone
Paleocene		Ispikan Formation	Conglomerate, sandstone, and minor shale
Cretaceous-Paleocene		Thrust Wakai mélange	Agglomerate, purple shale, marl Chert, pelagic, limestone, Marble and mafic and ulteramafic Rocks.

Discussion

Convergence collection occurred throughout the Cenozoic time between the Arabian and Eurasian plates. Makran accrettionary complex and Himalayan orogeny is the result of that evolution- (Harms *et. al.,* 1984). Its first evolutionary phase was recognized by turbidite deposition of muds and quartzolithic sands.

Wide accretionary wedge along the Makran coastal belt built up by sediment scraped off the Arabian plate during late cretaceous to Early Paleocene (Leggett and Platt 1984; Platt *et. al.*, 1985, 1988) Coastal belt have to uplift due to underplating of the sediments and accretion and coastline migrated to seawared (white 1983, Platt *et. al*., 1988).

Mudstone, cyclically interbedded sandstone and mudstone and limestone succession are found in the younger sedimentary succession of the coastal belt of Makran. (Table 2; Kassi *et. al.*, 2011; Kassi *et. al.*, 2007; Hunting survey corporaion, 1961).

There is nevertheless very limited literature is available on the occurrence and distribution of mineral on the surface of coastal belt of Makran, however we found some importation common mineral that have not been reported and /or described before, which occur along the coastal belt of Makran.

The purpose of this paper is to present a preliminary interpretation of XRD results (also preliminary) from the analysis of sediment samples.

The study area is recognized by perturbed area (relief/erosion effects) and calm area where hemiplegic sediment presents.

Present research shows mostly Aeolian and marine action take part a significant role and shape of coastal geomorphology also take part of important role in the accumulation of minerals. The distribution pattern reveal by Quartz, Calicte, Baratovite and Kaolinite, propose that setting velocity and differential transportation have a major role in their distribution in the study area.

Conclusion

Author conducted a field survey along a major portion of Markan coastal belt. For this purpose, six major areas selected with respect to the accessible coast line. These areas were Sur Bandar, Koh Mehdi, Ganz, Pishukan, Gwader and Jiwani. Eighteen sampling station prepared in these region. Sediment sample were collected by the Augur and packed in the plastic bags.

These packets of sediment samples bring to NIO laboratory for preparation the sample analysis. These samples carried out at "Center for pure and Applied Geology Sindh University Jamshoro" for the sediments mineralogy evaluations and used D8 ADVANCE X-Ray Diffractometer for this purpose.

Sediments mineralogy evolutions showed that sediments sample had Calcite, Quartz, Kaolinites and Baratovite. Quartz and Calcite are found throughout the Coastal belt of the study area and a major portion of the study area has Kaolinites in this region. River sediments originate by the erosion process of near surface, exposed igneous, metamorphic or sedimentary rock and transport by running water in rivers, Ocean currents.

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