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GEO-ENVIRONMENTAL ASSESMENT ALONG SOUTHERN AND WESTERN COASTAL BELT OF SRI LANKA AFTER THE INDIAN OCEAN MEGA TSUNAMI

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Abstract

Geo-environmental assessment after the recent mega tsunami, along the southern and western coastal belt indicates varying effects to the beach profile, mineral deposits, surface and ground water, and soil. The most significant effect was due to the beach erosion which had changed the beach profile creating deep water near the shore allowing waves to break much further inland than usual triggering further coastal erosion with the south western monsoon. Destruction of live corals, salinization of drinking water and agricultural soils, water logging in abandoned inland coral pits severely causing epidemic threats, are some of the other major geo-environmental issues along this coastal region. Considerable amount of heavy minerals (from Beruwela to Hambanthota) which are potential placer deposits of ilmanite, rutile, monazite, zircon, and garnet has been removed from the coast line and deposited further inland in a wide scatted area, thus, degrading this potential placer deposit. Immediate actions have to be undertaken to rectify most of these environmental issues.

Introduction

Mega tsunami, struck on the Indian Ocean on 26th of Dec. 2004 has severely affected Sri Lankan coastal belt causing widespread damage to the socio economic condition of Sri Lanka. Gunathilaka, (2005) has discussed the origin and the effects in detail about the recent Indian Ocean mega tsunami. Tsunamis in the recent global history has caused severe damage to coastal property and life (Barnes-Svarney, 1988; Dudley, 1998; Gonzalez, 1999; Gunathilaka 2005) Waves have smashed into the shore like a wall of water carrying everything on their path resulting significant damage to life and property. This tsunami showed us that tsunamis can strike the shores with devastating force, sometimes reaching heights of more than 3-5 m. The flooding by individual waves typically lasted from ten minutes to a half-hour, so the danger period has lasted for several hours. Among the whole lot of destruction of a tsunami there are three main factors which caused the means for destruction in Sri Lankan coastal zone. They are inundation, wave impact

on structures, and erosion. Strong, tsunami-induced currents lead to the erosion of foundations and the collapse of bridges. Flotation and drag forces move houses and overturn railroad cars. Considerable damage is caused by the resultant floating debris, including boats and cars that become dangerous projectiles that crashed into buildings, and break power lines. In this study, we are trying to understand the geo-environmental effects on beach profile, economic mineral deposits, ground water, surface water and coastal soil by the Indian Ocean tsunami. Our results show varying effects.

Methodology

Selected study area was along the coastal belt from Colombo to Yala. GPS co-ordinates as well as the distance from the sea were recorded from all the studied sites. Digital photo graphs were taken. Tsunami sediment thickness, run-up, erosional features and inundation distance, were studied along the tsunami affected coastal zones. All the studied sights were investigated for the environmental issues such as faecal pollution, oil pollution, toxic contaminants, visual pollution, air pollution, odour, thermal pollution, salinization, causing diseases, down grading of the mineral deposits, and other related environmental issues.

Results and Discussion

Tsunami waves were enormous and had a considerable impact on the western and southern coast of Sri Lanka. Geo-environmental impacts due to the tsunami are

1. erosion due to mechanical strength of tsunami wave
2. sediment deposition due to wave energy changes
3. contamination due to saline water intrusion

These impacts were affected in different ways to different geo-environmental features (Beach profiles, coastal mineral deposits, coral beds, ground water soil, etc.) in the southern and western coastal areas.

Effect on beach profile

Tsunami waves could either deposit or erode sediments in coastal land area. Present studies show, that many areas in southwestern coasts are dominated by erosion rather than deposition. Most of the beach areas show at least 300m of erosional zone while deposition predominated afterwards. Deposition of tsunami sediments were observed even at 1 km distance (about 1-2 cm) in areas at Yala near Mahasilawewa. These erosional and the depositional pattern of tsunami sediment can be used to reconstruct tsunami wave properties (Minoura et al., 1997). Considerable amount of sediments have eroded from this 300m zone as you can see from the fig. 1

Fig.1: Extensive erosion of beach sediments at Yala national park

Tsunami erosion has created deep water near the shore allowing waves to break much further inland than usual (Fig. 2). This may cause further coastal erosion especially during south western monsoon.

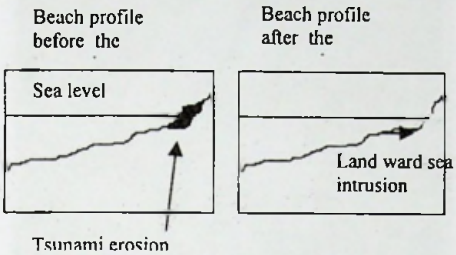

Fig. 2: Beach profile change before and the after tsunami

Effects on mineral deposits

There are considerable amount of mineral deposits such as heavy mineral sands, corals, construction aggregates, salt and gypsum, located along the southern and western coastal belt of Sri Lanka

Effects on Beach Sand and Heavy minerals

Due to the heavy erosion within the near shore 300m zone along most of the tsunami affected coastal belt considerable amount of sediment had been removed and dumped further inland, as observed in Yala National Park (Fig. 2). Most of these coastal sediments are enriched with heavy minerals such as garnet, ilmanite, rutile and monazite. Erosion by tsunami has removed large amount of these heavy minerals from the coast line and dumped further inland in a wide scattered area. Therefore, these potential placer deposits might have degrade up to certain level by tsunami.

Fig. 4: Heavy mineral rich beach sand deposit from Beruwela area

Effects on Salton

Hambanthota and Bundala are two of the major salton which produces rock salts and gypsum to the requirement of country. Tsunami has severely impacted on both these saltons destroying infrastructure including roads, and water ways, those bring sea water into the salton. Heavy deposition of sand has filled most of salton fields causing massive capital expenditure to renovate them. Tsunami waves have broken part of the sand bar (Fig. 3) which separated salton and the sea bringing large amount turbulent water causing wide spread damage including (Fig. 4) death to many people. Since most of the death bodies were recovered from the salt domes people are still reluctant use such salts for their food requirements even though necessary cleaning has done, putting much pressure on the saltons to recover from this economic disaster.

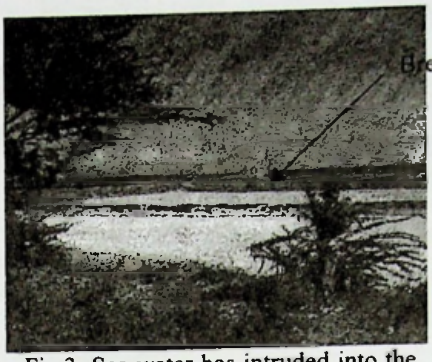

Fig.3: Sea water has intruded into the salton breaking part of the sand bar that separated sea and the salton

Fig.4: Severe infrastructure damage to the salton

Effects on live corals and inland corals

Tropical subtropical conditions are an ideal south western coastal zone of Sri Lanka was an ideal location for coral growth similar to Widespread coral reefs were observed in these parts of the country. These coral reefs have acted as a barrier to retard tsunami waves. The areas where people have damaged this coral reef has severely exposed to the tsunami wave making unprecedented damage such areas as where the train tragedy has taken place. Tsunami has broken some parts of the corals by its mechanical strength.

There is considerable number of coral debris scatter (Fig. 5) around the western and southern coastal area.

Fig. 5: Scattered coral fragments in Ussangoda area

Particularly in Ussangoda area there were large amount of scatted unbleached (which indicates the freshly broken coral from a live reef) fragments. However, there was not any significant damage to the Ussangoda serpentinite deposit by tsunami, understandably since this deposit forms very positive relief even though located in coastal zone.

Southern and western coastal belt also characterized by large inland coral reefs running parallel to the coast. These corals were probably resulted during Holocene maximum sea level condition. During the recent past unauthorized as well as authorized coral mining was widespread in this region. There were large number excavated pits in these areas which were mostly or partially filled. Tsunami has re-excavated (Fig. 6) these partially filled pits and filled them with contaminated water causing epidemic threat,

including mosquito problems. In addition, most of the tsunami debris was dumped into these pits turning these pits further deteriorating them.

Fig.6: Inland coral pits were re-excavated by tsunami

Soil and Ground water contamination

Tsunami has brought large amount of sea water inland sometimes inundating distance more than 2kms. Considerable amount of water should have been impregnated the coastal soil and the aquifers. Most of the dug wells from which people gets drinking water in the south western coastal area still remains saline (Pres. Com with people in the area). In addition, most of the pits dug for excavation of inland coral has filled with sea water possibly along with other contaminants in the sediments making the underneath sandstone aquifer further salinated by slow seepage of sea water remained in those pits even after several months of tsunami.

Conclusion

Tsunami had multiple effects on southern and western coastal geo-environmental features.

1. Severe beach erosion (could be a major problem in the future causing even a smaller storm a significant coastal flooding).
2. Erosion of potential heavy mineral deposits.
3. Re-excavation of the coral pits creating potential threat to be a source of epidemics.
4. Destruction of live coral reefs.
5. Salinization of the soil and coastal sand stone aquifers.

Immediate actions have to be taken to study these areas in detail especially to understand changes of beach profile and to demarcate an area for possible flooding by storm events (which is usually more frequent than tsunami events). Re-excavated coral pits should refill, immediately. Relationship between soil salinity and crop damages has to be studied. Long term study on water quality of coastal aquifer (considerable amount of Sri Lankan population depends on this coastal aquifer) has to be started soon. Based on such detailed studies, Sri Lankan government must get the leadership to build an effective disaster management program not only for future tsunamis but also for other disasters such as floods, storms, earthquakes and landslides.

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