Assessment of the environmental impact of brine waste on the marine environment

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1. INTRODUCTION

An assessment of the environmental impact of brine waste released in the Mesolongi lagoon during the salt production at the Mesolongi salt works was undertaken. For this work the space and time variability of the Cl^-, $SO_4^=$, Ca^{2+}, Mg^{2+}, Na^+ and K^+ concentrations, the conductivity, temperature and pH in the area of dumping was determined and the rate of dilution of brine waste was investigated. Most measurements were carried out twice a month for one year (May 1988-May 1999).

The geological setting of the Mesologi area is given by B.P. Co(1971), whilst the physiographic settings of the crystallizers, which produce the brine waste is described by Varnavas and Lekkas(1996). The metal distribution in the saltworks (salinas) is given by Varnavas and Lekkas (1988).

2. RESULTS AND DISCUSSION

For a long period of time the seawater column 2 m. above seafloor in the channel of discharge of the brine waste is characterised by marked increase in suspended particulate matter, Cl^-, $SO_4^=$, K^+, Na^+, Mg^{2+}, Ca^{2+}, low pH and dissolved oxygen. The spatial variability of SO_4 and pH in the surface and bottom waters along the channel of discharge is shown in figures 1,2. Such enrichments and depletions were also observed at certain areas of the seafloor in June, July and August prior to the brine dumping.It is therefore highly probable that there has not been a complete dilution of the brine waste released in the previous year.

An investigation of the geomorphological features of the area where the brine waste is concentrated showed the occurence of a basin. Therefore the morphology of the seafloor plays an important role in the rate of dilution of brine waste.

In order to investigate the vertical variability of brine waste in the water column the conductivity measurements were carried out at profiles at various stations along the channel of dumping.

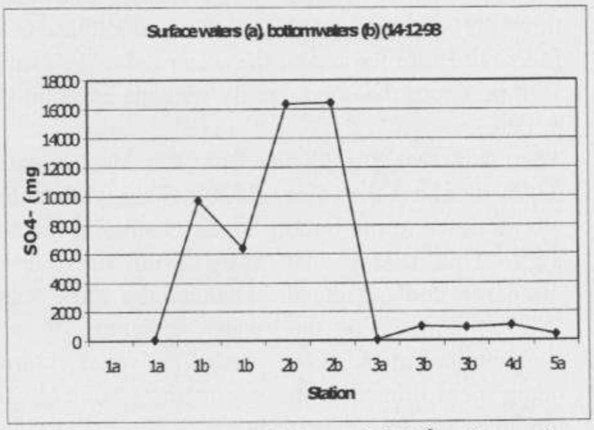

Figure 1. Spatial variability of SO_4^{2-} along the channel of discharge

The general picture obtained after the discharge of the brine waste is as follows : Near the outfall the conductivity remains constant from the top of the water column down to 1 m. (being - 50 mS/cm), while it increases from 1 m. depth down to 2.5 m. where it reaches 190 mS/cm.

Similarly, the temperature remains constant from the top of the water column down to 1 c, increasing constantly from this depth down to 2.5 m. This means that the brine waste accumulate at the bottom of the water column reaching the level of 1 m. from the seasurface.

Two weeks after the begining of discharge of the brine waste, in mid-September '98 it was found that at certain stations the conductivity reached 200 mS/cm at the seasurface, showing that the brine waste covered the complete water column.

The conductivity remained high and constant (200 mS/cm) from the top of the water column down to 1.25 m. depth, from 1.25 m. to 2.0 m, then it decreased to 100 mS/cm At 2,25 m. it increases again, reaching 150 mS/cm remaining at this level down to 2.80 m. depth. The temperature follows conductivity in its vertical variability. It is therefore seen that at this subenvironment there are three main layers: one at the top of the water column with the highest conductivity (level of discharge) an intermediate layer with moderate dilution of the waste (intermediate conductivity) and the bottom layer (with high conductivity).

During the same period, far away from the site of discharge at the crossing point of the two channels (the channel of discharge and the main channel of the area) in a deeper zone, which is also characterized by greater water masses and water flow the vertical variability of conductivity is as follows : From the top of the water column down to 1.70 m. depth the conductivity remains constant (54 mS/cm).

Then it increases gradually from this level down to 3.0 m. reaching the value of 130 mS/cm while below 3.0 m. down to the bottom of the channel it remains high. This means that away from the site of discharge and outside the channel the brine waste still remained in the water column. It was concentrated in the lower part of the water column, being more diluted at the intermediate zone but the top layer was free of brine waste.

The conductivity measurements and the ion analyses continued at least twice a month until the end of April 1999. It was found that in the center of the channel of discharge there is a basin at the bottom of which the conductivity values remained high throughout the whole sampling period.

The analysis of seawater samples at profiles showed that the samples showing high conductivity values were always characterized by extremely high concentrations of Cl^-, $SO_4^=$, K^+, Na^+, Mg^{2+} and low pH and dissolved oxygen.

An investigation of the time variability of the concentrations of Cl^-, $SO_4^=$, K^+, Na^+, Mg^{2+}, pH and dissolved oxygen showed that no significant variability was observed in the bottom layer of a large area in the channel of discharge.

3. CONCLUSIONS

It is concluded that brine waste is trapped in a basin occuring in the channel of discharge. It remains there even until the begining of the discharge of the brine waste of the following harvest. The anoxic environment formed in this basin due to the presence of brine waste for a long period of time leads to geochemical reactions in the sediments forming poisonous gases. This, combined with the low pH and the lack of oxygen forms a toxic environment which needs further investigation by the analysis of sediment cores and the detailed geochemical maping of the basins in which the brine waste is trapped. These investigations are necessary in order to make the correct decisions for the implementation of a remediation action plan in the area.

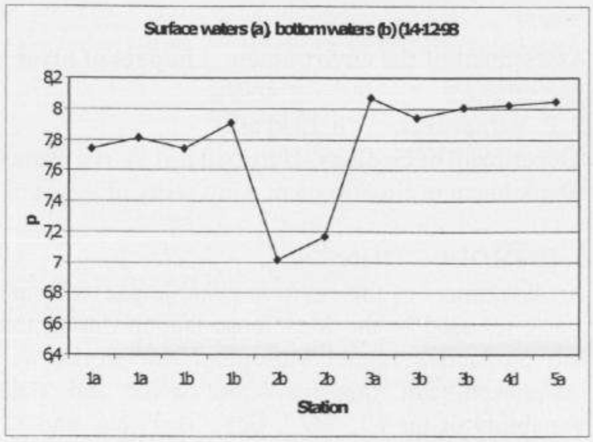

Figure 2. Spatial variability of pH along the channel of discharge

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