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Assessment of trace element accumulation in surface sediments off Chennai coast after a major flood event

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ABSTRACT

The present study was conducted to assess the trace element concentration in marine surface sediments after major flood event of Chennai metropolis, India. Thirty surface samples were collected from off Chennai coast. Trace elements, organic matter, $CaCO_3$, sand-silt-clay and C/N ratios were studied to understand the accumulation dynamics on sediments. The elemental concentration, calcium carbonate and OM distribution suggest that they are derived from urban runoff and transported through Adyar and Cooum Rivers. The enrichment factor reveals that the sediments are enriched by Pb, Cu, Zn, Cr, Co, Ni followed by Fe. The observed Igeo value shows that the samples are contaminated by Pb, Cu and Zn. The elemental concentration of the surface sediments is low when compared to other coastal region except Pb. The elevated level of Pb in the surface sediments is probably due to migration of contaminated urban soil from industrial and transportation sectors into marine environment.

The allogenic sediments deposited in estuarine and coastal environments are becoming increasingly polluted with minor metals due to urban and industrial development in coastal regions. Hence, understanding the sources of pollution in offshore aquatic systems is important to monitor environmental degradation. Anthropogenic sources like discharge of industrial effluents and sewage dumping contribute significantly to pollution and sediments become the ultimate sink (Magesh et al., 2011; Kasilingam et al., 2016). In this connection, flood is one of the natural disasters, contribute the allogenic polluted sediments to the marine environment. The 2015 South Indian floods resulted from heavy rainfall generated by the annual northeast monsoon in November–December 2015. They affected the Coromandel Coastal region of the South Indian states like Tamil Nadu and Andhra Pradesh, and the union territory of Puducherry specifically Chennai city. The flooding has been attributed to the 2014–16 El Niño events. The abnormal raining event set off the flood and it was intensified due to unregulated urban planning, illegal construction and improper design and maintenance of drainage systems.

Chennai is metropolitan city, situated at 13° 04′ N 80° 17′ E on the southeast coast of India and in the northeast corner of Tamil Nadu (Fig. 1). It is located on a flat coastal plain with an average elevation of 6 m. The geology of Chennai comprises mostly of clay, shale and sandstone. The average annual rainfall is about 1400 mm and it receives rainfall mostly by north-east monsoons, from September to December. The two ephemeral streams running through the study area namely Cooum

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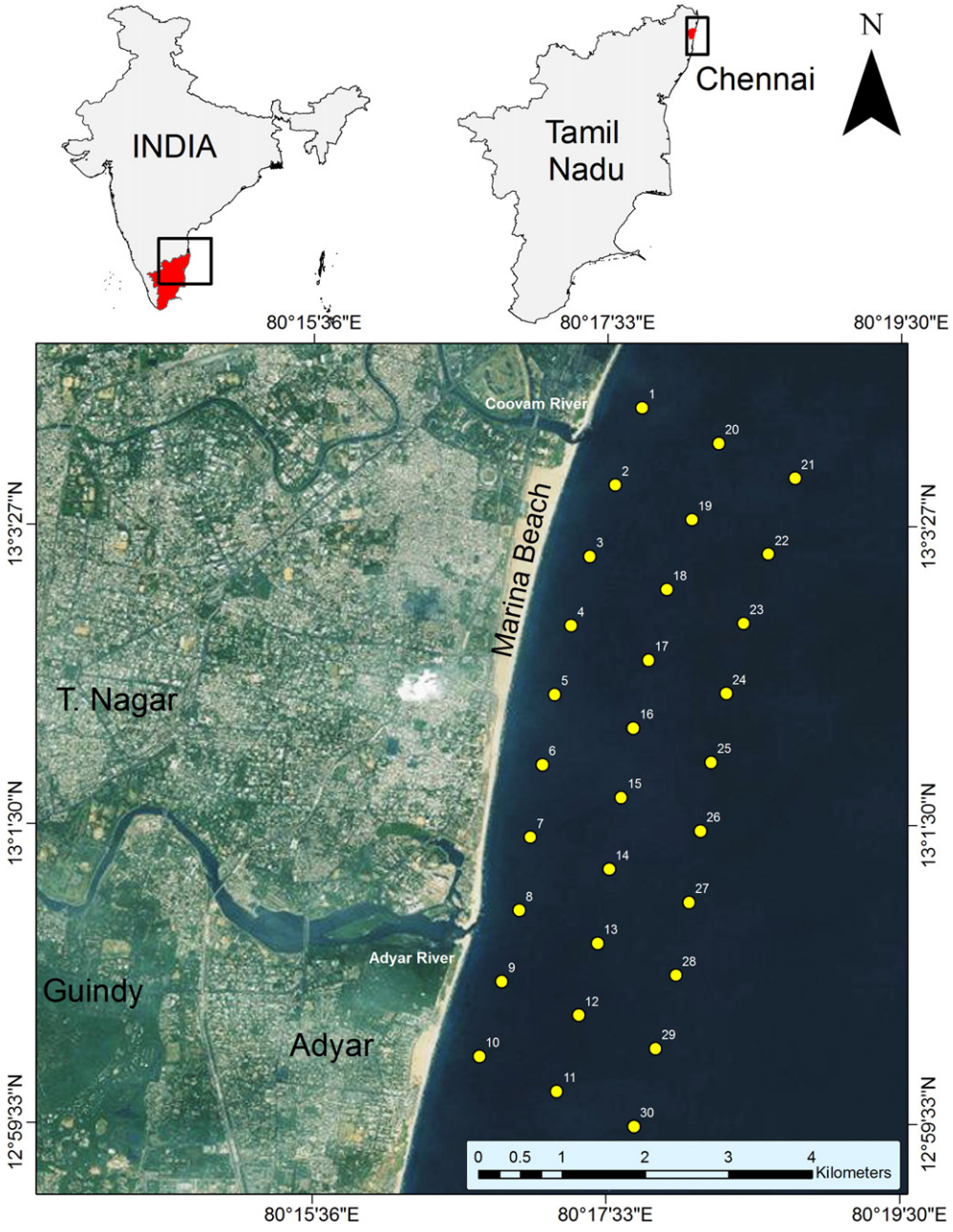

Fig. 1. Location of the study area.

River in the central region and the Adyar River in the southern region. These two rivers are heavily polluted with effluents and trash from domestic and commercial sources. Many researches carried out numerous works on trace elemental concentration in tsunamigenic sediments, drought, flooding in urban areas, tsunami event including short term and long-term impact on biological system, (Ranjan et al., 2008, Srinivasalu et al., 2010, Reza Modarres et al., 2016, Diakakis et al., 2016, Carla Morri et al., 2015, Hussain et al., 2010). However, the metal accumulation dynamics in the sediments off Chennai coast after the major flood event is not reported so far and it is the first ever report of its kind. Therefore, the present study was focused on the elemental concentration and C/N ratio on marine sediments off Chennai coastal region after major flood event.

Thirty marine surface sediment samples were collected using van veen grab sampler between Adyar and Cooum River mouth in a gridded pattern. The sampling locations were fixed using a hand held GPS (Garmin-eTrex). The collected samples were properly numbered and transferred to laboratory for further analysis. The sediment samples were dried at 60 °C in hot air oven and dried samples were pulverized for elemental analysis. Calcium carbonate ($CaCO_3$) and trace element analysis was performed as suggested by Loring and Rantala (1992). Organic matter was determined by exothermic heating and oxidation with

Table 1
Comparison of MESS 2 certified values for total trace elements.

Elements	MESS 2		
	Obtained value	Certified value	% recovered
Fe	4.25	4.34	97.93
Cr	104.1	105	99.14
Mn	322.6	324	99.57
Ni	45.3	46.9	96.59
Cu	33.2	33.9	97.94
Zn	153	159	96.23
Cd	0.22	0.24	91.67
Pb	22.3	21.1	105.69