More than seventy earthquakes of different magnitude (main and aftershocks) have been recorded from 26 December, 2004 to 6 January, 2005. Out of total number of earthquakes recorded, only 53 earthquakes can be located as listed in Table 1. Fifteen earthquakes in the magnitude range between 5.4 and 8.9 were recorded from Sumatra region and 38 earthquakes from Andaman/Nicobar Islands in the magnitude range between 5.2 and 6.3. Majority of aftershocks occurred in the Andaman/Nicobar Islands. The seismogram of the main Sumatra earthquake vertical component and three components are shown in Figs.1 and 2. The epicenter plot of aftershocks are plotted as shown in Fig.3.

This major megathrust earthquake occurred on the interface of India and Burma plates and was caused by the release of stresses that develop as the Indian plate subducts beneath the overriding Burma plate. As with the recent event, megathrust earthquakes often generate large seismic sea waves called tsunamis that can cause damage over a much wider area than is directly affected by ground shaking near the earthquake rupture. When the earthquake occurs, seismic sea waves of small magnitude are caused on the surface. These seismic sea waves travel very fast up to 800 km per hour, which means that in the present case the sea waves hit Tamil Nadu after three hours.

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GENERAL PATH OF THE TSUNAMI OF 26 DECEMBER 2004

The Tsunami generated off Sumatra on 26 Dec 2004 traveled over some 4500 km from Sumatra across to Somalia in the east coast of South Africa. It hit India along its eastern coast mainly south of Visakhapatnam but did not viist Orissa or Bengal coast, the northern part of the Bay of Bengal. It visited Kanyakumari and turning northwards thereafter hit several low lying areas on the western coastal tip up to Cochin some 350 km from Kanyakumari Incidentally the west coast of Kerala was hit from strong waves striking eastwards. However the tsunami waves did not proceed to the northern part of the Arabian sea. I have been addressing the question as to why the Tsunami that could travel another 2500 km from the southern tip of India to the Maldives and African Coast could not proceed to the Bengal basin or well into the Arabian sea.

We have a working picture of the bathmetry of the Bay of Bengal and the sediments flow from the Ganges down to very much south of Sri Lanka. The 90 degrees east and the 85 degree east ridges may have influenced the course of the Tsunami but well before they reached Sri Lanka and their influence has not been very effective.

There are two hydrodynamic aspects of a tsunami, as I infer, (i) the wave power largely modulated by the initial thrust and sea floor topography; they become more ferocious as they are obstructed by a shallowing coast line and (ii) the rise in the water level. I suppose the manifestation of a tsunami along the lowlying coasts are due to both these aspects, so that while some parts of the coast are forcefully hit and damaged, large areas get flooded depending on the height contours above sea level.

So one possible explanation why the tsunami did not move northwards of the Bay of Bengal is the resistance offered by the Bengal Fan. The Ganges brings a lot of sediments down the Himalaya and empties the same into the Bay of Bengal. Satellite pictures reveal that the Ganga sediments are carried all the way from the Bengal Delta (swath of no ground) to several thousands of kilometers down to south of the Sri Lanka. Similarly The Indus sediments are carried down to Somalia coast. (I have less information on the Indus now but am collecting more data). The Tsunami would have met this southward flowing load of sediments. The waters that carry these sediments may be denser than the average sea water by virtue of the charged sediments and the southward flowing sea water may have a great deal of energy in itself. They therefore can offer a hydrodynamic force restricting the flow of the Tsunami northwards. Water level considerations may have also stopped a hydrostatic flow of the Tsunami water system northwards. In fact south flowing sediments, though very much slower in their motion may, however, have even added part of their velocity to the Tsunami waves, thereby rendering their flow a little more rapid.

The model of a the Bengal sedimentary fan and perhaps the Indus fan too providing a hydrodynamic barrier for tsunamis arising from the Sunda-Andaman thrust zone if sustainable scientifically, has very deep implications.

1. The 26 Dec 2004 Tsunami being the largest in the Indian Ocean, we can expect most of tsunamis generated at the great Andaman-Sumatra thrust zone

of a lesser magnitude may not penetrate into the northern part of the Bay of Bengal. This is consistent with the general belief that no large tsunamis have hit the northern part of the Bay of Bengal.

2. The northern boundary of the Tsunami wave system (if I may designate it so) may not be overreached by any other Tsunami emanating from the same source direction as their dynamic and hydrostatic energy is not likely to exceed the Great Tsunami of 26-12-2004.

These conclusions do not make the northern Bay of Bengal or northern Indus basin immune to tsunamis from other sources, as the northward extension of the Great Andaman Sunda trench thrust extending to the Myanmar coast or the active faults in the Makran or Kutch coast in the Arabian sea. They underline the need to study the impact of several hydrodynamic aspects of the both the Bay and Bengal and the Arabian sea on tsunami transmission that can then provide good guide lines for evolving a tsunami monitoring system.

Tsunami and the East Coast

As earlier pointed out, the havoc generated by the tsunami is due both to the large energy imbibed by it at the source region and the increased sea level associated with Tsunami water system that then genrates a hydrostatic flow.As a result the wave energy distributed over several hundred kilometers of wavelengths are rapidly enhanced depending on the resistance that is offered by the continental slopes. Why Nagapattinum, Cuddalore and such areas in the east coast were affected may be related to the nature of slope resistance along the coast and the how low the areas are in relation to the hydrostatic head of the tsunami water system.The coastal dynamics needs to be carefully evaluated.

Tsunami and the West Coast

The tsunami visited the 350 km long stretch between Kanyakumari and Cochin and there were manifestations of the surges of the waves to heights of ~5 m in especially the Alappad coast and there were surge of water in such low-lying areas as the Kaykulam Kayal, Arattupuzha-Thrikkunnapuzha coastal bar and then around Kochi. The extent of submergence was determined by the head of the tsunami system and the contours of the low-lying areas. Notably the tract covered by a large mud bank off Ambalapuzha (between Kayamkulam and Alleppey, was protected from the Tsunami that was so ferrocious in the area immediately to the south. This raises the question, did the mud banks anull the ferrocity of the waves by the high density of the mudbank fluid system? I would like to believe they did.

Heavy Minerals along the Western Offshore

The Tsunami waves , by virtue of their greater energy seem to have mobilised the off shore heavy mineral accumulations and brought them up in the Alappad and Arattupuzha regions. The sediments left behind in these areas are very rich in black sands.

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THE NEED FOR TSUNAMI MUSEUMS IN SOUTH ASIA

That Indian Ocean region has no history of tsunamis is a myth. Ten deadly tsunamis swept the Indian Ocean since 1762 and out of these five were around Indonesia. The elite scientific establishments like USGS, BGS and NGRI will have a lot to explain to posterity about their killing silence after learning about a quake of intensity 9 in ocean. International ethics and humanity called for a warning on hotlines for vigil all over coasts where for several hours one by one death danced making a mockery of all our progress in science and technology. Be it as it may, all the Indian Ocean nations would do well to set up Tsunami Museums on the pattern of Pacific Tsunami Museum. Thanks to systematic awareness, deaths have been much fewer in Pacific compared to our region where a dismal record of misery has been set. Such museums would go a long way in creating awareness about tsunamis and save lives in future. Had our coastal population been aware about tsunamis, they would definitely run upland about 30 feet high and saved their lives. It is likely that now onwards our present generation would be careful when they see ocean waters suddenly recede too far and stay there for a while. This would send alarm bells ringing and they would immediately run uphill provided a tsunami strikes during day time.

While day after day we hear of dare devil survivors from Indian Ocean, stories of Pacific tsunamis carry great lessons and are extremely interesting. The last significant tsunami