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Investigation changes sea level of Caspian Sea on Guilin's Coastlines in Iran

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ABSTRACT: In recent years, the coastline of Caspian Sea in Guilan province especially the mouth of big rivers such as Sefidroud delta has changed increasingly due to the environmental, continental and marine factors. The changes in position of these coastlines have made some damages. The changes of water level that come from the land, the differences in the land sediment levels, the situation of erosion in coastline's sediments such as continental factor, changes of sea level, patterns of current and Caspian Sea waves are some changes that occurs in Caspian Sea's coastlines. Purpose of this study was to investigate causes of these factors in different regions of Guilan's coastlines. Using of aerial photos in two periods of years in 1967 and 1994 with the scale of 1/20000 and using of software's such as Ilwis, and Photoshop, sediment levels was estimated. Some geographic maps and topography with the scales of 1/20000, 1/50000, and space measurement used in order to complete information in this research. The sedimentary units that studied were Quaternary units including Qt_1, Qt_2 and QM, which are related to land environment Qts and Qsp units are belonged to land and Qt_1, Qt_2, Qt_3 are related to rivers environment and finally the Q_2be, Q_2b, and Qbm units are related to middle and under coastline. The Guilan's coastline progress under the sea erosion was estimated in Astaneh-Ashrafiye 84.08 ha, Talesh, 49.52 ha, Anzali, 45.87 ha, Lasko-kelaye, 1430.69 ha and Roudsar, 678.5 ha. Retrograde under the coastline's sediment was estimated in Astaneh-Ashrafiye, 276.99, Talesh, 48.31, Anzali. Has not retrograde, Lasko-kelaye, 2.04, and Roudsar 5.46 ha.

Keywords: water advance, sea level changes, Caspian Sea, Guilan shorelines, sedimentation

INTRODUCTION

The length of Caspian Sea in Guilan province, From Astara border to the last border of this province, is about 320 Km_s and it's width at the broadest point is 50 Km_s and in the narrowest point is 100 ms. The important rivers which enter Caspian Sea through southern basin include: Sefidroud , which origin is located far from Caspian Sea banks. In addition, There are some small rivers from more than 74 basins which Located in the south of Caspian in Guilan province. Guilan province has a moderate humid weather in all the plain and low lands of shoreline parts from Roudsar to Astara beach. The wind velocity with 8.8 Km/h shows the most speed while in the winter and the least velocity of wind was in April with average of 4.3 Km/h. The rate of rainfall across Guilan Coastlines is varied from 980 mm to 1900 mm. Four periodical characteristics were identified from the beginning of systematic observations of water level (in 1830): A relatively consistent period during 1830-1929 (-25.5 m) A rapid decrease by 1.7 m_s during 1930-1941(Kozarev and Makarova, 1988) and then in 1942-1977 there was a rapid decrease. At end of this period the level of Caspian Sea was at lowest point in last 160 years , that was -29 m_s(Shiklomanov,1981).The total decrease in water level between 1900-1977 was 3ms (Ratcovich rt al., 1973).From 1978 the level of Caspian Sea increased and now it has a relatively increase of 2.55ms (Rferren and Leidy, 2001).The change in level of Caspian Sea is possible to be the result of a factor or a mixture of different factors: the change of climate, technical and human activities. effect of each factor as an effective one in total change of sea level isn't the same as the other (Ihdanova et al, 1976).From the topology structure point of view , coastal area of Guilan between two coastal parts of Astara – Poonel, and from Poonel to the border of Mazandaran province is considerable. In western area of Guilan,

the present time's coastal terraces have formed a band with width of 2-8 Kms which formation is related to intense movements of topology of Astara fault. The depositions of coastal area is often consisted of settles and alluvium boulders which are separated from elevations. The coastal profile deposits are relatively in variation from rubble–stones to sand. The views of land morphology of coasts of northern Iran are formed affectively by different phenomena of topology of hydrodynamic and climate. Most of these views like delta of Sefidroud River's sandy bank, the plains and coastal torrential fields are in group of views resulted from deposition and the transferee of deposits from land, the marine deposition, waves and marine flows are important in their formation. Because of the sea deepness in southern coasts. decrease and increase of sea level in different times has had no considerable effect on it and has had less in scission. The coastal edge in Guilan is consisted of accumulated deposits by rivers and dunes. In most areas, the dunes cause the break between sea and ponds. In the areas in which rivers enter the sea, the coastline is clotted and a swamp is often created in their mouth.

MATERIAL AND METHODS

The Caspian Sea is the biggest lake in the world which is located north of Iran and south of Russia it is located between northern latitude in 33 minute and 36^0 (the southwest area) and 7 minute (the northeast area) and east distance 46° and $43^{'}$ western until 54° and $50^{'}$ eastern. Guilan province has temperate and humid weather. In addition, it includes all plains and low coastline. In doing, this project used some library study, viewing the previous works,field measurement and GIS. Some information achieved from aerial photo 1/20000 of year 1967and 1/2000 of year 1994, topography maps 1/50000 maps of Geography and satellite's images meteorological statistic and wave statistics, some scientific reports and related articles, and some books about the different coastline of common wealth countries around the Caspian Sea. The isolation of images between periods of 1967-1994 was in form of aerial scan as a Gray Scale with 200, 250 DPI. The images of scan were not margin and the images had numbers to doing this stage, and providing photo Mosaic Orthrophoto for this. Used graphic software such as Photoshop. Based on Topography maps, connecting of images provided in sector of 15'. The result of this function was in distance of 15' and in the coastline area. After that, for determining the limit of image in order to drawing and doing other functions was sent to Ilwis environment. The GIS studies of Caspian Sea's coastline provided a classic study including, input, process, and output of information as maps. The aims of this study were to determine the position of erosion and sediment in coastline and natural factors in two period of photography, and determining location of sediment and erosion.

RESULTS AND DISCUSSION

Caspian Sea in Guilan province and it's impression on coasts morphology changes has been reviewed in two periods. The water proceeding in Guilan coasts has basic role in geomorphology changes depository coastal units and changes in their position. erosion and deposition phenomena are concentrated mainly on specific areas, across Caspian coast, in erosion and deposition and coast lands which have changed under influence of these processes, the division is considered with geomorphologic point of view and same maps are provided.

Geomorphologic forms resulted from deposition

In the region with different sedimentary environments, and on the basis of kind and constructive power, deposits are created in different environments of these forms, ponds and coastal swamps(Bird, 2000).

Lagoons and swamps

Morphological views are observable in different parts of Guilan coast. The sea water proceeding and entrance of rivers from upstream that have caused creation of these region. has lead to trapping of deposits among them and continuation of this cycle has caused the expansion of lagoon coastlines in a wide range of Caspian Sea coasts .

Anzali Gulf

The most famous gulf is Anzali gulf which is located in southwestern and Rasht city and 40 Km far from north of this city and is separated from the sea by a narrow sandy band in which sea forms are on the mouth and the connection way with sea are on the other section of it.

Sandy Dune bank and Sandy plain splits

One of the important bars and coastal area geomorphologic views under study are dunes which are found in coastal regions. These dunes are under erosion and movement by waves and swelling of wind in the region. The dunes in the region are most often in the form of transversal dunes.

Delta

In Guilan coasts, the great and famous delta of Sefidroud is the most famed delta in Caspian Sea. In addition, in krgan-roud and other parts of Guilan, it can be seen. The erosional deposition coastal shores under deposition and varieties without changes in Safidroud delta - Which is imminence to Caspian Sea in Kiashahr region -, is clearly distinguishable.

Marine Terraces

Marine terrace is another land morphological views of eastern coasts of Caspian Sea which formation is related to change of seawater's level in a long-term period. The reason for these vacillations, is change in climate conditions and geological activities of Caspian Sea bed. Generally in area, three alluvium terraces in different levels of elevation are observable.

Flood plains and muddy areas

Tow forms that are resulted from deposition in coastal plains are flood and muddy plains, which belongs to river circumstances .

Alluvial fans

At foot of coastal terrace areas , where the elevations with steep gradient are limited to plains, the Conical shape deposits accumulations are created. These shapes can be seen in Talesh, and Khotbeh - Sara River. general length of coast is relatively parallel with Astara fault and is northern–southern. sandy bands among relatively great rivers are formed in the shape of parallel and curved bands.

Estuaries or shallow holes

These holes behind sandy coasts are created as a result of water proceeding that water has had proceed and withdrawal after it's flow in these estuaries and has created a specific sight and view which some rivers are connected to them.

On the basis of field measurement and some pervious results, causes of changes in the sedimentary units were from different process, such as coastline erosion (progressing), sedimentary layers (under grading), making new sedimentary units and human activities in making ports, roads, cities and creating some small ponds behind the sandy hills and also some changes that occurs in coastline's morphology (Ignatov..Kaplin. Lukyanova&.solovieva .1993).

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Tallish region Hash par

western coastline of Caspian Sea in Talesh region with leaving sediments progress toward the sea nearly in areas of 31.48 ha. This region by leaving sediments from rivers has created a coastline in areas of 15.75 ha. In addition, some areas that have remained under river's sediment are in areas of 3.52 ha. The patterns of progressing and sediments in Talesh are showed in table5.

Bandar Anzali region

According to results, it can be seen in all regions, coastline profile that coastline's sediments progress with. The areas of it in margin of Anzali coastline is 45.81 ha. Other process is present not in this region. Totally the sediment patterns and progress is dominated on leaving sediment (table1).

Astaneh-Ashrafiye region

This region and also Kiashahr coastline have particular morphology because of entering water of Sefidroud River and transporting of sediment and some short and long time changes in movement line. This region has different form. The sediment areas are 59.10 ha, and in the coastline are about 276.99 ha. Under grading of water and coastline, sediment areas is about 48.08 ha (table2).

Lasko-Kalaye region

This region is extended toward the Langroud and has sandy coastline. This coastline has curvature. The coastline sediment areas in this region are 1430.69 ha. This progress is the largest in coastline region of Guilan province and leaving the sediment is few and is about 2.04 ha (table3). The patterns in this region has been sedimentary part and water progressing.

Roudsar region

This region is continuation of Langroud coastline and it is toward the Chaboksar. It has sandy coastline. The dominate patterns of this region is sediment pattern and water progressing. Moreover, its area is 678.50 ha. It is second area due to changes in the province. Leaving sediment is in center of Roudsar that is around the west mouth of Puleroud River, and its area is about 5.46 ha. The sediments areas of channels and rivers are 51.69 ha and the most rate of leaving sediment is about 84.68 ha (table4). The coastline profile has extended toward the sea.

Table 1. Sedimentary deposition changes of two periods in Bandar Anzali Region (1967-1994).

Row	Units	Area(ha) (1967)	Area(ha) (1994)	Changes (ha)
1	Backshore	45.08	33.87	-11.20
2	Farms	49.81	27.17	-22.64
3	Qal_1	43.35	52.97	+9.62
4	Qsp	418.94	0	-418.94
5	Qt_2	105.73	192.002	+86.272
6	Qt_s	68.78	585.45	+516.67
7	lagoon	74.24	1857.61	1783.37
8	Urban areas	48.73	173.77	+125.04

Table 2. Sedimentary deposition changes of two periods inAstane Region (1967-1994).

Row	Units	Area(ha) (1967)	Area(ha) (1994)	Changes (ha)
1	Backshore	207.97	65.10	-142.87
2	Farms	1017..97	181.48	-836.49
3	Qal_1	353.35	476.68	+123.28
4	Qal_2	169.69	103.87	-65.82
5	Qal_3	1958.12	597.38	-1360.74
6	Qt_2	2079.15	1786.39	-292.76
7	Qt_s	602.12	338.58	-263.54
8	Lagoon	624.95	235.45	-389.5
9	Urban areas	78.86	14.20	-64.66

Table 3. Sedimentary deposition changes of two periods in Laskokelaye Region (1967-1994).

Row	Units	Area(ha) (1967)	Area(ha) (1994)	Changes (ha)
1	Backshore	325.94	106.41	-219.53
2	Farms	1963.58	145.64	-1817.94
3	Qal_1	14.81	0	-14.81
4	Qal_2	60.37	35.08	-25.29
5	Qal_3	3122.08	1843.14	-1278.94
6	Qsp	134.45	1283.33	+1148.88
7	Qt_2	7431.81	2646.32	-4785.49
8	Qt_s	1563.03	366.57	-1196.46
9	lagoon	600.01	402.58	-197.43
10	Urban areas	111.94	47.35	-64.59

Table 4. Sedimentary deposition changes of two periods in Roudsar Region (1967-1994).

Row	Units	Area(ha) (1967)	Area(ha) (1994)	Changes (ha)
1	Backshore	332.88	143.88	-189
2	Farms	1889.22	653.85	-1235.37
3	Qal_1	176.52	173.79	-2.73
4	Qal_2	247.97	366.04	118.07
5	Qal_3	665.66	3675.48	+3009.82
6	Qsp	1559.91	920.14	-639.77
7	Qt_1	56.52	12.14	-44.38
8	Qt2	8238.07	6556.45	-1681.62
9	Qts	347.61	43.63	-303.98
10	Rock unit	347.61	76.49	-642.44
11	Lagoon	79.80	82.78	+298
12	Urban areas	87.84	124.70	+36.86

Table 5. Sedimentary deposition changes of two periods in Hashtpar-Talash Region (1967-1994).

Row	Units	Area(ha) (1967)	Area(ha) (1994)	Changes (ha)
1	Backshore	70.48	124.24	+53.76
2	Farms	381.71	1037.28	+655.57
3	Qal_1	-----	275.44	+275.44
4	Qal_2	83.08	424.89	341.81
5	Qal_3	791.16	1315.60	+524.44
6	Qsp	166.54	424.95	+258.41
7	Qt_1	271.53	144.74	-126.79
8	Qt_2	899.51	7248.68	+6349.17
9	Qts	152.36	227.21	+74.85

which (+) indicates an increase in extent of withdrawal (-)indicates to a decrease in water proceeding towards coast numbers and dispersion of bars. The difference between occurred changes in consequences of proceed and withdrawal and it's effect on morphology form trans for motions has been calculated.

CONCLUSION

In recent decades, different natural and humanistic factors caused to increase the Caspian Sea level of water and it's changing. This increasing in level of water has begun from 1967and this increasing caused drowning of a wide area. It is believed that increase and decrease in the Caspian water level of, every 30 or 35 years consistently, occurs simultaneously with hot weather's alternation and drought (Berg. 1960). Now the greenhouse effect is the effective key factor on vacillation of level of Caspian Sea in the wide field of it. According to the view, contribution of climate in sea level changes is about 85%. In addition to the observation of changes periodically in Caspian Sea, the sudden changes can transform the morphology of coasts too, and make many areas useless(Shiklomanov 1981). With proceeding of water, same problems can be observed, like drowning of many residential and commercial areas in Anzali and Astara parts, gardens and farmlands of Langroud to Roudsar, creation of fetid water and change of lands in Chamkhale, river-basins of Astara, Kiashahr and Lasko-Kalaye, growth of reed and osier in lands under influence of water proceeding and drowning of many farm lands. Because of sand and gravel collection from river mouths, penetration of sea water and it's proceeding has increased and caused change of coast's morphology and changes in dispersion and kind of Guilan coast's plants(Rferren&Leidy,2001). withdrawal of dunes behind the coasts has lead to unassailability of coasts and proceeding of water and basic changes in dispersion and has made the place of wave break, deep and long. The collection of sand and gravel form coastlines too, that has caused change of sea level; and it's advance which has caused erosion of many areas in coast and has drowned the coastline. In Guilan coasts the high waves have a considerable role in coast morphology(Bruun.1962).created waves, regarding to water proceeding in recent, decade have lead to transferee of river's deposits and the parts which have terrestrial and drought source and observed across Guilan coasts rivers. In some coastal areas from west to east are transferred by waves to different places and accumulated there , and this dispersion of deposits has a considerable role in changing the level of water. Deposits Regarding to transferring accumulate in river mouth and place of entrance to coast. Most of these rivers results from lands and then join the sea at the end transfer of deposits move by marine flows and waves, and accumulate in some parts of coast, then create a great area which is considerable from morphology point of view.

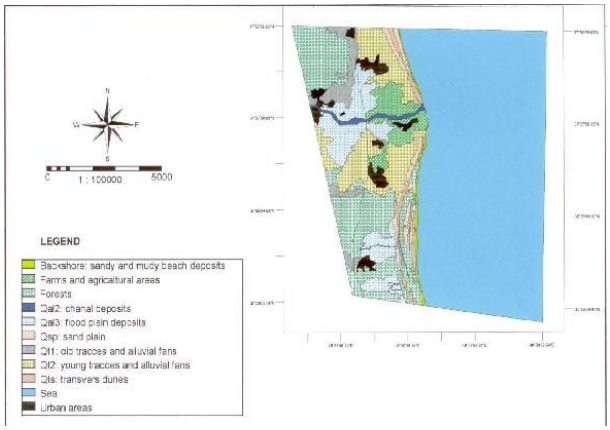

Fig 1.map of sedimentary units and geomorphology features in Talash -Hashtpar- zone on aerial photography (1967).

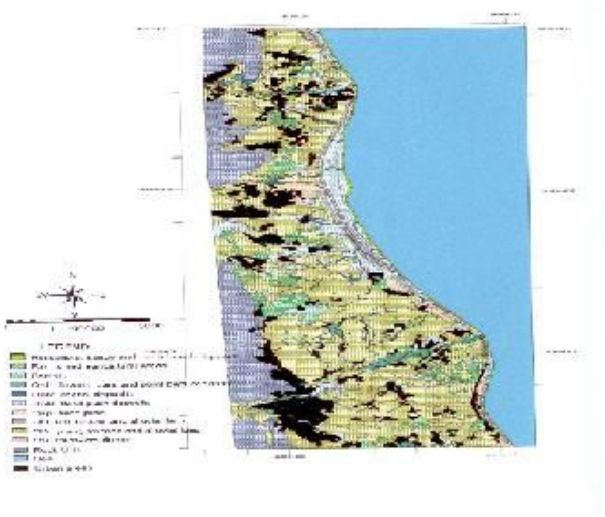

Fig 2.map of sedimentary units and geomorphology features in Talash-Hashtpar- zone on aerial photography (1994).

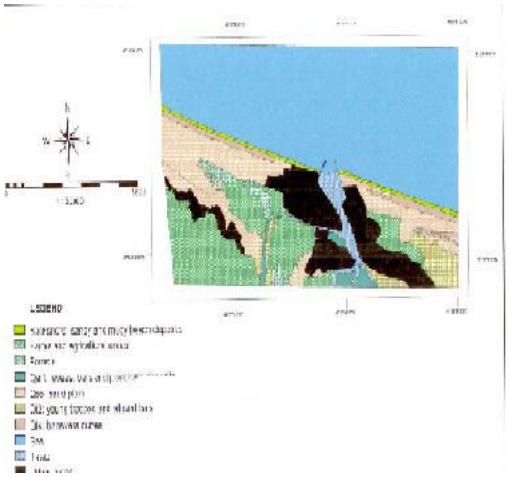

Fig 3. map of sedimentary units and geomorphology features in Anzali- zone on aerial photography (1967).

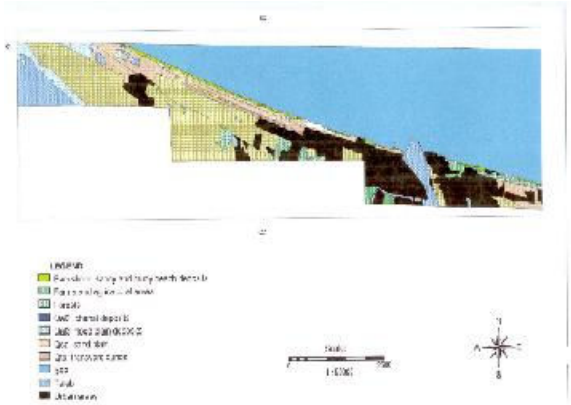

Fig 4. map of sedimentary units and geomorphology features in Anzali- zone on aerial photography (1994).

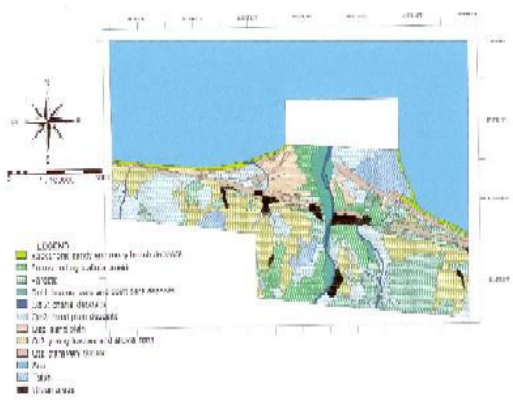

Fig 5. map of sedimentary units and geomorphology features in Astane_Ashrafie - zone on aerial photography (1967).

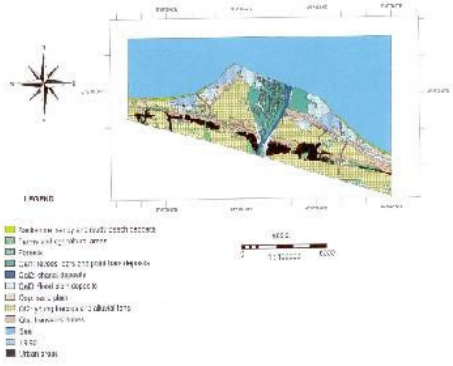

Fig 6. map of sedimentary units and geomorphology shapes in Astane_Ashrafie - zone on aerial photography (1994).

Fig 7. map of sedimentary units and geomorphology features in Laskokelaye- zone on aerial photography (1967).

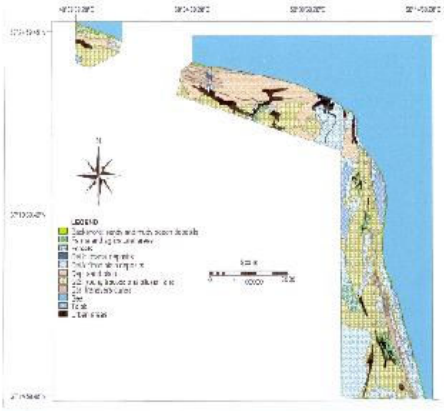

Fig 8. map of sedimentary units and geomorphology features in Laskokelaye - zone on aerial photography (1994).

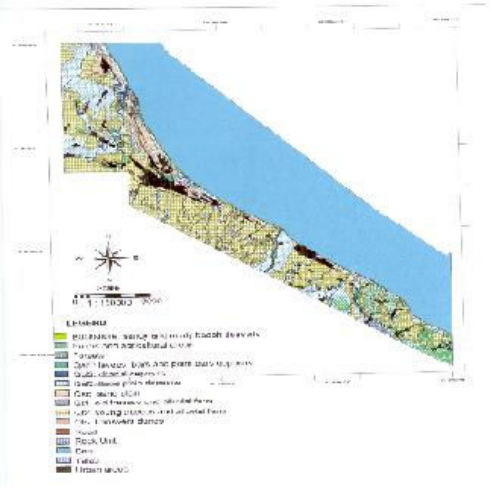

Fig 9. map of sedimentary units and geomorphology features in Roudsar - zone on aerial photography (1967).

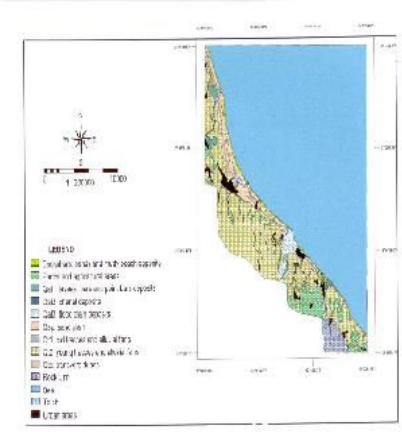

Fig 10. map of sedimentary units and geomorphology features in Roudsar - zone on aerial photography (1994).

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