CLASSIFICATION OF GEM-BEARING SEDIMENTARY DEPOSITS IN THE KALU GANGA BASIN, SOUTH-WESTERN SRI LANKA

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Introduction

Sri Lanka is renowned for its production of precious gemstones over a long period of time. The gems are mainly extracted from secondary deposits of Rathnapura Beds in the Kalu Ganga Basin. These sedimentary deposits are filled on broad valleys of the Kalu Ganga Basin that are situated at the frontier between the "Sabaragamuwa Mountain Range" and the middle block of the "Central Highlands" of Sri Lanka (Figure 1). The stratigraphy of the Ratnapura Beds is very complex and their inherited sedimentalogical processes and chronological histories are not yet well known. A comprehensive study on sedimentalogical processes and chronological history on these deposits should be built on a detailed study on stratigraphy. A preliminary stratigraphy for the sedimentary deposits of the Ratnapura Beds was presented by Dahanayake et al., (1980) who suggested that fluvial processes are the mechanisms responsible for forming alluvial deposits. In contrast, Gunatilake (2007) proposed that basin-wide channelized landslides and debris flows are the dominant mechanisms in making these thick piles of alluvial deposits. However, only a comprehensive and systematic sedimentalogical study will disclose the exact nature of sediment delivery mechanisms to the alluvial fills at Ratnapura Beds. Hence, the construction of detailed stratigraphy of the Rathnapura Beds, a prerequisite for a comprehensive sedimentalogical and chronological study, is of high significance and the focus of this research.

Methodology

Dahanayake et al., (1980) have proposed that sedimentary gem deposits of Sri Lanka can be classified as residual, elluvial, and alluvial deposits, but their spatial distribution within the Kalu Ganga Basin is not explained. In this study, about 100 gem pits dispersed in the Kalu Ganga Basin were broadly observed to identify their depositional nature. Each pit was assessed visually to aid in interpretation of the sedimentation

history. Out of them, 7 gem pits located in the lower catchment were selected to study their detailed stratigraphy (Figure 2). Mining of gems was in operation during the time of sampling, and so the walls of the main shaft were protected by timber and vegetation, limiting the number of sample positions. Therefore, samples were collected in all pits at regular depth intervals from 10cm to 40cm depending on accessibility. Samples were then used for grain size determination after burning of organic components. The percentages of clay, silt, sand and gravel (2mm-2cm) present in the layer were used to define a sedimentalogical term.

Results and Discussion

In general, gem minerals in the sedimentary deposits occur in the basal layer (locally known as the "*illam*" layer), which is a mixture of clay, silt, sand, pebbles, cobbles and boulders, immediately overlying weathered bed rock (locally called "*malawa*" layer). In some instances, additional gem-bearing layer(s) are found within the overlying alluvial fill depending on its location.

Detailed observations of this study reveal that five types of gem-bearing secondary deposits occur in the Kalu Ganga basin with a spatial difference in their stratigraphy that is primarily determined by the elevation. In the upper catchment of the Kalu Ganga basin, the area where elevation is ca. 500m above, gem-bearing gravels are mined at two stratigraphic sections that were developed under different geomorphological settings. In this region, gem-bearing gravel layers are accumulated on the bottom of stream valleys and can be categorized as shallow alluvial deposits. In the upper catchment, gem minerals are also trapped on the hillslopes and occur as elluvial deposits developed on hillslopes. Similar to the upper catchment, alluvial deposits are developed on the stream valleys in the middle catchment of the Kalu Ganga Basin where the elevation ranges from ca. 100m to ca. 500m. Elluvial deposits are also characterized on the hillslopes in the middle catchment of Kalu Ganga Basin. The lower catchment of the Kalu Ganga basin where elevation is below ca. 100m is characterized by the presence of only one type of sedimentary deposits i.e. deep stream valley deposits, and can be termed as deep alluvial deposits. Mineralogical and textural studies revealed that these five types have distinct differences.

Alluvial deposits found in the lower catchment of the Kalu Ganga basin are very deep, characterized by a number of strata, inhomogeneous in composition and texture indicating that they are formed by a series of geomorphological processes. These deposits should be influenced by sea level changes and climatic fluctuations in the region and will be ideal proxies for paleo-environmental and sea level change studies. Therefore, detailed studies were carried out in 7 selected alluvial deposits in the lower catchment of the Kalu Ganga Basin to investigative their textural characteristics. These alluvial deposits form as a result of weathering, hillslope transportation, fluvial transportation along the steeply flown rivers and then gemstone deposition in lower gradient settings. They are mainly found in ancient river beds, ancient flood plains and modern flood plains, typically close to tributaries and the main trunk of Kalu Ganga River. Generally, the gem-bearing layer, which contains coarse grains of quartz and rock fragments together with fine heavy minerals, occurs as a basal layer at the base of the section, immediately overlying weathered bedrock. In this study, the basal layer is interpreted to be mid-channel deposits in a palaeochannel bed formed on bedrock. A thick alluvial fill has accumulated subsequently overlying this basal layer. One or more coarse layers with gem potential, but with grain-sizes finer than those in the basal layer, are found within the alluvial fill (Figure 2).

Conclusion

Five types of sedimentary gem deposits can be observed in the Kalu Ganga basin. They are (i) elluvial deposits on the hillslopes, (ii) shallow alluvial deposits in the stream valleys of the upper region of the basin, (iii) elluvial deposits on the hillslopes in the middle region of the basin, (iv) alluvial deposits in the stream valleys of the middle region of the basin, and (v) deep alluvial deposits in the river valley of the lower catchment. Further, alluvial deposits in the stream valleys in the lower catchment were found to be most significant for paleo-climatic studies because their deposition pattern have responded to paleoclimatic fluctuations and sea level changes. In the alluvial deposits of lower catchment, the gem-bearing basal layer, deposited as a mid-channel deposit on the bedrock palaeochannel bed, can be clearly distinguished from the alluvial fill that has accumulated by deposition of suspended load. One or more coarser layers with gem potential also occur within the

alluvial fill in the lower catchment, which can be recognized as fluvial mid-channel deposits overlying alluvium and/or point bar deposits.

References

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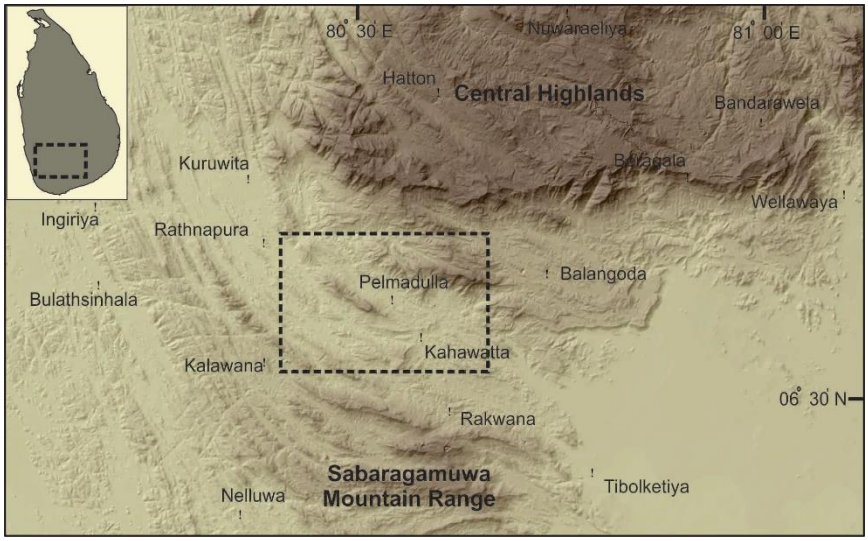

Figure 1 Elevation model showing alluvial deposits in stream valleys of the lower catchment of the Kalu Ganga Basin and location of the seven gem pits sampled (within the rectangular box).

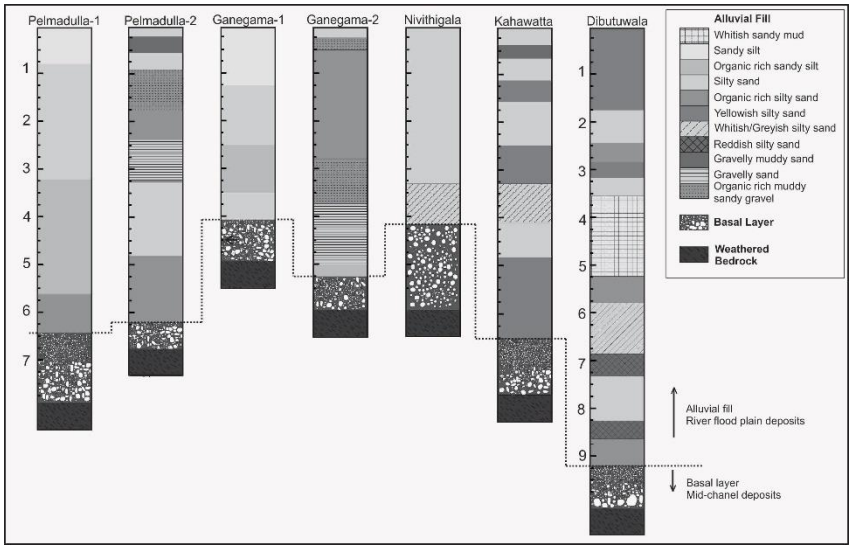

Figure 2 Stratigraphy of the seven sections in the Rathnapura gem field highlighting the basal layer, alluvial fill and its sub-units.