Marine Pollution Bulletin 131 (2018) 453–459

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Baseline

# Rate of sediment accumulation and historic metal contamination in a tidewater glacier fjord, Svalbard

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ARTICLE INFO

*Keywords:*
Pollution
Geochronology
Melting
Climate
Accumulation

ABSTRACT

The sedimentation rates in Arctic fjords are influenced by the changes in the glacial inputs. The recent studies have indicated the retreat of glaciers due to climate change and subsequent increase in melt water outflow with high content of debris. The debris may contain natural and anthropogenically originated contaminants. The present study analysed the sedimentation rate in inner Kongsfjorden, Ny-Ålesund, Svalbard using $^{210}Pb/^{210}Po$ dating technique. The sedimentation rate ranged between 0.22 and 0.37 cm/year during the last 112 years. The average sedimentation rate obtained was 0.28 cm/y. The rate has been increased during the last 20 years and it might be due to the increased influx of glacial melt water containing debris. Metals and other elements showed an increasing trend towards the surface and observed high deposition rate since 1970s, indicating influence of industrial emissions and it can be a potential threat to Arctic biota.

Global climatic variations and its effects can be easily monitored at polar environments especially in Arctic regions, as it is highly sensitive and worst affected one (Mallorya et al., 2015; Lu et al., 2012). The fjords are vital systems in the Arctic and serve as major points to measure the cause and effect of environmental change. The rate of sediment production and sedimentation in fjords is influenced by glacier front, fjord walls, side streams and other topographical factors (Zaborska et al., 2000; Marek, 2008). Hence there is a high chance of co-deposition of contaminants, which are originated from the industrial emissions and deposited on the ice sheets/glaciers, at the tide water glacier fjords. Therefore the global climate changes and increasing melting may have a significant influence on the deposition of pollutants in the marine ecosystem (Robert, 2000). The present study investigates rate of sedimentation and historic metal contamination close to a glacier front in Kongsfjorden, an Arctic Fjord system at Ny-Alesund, Svalbard.

Kongsfjorden is located in the northwest of Spitsbergen (the largest island in Svalbard archipelago) between 78°52′ and 79°04′ N and 11°20′ and 12°36′E, and is oriented from the southeast to the northwest, with a length of 20 km and a width varying from 4 to 10 km (Svendsen et al., 2002).

Sediment core (28 cm) was collected from Kongsfjorden during the Indian Arctic expedition using Haps corer of 30 cm long. The sample location was very near to tide-water glacier Kronebreen (largest one in Svalbard) and the glacier front is known as Conwaybreen and Kongsbreen (Lat 78.993 and Long 12.3) (Fig. 1). The core was sub sampled at 1 cm interval (a total of 28 samples) and analysed for various parameters.

The age and the activity of core sediment were estimated by alpha spectroscopic method using $^{210}Pb/^{210}Po$ using Constant Rate of Supply (CRS) model (Pandit et al., 2014; Arman, 2006). Geochronological analysis of each samples were performed in at least replicate. $Po^{209}$ and $Po^{208}$ were used as mixed tracer to know the chemical recovery of $Po^{210}$ from sediment samples. Am – Pu source of known activity was used for calibrating the energy and efficiency of alpha spectrometer. Natural uranium source was also used for confirmation of energy calibration. The quality assurance of measurements was assessed through analysis of the Standard Reference Material IAEA-135 Marine Sediment sample. A total number of 17 out of 28 samples were used for the analysis. Sample interval was fine at surface and coarse towards bottom. Mass Accumulation Rate (MAR) (measure of the dry mass accumulating per unit area and time) was also calculated (Clark et al., 1990).

The heavy metals in the core sediment were estimated using ICP-MS (Yuan et al., 2004) after microwave (MARS Xpress, CEM, USA) assisted acid digestion. The concentration of mercury in the core sediment was analysed using Cold vapour atomic fluorescence spectrophotometer

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https://doi.org/10.1016/j.marpolbul.2018.04.057
Received 8 November 2017; Received in revised form 13 April 2018; Accepted 25 April 2018


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