DISSOLVED METHANE PROFILE IN AN EUTROFIC RESERVOIR

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Introduction. Methane is the final product of anaerobic degradation of organic matter. Methane is the third most important greenhouse gas with a global warming potential of 25 (1). Since pre-industrial era, methane concentration in the atmosphere has increased by 170% and it is estimated that it will increase by an additional 25 to 70% by 2030, compared to 2000 (2). Eutrophic lakes and wetlands are responsible for a quarter of total methane emissions (3). In aquatic ecosystems, methane is produced in anaerobic sediments by methanogen archaea, migrate to the water column and then to the atmosphere by diffusion and ebullition. In the water column, a significant amount of methane is oxidized by methanotrophic bacteria. As a result of these antagonistic processes, a gradient of methane, from the sediment to the atmosphere is usually observed. However, during winter, most of temperate lakes are subject to mixing caused by significant cooling of surface water. During this mixing, the water column become homogeneous and no gradient in water parameters is observed. However to the best of our knowledge, the effect of mixing on dissolved methane gradient has never been reported before.

Methods. A 400 ha temperate eutrophic reservoir located in an urban area (Lago de Guadalupe, 19°37’54” N, 99°15’39”W) was selected as model of study. In this lake, dissolved methane concentration was determined in summer (stratification period) and winter (mixing period) at 8 locations and several depths (each m), according to Sepulveda (4), giving a total of 83 triplicate measurements for each period. The dissolved methane data were used to generate 2D maps of methane concentration with Surfer 10 software (Golden Software, USA).

Results. During stratification (summer), a clear gradient of methane concentration was observed, from the bottom to the surface of the reservoir (Fig. 1). This gradient was in accordance to the stratification of the main water quality parameters determined (temperature, pH and dissolved oxygen, within others. Not shown). During stratification, the average methane concentration was 2.073 mg/l. A sharp dissolved methane concentration was observed at the oxic/anoxic interface, suggesting a high methanotrophic activity in presence of oxygen. During mixing (winter), no gradient of dissolved of methane was observed and the average concentration was 0.74 mg/l., significantly lower than during stratification. As no significant decrease of methanogenic was expected between both periods; methane being produced in thermally unchanged sediments (data not shown), the results presented here suggest that the overall methanotrophic activity was higher during mixing period than during stratification. Although to be confirmed, transport of oxygen from superficial layers to deeper layer might explain the latter.

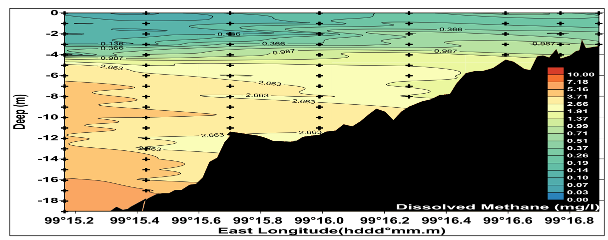

Fig.1 Dissolved methane maps in summer (Sep-29) showing point where the sample was taken ♦

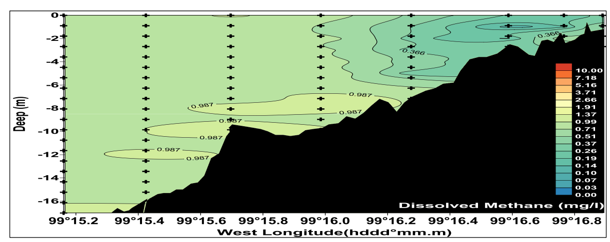

Fig.2 Dissolved methane maps in winter (Dic-04) showing point where the sample was taken ♦

Conclusions. Dissolved methane is subject to mixing as any other water quality parameter. Mixing apparently caused higher methanotrophic activity, probably caused by oxygen transport to lower water. This should be confirmed by additional research.

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