A Study on Evolution of Koggala Lagoon during the Holocene

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Introduction

Climate change will have significant impacts on the oceans and on the coastal zone at a global scale. It will introduce new hazards and increase existing hazard potential, both with respect to magnitude and frequency of occurrence, in coastal regions. The hazards would be sea level rise, storm and tsunami events. Sea level rise is one of the major problems experienced by many nations including Sri Lanka

Sediment entrainment in the coastal environment is changed according to the climate changes. So their sedimentation rates also change, depending on the type and its magnitude. Therefore, the past depositional environments of sediments and their provenance can be identified by studying the physical, chemical, biological and textural properties of sediments preserved in coastal environments. This helps to understand the past environmental changes, which can also be expressed as “studying the paleo-coastal environmental evolution”. Indeed this evolutionary history can be used to interpret past and future environmental aspects in order to build a more comprehensive framework to understand the behavior of the natural system. This study attempts modeling the evolution of the Koggala Lagoon in Southern Sri Lanka in the said context.

Methodology

Two continuous sediment cores KG 1 and KG 2 were extracted from the Koggala Lagoon. KG 1 was extracted closer to the sea side (1100 m) and KG 2 further 1900m inland from the sea. Both cores were logged and photographed. Organic matter content was analyzed by Loss on Ignition (LOI) method and dry sand percentage was calculated by wet sieving with 63 μm sieve. Geochemical variation of sediment cores was analyzed using handheld X-ray fluorescence analyzer (Bruker S1). Gamma ray intensity and concentration were analyzed using gamma ray spectrometer for the two cores. Sub-samples taken from different depositional environments and recognized events were identified through the binocular polarized microscope. Data were plotted using Pan Plot software. The ages for the boundaries of mid-Holocene sea level variations and recognized events were approximately calculated using the published regional age models equation (Ranasinghe*et al*., 2013.).

Results and Discussion

Physical, chemical, textural, and biological properties of sediments in cores were used to distinguish the stratigraphy and the provenance of sediments. According to the evidence three correlating stratigraphic units could be identified in Koggala cores. Core KG 1 contains Unit I, Unit II and Unit III while core KG 2 has Unit I and Unit II. Unit II shows evidence for marine influence while Units I and Units III characterize terrigenous conditions.

Unit III provides clues for a closed lake system with less marine influence and low energy environment. Terrestrial proxies and beach elements in Unit I show the end of marine influence which started from 52 cm. Unit II in both KG 1 and KG 2 cores represents a lagoon/bay with direct marine influence and a higher-energy environment due to its opening to the ocean. This

Unit II suggests that the sea level rose above the present level at about 5594 yrs before present (BP) and reached the present level around 2195 yrs BP, after several fluctuations. Unit I in both KG 1 and KG 2 cores represents a lagoon/bay with high energy estuary with less marine influence.

Three natural hazards were identified according to the results in the depth of 136 cm, 116 cm and 29 cm in both KG 1 and KG 2. The ages of the previous hazards were respectively 4520 yrs BP, 4022 yrs BP and 2004 AD. These events are recognized as tsunami. Koggala cores provide evidence for the end of submergence in southwestern coastal plain of Sri Lanka by the Holocene transgression approximately 2195 yrs BP. This age is closely related to the 3000 yrs BP, 3000-2000 yrs BP and 2100 yrs BP ages for falling of the Mid-Holocene highstand to the present sea level in Sri Lanka (Ranasinghe*et al*., 2013; Katupotha, 1995; Ramsay, 1995), and Maldives (Kench*et al*., 2009) respectively. Also these cores provided evidence for significant paleo tsunami event occurred in southwestern coastal plain of Sri Lanka which was approximately 4022 yrs BP. This age is closely related with Ranasinghe*et al*. (2013).

Conclusions

Koggala in southern Sri Lanka show coastal changes in response to relative sea level changes during the Holocene. Stratigraphy, biological assemblages, physical, and chemical properties of sediment including texture provide evidences for the reconstruction of the coastal environment and sea level variations. Three stratigraphic units could be recognized in both cores KG1 and KG2. A closed lake system with less marine influence and low energy environment could be recognized by unit III. Unit II in both KG 1 and KG 2 cores represents a lagoon/bay with direct marine influence and a higher-energy environment due to its opening to the ocean. Unit II is indicative of sea level rise above the present level at about 5594 yrs BP and reached the present level around 2195 yrs BP, after several fluctuations. Unit I in both KG 1 and KG 2 cores represents a lagoon/bay with high energy estuary with less marine influence. This narrative can be considered as the evolution history of Koggala lagoon has been evolved during the recent epoch of Holocene.

Three natural hazards were identified according to the tsunami deposits in the depth of 136cm, 116cm and 29cm in both KG 1 and KG 2. The ages of the previous hazards were respectively 4520 yrs BP, 4022 yrs BP, 2004 AD. These hazards were mentioned as a tsunami. According to the age estimates, Holocene transgression and the recognized events that correlate with local and regional records.

References

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