Occurrence and Depositional Character of Monazite Deposit in the Offshore and Coastal Zone around South-West Region in Sri Lanka

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Abstract : Onshore or offshore, ocean offers us a larger number of industrial minerals. Monazite is one of these minerals found on beach placers in north eastern and south western coastal region of Sri Lanka. Our study area, both onshore and offshore from south western region, encompasses Induruwa and Polkotuwa. This research is focused on analyzing the depositional character of monazite and to evaluate the suitability as an ore deposit. Our methodology comprised of in-situ sampling periodically in predetermined locations and laboratory testing for monazite concentration by grain size analysis and observation though microscope. Results show significant correlation between the monazite concentration in the coastal zone and monsoonal changes. Further, accumulation of this Monazite is significantly controlled by coastal morphology. However, the absence of monazite in the offshore region contradicts with United Nations Revolving Fund for Natural Resources Exploration results. In this study, we have identified three coastal areas; Maha Induruwa, Kalutara and Polkotuwa for exploiting Monazite as an ore deposit. In these hotspots, Monazite concentration ranges from 2.2 % to 9.1%, especially during south western monsoon. Therefore we propose to mine them only during south western monsoon, digging 1m surface layer and extracting monazite by collecting only <256μm fraction.

Key Words: Monazite, Kalu ganga, offshore, Monsoon, sediments

1. Introduction

Sri Lanka being a country that owns a larger area as its Exclusive Economic Zone, more than eight times land area of the country, it is natural to look forward for the future with the benefits of ocean. Regardless of onshore or offshore it offers us a larger number of industrial minerals. Monazite is one of these minerals commonly found on beach placers in north eastern and in south western coastal region of Sri Lanka.

Monazite becomes important since it is the ore mineral for Thorium,

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Lanthanum and Cerium. In addition it can be used as a catalyst in oil refining. Because of their high density monazite minerals concentrate in alluvial sands when released by the weathering pegmatites.

The beaches of Sri Lanka are rich with various sands such as Ilmenite, Rutile, Monazite, Zircon, Garnet and Silica. The largest deposit of mineral sands is found in Pulmoddai, a beach placer deposit along the eastern coast. Large monazite and garnet deposits have also been discovered at Beruwala and Hambantota beaches. In this study, we are mainly focused on understanding the depositional character of the Beach and offshore Monazite placer deposit in the south-western coast of Sri Lanka.

2. Material and Methods

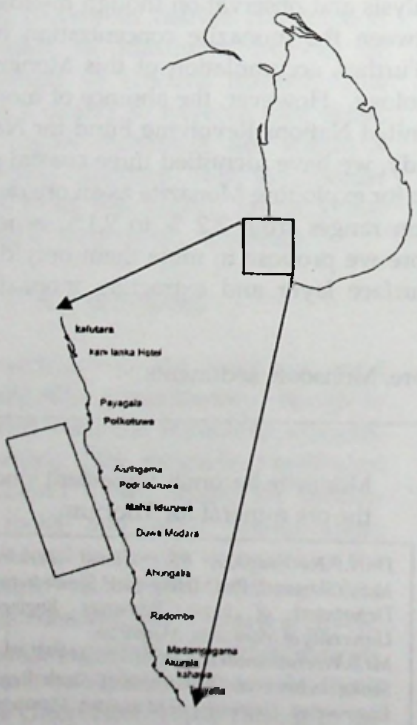

Fig. 1 Onshore and offshore sampling locations

2.1 Sampling

Beach survey

On shore sand sampling was carried out along the coast from Telwatta to Panadura in south west coastal region to investigate the monazite concentration with the seasonal changes.

Table 1 Onshore sediment sampling

Filed Visit No.	Monsoon Period	Date
1	South Western	23.10.2009
2	North Eastern	05.03.2010
3	Inter	29.04.2010
4	South Western	17.06.2010

Field visit along Kalu Ganga was carried out on 15th May 2010 to collect river sediment samples.

Offshore survey

An Offshore field visit was also conducted around Beruwala area to collect surface sediments samples from the seafloor on 1st and 2nd of November 2009. Sediments were collected in 1km x 1km grid, using a grab sampler (Fig. 1).

2.2 In Laboratory

Sieve analysis

Samples were dry sieved using 2mm, 850µm, 500µm, 425µm, 250µm, 180µm, 125µm and 75µm sieves after shaking four 5 minutes.

Microscopic study

The retained fraction after the 250µm sieve of each sample was separated, (since it showed highest Geiger reading always) and examined under the gemmological microscope with a magnification of 2x10. Three thin sections from each sample were studied spreading sediments sparsely on a glass slide (Fig. 2). Monazite percentages were calculated by grain counting using a square of (1x1) mm drawn on the glass slide.

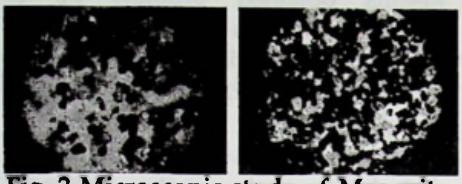

Fig. 2 Microscopic study of Monazite grains

3. Results and Discussions

The obtained onshore results show the variations of the Monazite percentages in different locations (Fig. 3). Mahainduruwa, Polkotuwa and Kaluthra had the highest percentages of Monazite in all four sampling periods. However, these values were significant during south western monsoon (e.g. Mahainduruwa had 9%) whereas during North-eastern and inter monsoon periods monazite concentration has dropped by several folds (e.g. Maha Induruwa had almost no monazite during North-eastern monsoon while during the inter monsoon monazite percentage was close to 3%).

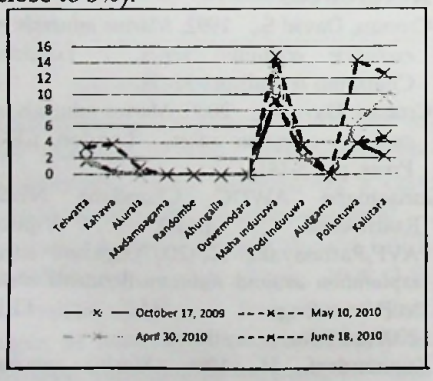

Fig. 3 – Average Monazite percentages

During south western monsoon ocean become more dynamic, leading significant coastal erosion resulting heavy minerals including Monazite to remain in the coastal zone removing lighter quartz and other minerals.

Periodic Variation of Monazite concentration during these periods may not only function of monsoon and the resultant wave regime but also can be a function of coastal morphology. Our study locations had diverse coastal morphology with bays, straight beaches (broad/narrow) and headlands. Some of these locations also had cusp features. Usually Bays with cusp features are more favourable for monazite deposition (e.g. Maha Induruwa and Polkotuwa) whereas headlands and straight beaches are less favourable.

Study on Kalu Ganga sediments reveals absence of Monazite including any heavy mineral. Even the sand collected from the sand miners showed similar results. However, sediments collected from the 1st 1km along Kalu ganga had higher values of heavy minerals including Monazites. This region usually not mined for sand and therefore the heavies could most probably come along with the flood derived from the upstream sources.

On the other hand, offshore study for Monazite shows total absence of heavies including monazite. However United Nations Revolving Fund for Natural Resources Exploration (UNRFNRE) in 1997 (Fig. 4) has shown higher presence of monazite with other heavy minerals in the offshore paleo rivers. Perhaps 2004 tsunami might have removed surface heavy minerals from these particular regions. Besides, our study clearly shows Monazite concentration is just limited to the coastal zone (except in Paleo Rivers) and most probably derived from river source during flood periods.

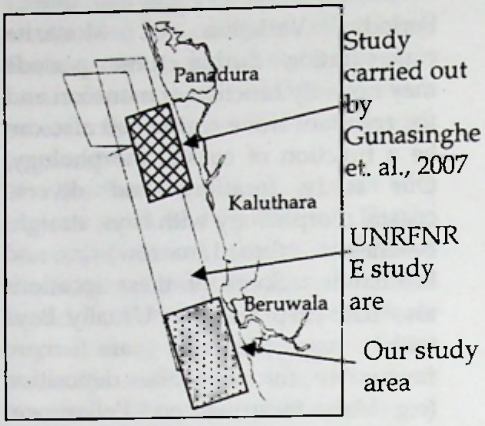

Fig. 4 The study done by United Nations Revolving Fund for Natural Resources Exploration (UNRFNRE) in 1997

We further believes offshore exploration should be carefully planned and limited to known features such as drawn river valleys

4. Conclusions

Textural, structural and mineralogical study carried out on sediment samples collected from both offshore and onshore regions of south western coastal region reveals, depositional character of monazite and its source enabling to access this Monazite as an abundant valuable earth resource. Our results conclude the Monazite deposition in the south western coastal region;

- has a higher accretion during the period of South-western monsoon
- has significant concentration at Mahainduruwa, Polkotuwa and Kaluthara regions
- has no source in offshore
- Likely source in Kalu Ganga and Bentota Ganga
- has the influence of coastal morphology

Results obtained promote us to recommend in-situ mining and sieving at the identified locations; Maha Induruwa, Kalutara and Polkotuwa of monazite bearing sand to separate <250 μm fraction, causing minimum disturbance to the coastal environment.

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