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**Characteristics and Seasonal Variations of pH in the Southern Shelf of the Caspian Sea**

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### **Extended Abstract**

This paper presents distribution and seasonal variations of pH over the southern Caspian Shelf adjacent to Iran. The pH data were collected down to 200m depth in two areas in east (off Babolsar in Mazandaran) and west (off Kiyashahr in Gilan) of the Caspian Sea southern coast. The data were collected using a pH sensor of a CTD probe in summer 2003 and spring and autumn 2004. In summer, when the surface water temperature was highest and the strongest seasonal thermo cline existed, the maximum value for pH was observed. In this season, pH had a value of 8.35-8.4 at the water surface.

This amount reduced to 8.2 at 80-m level and even deeper waters. In autumn, the pH was less than summer and was mainly 8.25 at the water surface outside of the shelf and 8.3-8.35 in the shelf and it gradually reduced by decreasing the depth. In early spring, during the formation process of new seasonal thermo cline, low temperature and maximum local river inflow, pH at the water surface was mainly 8.25 and reduced to 8.2 at 30-m level.

The results showed that seasonal variations of pH in the southern Caspian Shelf and the coastal waters adjacent to Iran is a function of seasonal variations in water temperature, characteristics of thermo cline, local rivers chemical characteristics and discharges, and production or degradation processes.

### **Introduction**

pH in the Caspian Sea has seasonal and spatial variations. In summer, the increase in phytoplankton production results in the absorption of CO<sub>2</sub> and a chain of reaction that take the free Hydrogen ion from the sea water, reduces the acidity and increases the pH. In autumn, the oxidation processes prevails the production processes and the amount of CO<sub>2</sub> increases in the water while the water pH reduces.

In the southern area of Caspian Sea, adjacent to Iran, the field measurements and data of physical and chemical characteristics of water, including pH value is very limited. In this paper by using field data analysis, the characteristics and seasonal variations of pH in the southern shelf of the Caspian Sea are presented and discussed. The data collected in summer 2003 and spring and autumn of 2004.

### **Study areas**

The study areas are located in the east and west of the southern coast of Caspian Sea in Iran. The eastern site extends between Babolsar and Sorkhehesar in Mazandaran province. The western site is located in Kiashahr near the mouth of the Sepid Rood River in the Gilan province.

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### **Data collection**

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pH measurements were conducted using the pH sensor of an Ocean Seven 316 CTD probe manufactured by Itronaut. The sensor has an accuracy of 0.01 in measuring the pH. The CTD was used in a free falling mode with a speed of  $1\text{ms}^{-1}$ .

The pH profiles in the eastern site were collected at 27 sampling stations in 4 transects (3 perpendicular and 1 parallel to the coast) in summer 2003 and spring 2004. In the western site, the data was collected at 17 sampling stations in a transect perpendicular to the coast in the autumn 2004.

### **Results and discussion**

The vertical structures of the pH in the eastern site in august 2003 are shown in figures 1a and 1b. At this time, the water temperature structure was characterized by a strong thermo cline located between 20 and 50m levels. Outside of the shelf (figure 2a) the pH was mainly 8.35 at the top 40m of water column.

The pH slightly increased and reached to 8.4 between 40 and 50m level. Below 50m, the pH gradually decreased to 8.2 at 80m level and then remained almost constant. Over the shelf, pH changed between 8.35 and 8.4.

The vertical structure of the pH in the western site in October 2004 is presented in Figure 2c. At this time, there was a thin thermo cline between 30 and 40m levels.

Outside of the shelf, pH was measured 8.25 at the top 30m of water column. The pH gradually decreased to 8 at 70m level and 7.9 at 120m and then remained almost constant.

The vertical structure of pH in spring 2004 is presented in Figure 2d. At this time the process of themocline formation started and vertical temperature structure was characterized by a warm surface layer of 10m with a temperature of  $14^{\circ}\text{C}$  and then gradually decreased.

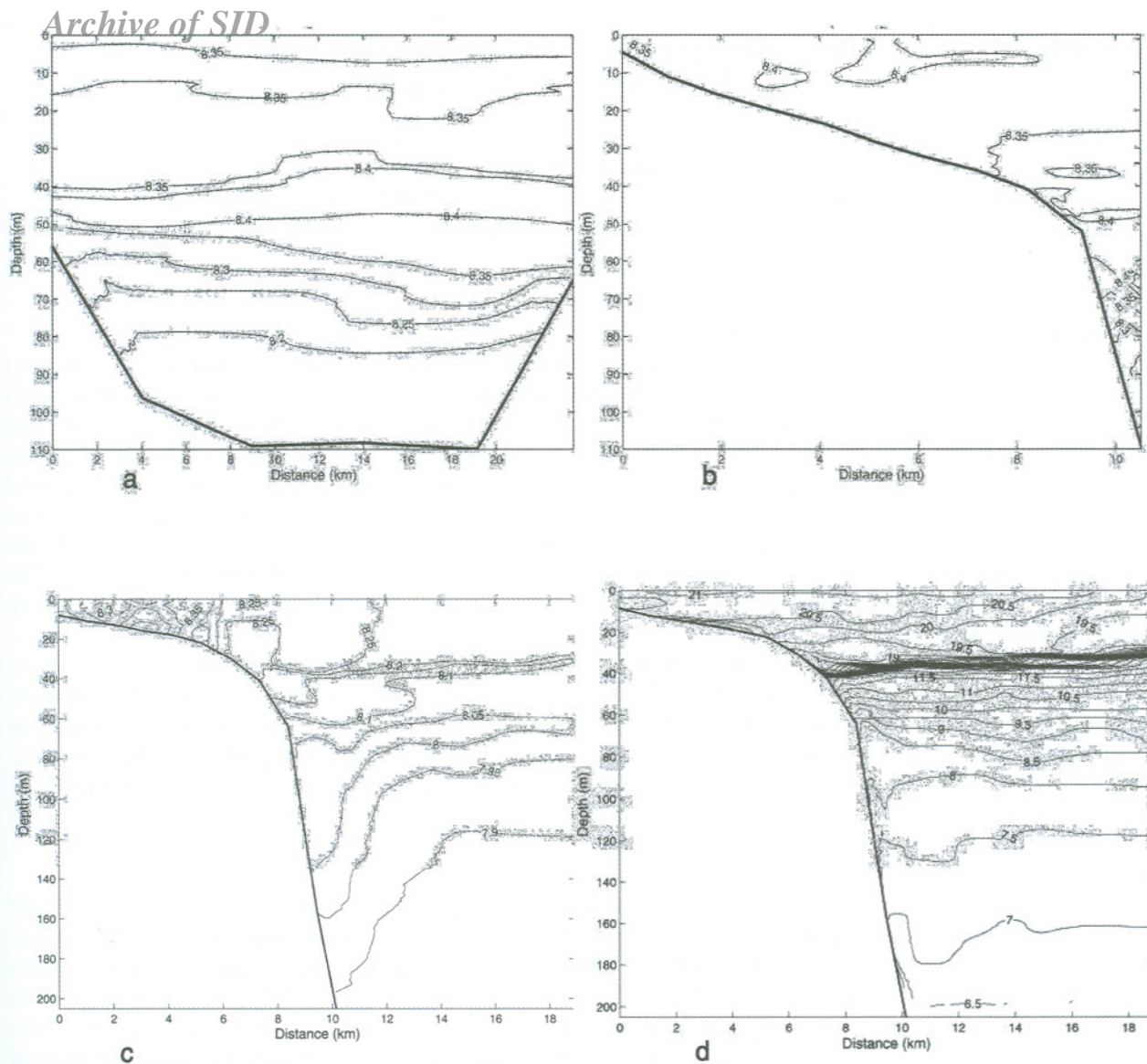
Outside of the shelf, the pH was 8.1 at the top 30m of the water column and reduced to 8 at 40m level and even for deeper waters.

The results indicated seasonal variations of pH in the southern coastal areas of the Caspian Sea adjacent to Iran. The pH variations were partly due to the seasonal changes in the processes of production or degradation and prevalence of either of them. Also, it depends on the seasonal variations in the discharge of local rivers and their water characteristics.

The maximum amounts of pH were observed in summer when the temperature was high. There was a strong thermo cline and high level of phytoplankton productivity.

In autumn the decrease of temperature and the prevalence of degradation process, the pH decreased significantly and in particular in deeper depths reduced to 7.9. Similarly observations in spring, when water temperature was low and river discharges highly affected coastal areas, the observed pH was between 8.05 and 8.1.





**Fig. 1:** Vertical variations of pH in the study area. a) Summer 2003 parallel to the coastline. b) Summer 2003 perpendicular to the coast. c) Autumn 2004 perpendicular to the coastline. d) Spring 2004 perpendicular to the coastline.

### Key words

Caspian Sea, pH, Seasonal Variations, Marine Environment