ORIGIN OF THE SILICA SAND DEPOSITS IN WESTERN SRI LANKA WITH SPECIAL EMPHASIS TO THE EKALA DEPOSIT

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INTRODUCTION

Among the sources for the quartz (silica) which are found in Sri Lanka, including vein quartz, quartz sand and quartzite, more attention is paid on quartz (silica) sand because silica sand is the major raw material used in manufacturing glass owing to its specific features being fine graded, white in colour and high purity making its commercially viable. Few commercially extracted silica sand deposits are known to occur in western Sri Lanka at Nattandiya, Marawila, Madampe, which extend towards south of Colombo as sporadically distributed deposits. The deposit intercalated with the marshy and lagoonal deposits, which has considerably acidic peaty soils and underlies the Precambrian metamorphic rocks. Relatively undisturbed deposit of silica sand has been recognized at Ekala, the territory of the Sri Lanka Air Force premises, which appeared to be of aeolian origin, has been unconfirmed until the present study (Fig.1). The objectives of the study were to (i) establish procedures for interpreting the provenance of silica sand deposits located at the west coast referring to the undisturbed deposit at Ekala and (ii) to study the effect of peaty layers to change the colour of silica sands from usual brown to white colour. Here we present mineralogical, sedimentological and geochemical evidence to prove the origin of silica sand deposits in the west of Sri Lanka.

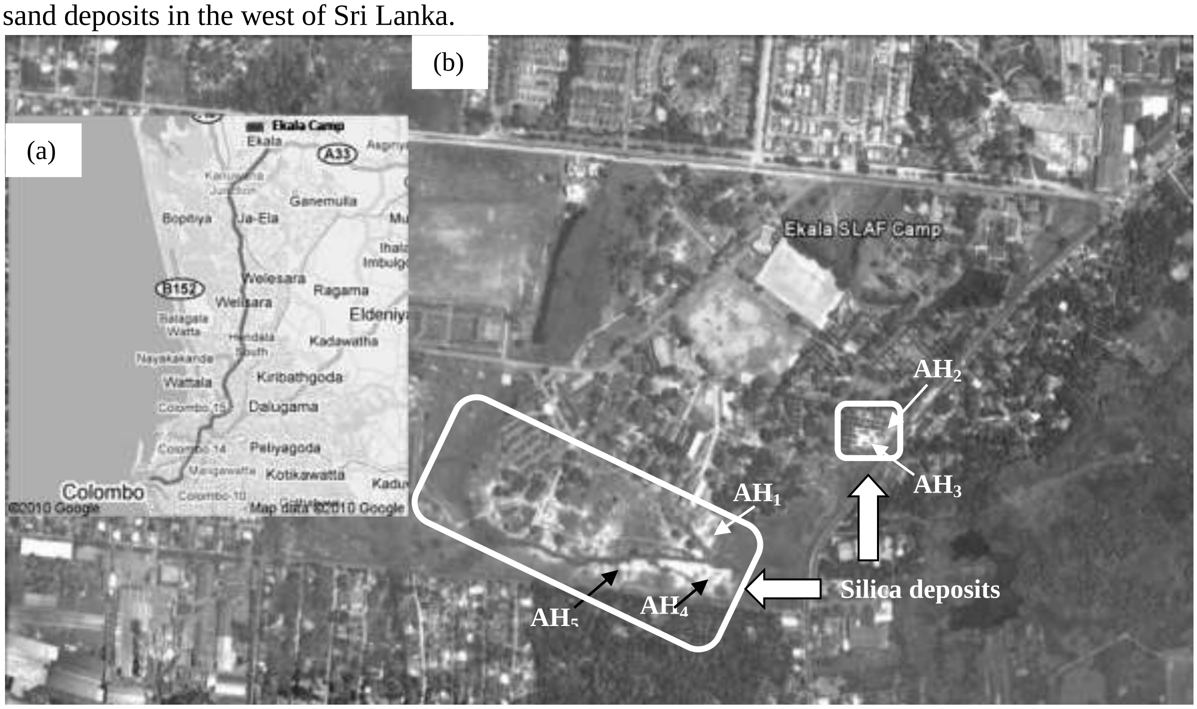

Fig. 1: (a) Road map to Ekala; (b) Aerial view of the Ekala Sri Lanka Air Force Camp *(Note: the occurrence of silica sand deposits are visible in white colour in aerial view)*

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METHODOLOGY

Five representative augur holes (AH_1, AH_2, AH_3, AH_4 and AH_5) were made up to 4 metres within the silica sand deposit. Out of which, layers comprised of white colour coarse- to medium silica sand, yellowish brown clayey sand, dark brown peaty sand and black peaty sand with different thicknesses. Samples were taken from each distinct layer from each augur hole and carefully obtained the representative homogeneous samples using cone & quartering method, especially for wet samples whereas riffle splitter was used to separate dry samples. Samples were weighed and wet sieved with 63 µm mesh to get rid of all silt and clay fraction and soluble ions. They were oven dried at 105 ^{o}C. Samples were then sieved using a series of meshes according to the Went Worth scale using the Rot- Tap shaker. The weight of separated samples according to the grain was used for mechanical analysis at the petrological laboratory of Geological Survey & Mines Bureau. Degree of sorting of the sand deposits were measured, frequency curves, cumulative frequency curves were compiled and standard deviation, skewness were calculated using the data obtained from each fractions of augur holes. Textural maturity of sand grains was observed after they were separated by the bromoform and magnetic method followed by optical examination using binocular microscopy. Laboratory test was performed to demonstrate the possibility of removing the sulphidic, hematitic and manganese coating of brown coloured silica sand. This was facilitated by using brown coloured sand, which was treated with 5 ml of dil. HCl in a glass tube and then gently warmed in a water bath for 15 minutes. The suspension was then decanted and few drops of potassium ferrocyanide were added to observe the change of colour.

RESULTS AND DISCUSSION

The grain size distribution of the quartz-bearing layer and the adjacent layers is generally bimodal, varying from coarse-sand to fine-sand (Fig. 2). However, locally the quartz grain size displays gradual transition from coarse-sand to silt. The relative larger mode lied at coarse fraction. So often the smaller mode was at the fine-grained sands. The sand sized-grains are sub-angular to sub-rounded, poorly sorted and positively skewed. They are free of coated with rusty sulphidic, hematitic and manganese staining, which is commonly seen in beach sands.

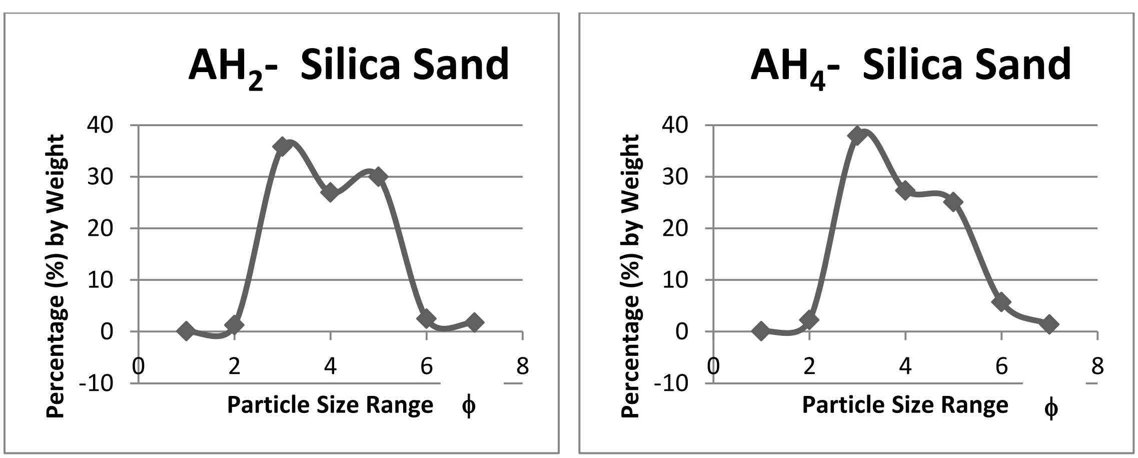

Fig. 2: Representative grain size distributions of the sand samples taken from two augur holes, which indicate a similar composition being composed of bi-modal distribution

As the shape of the grain-size distribution curve varies greatly between samples of different origin frequency plots of the grain-size distribution are particularly useful for identifying the distribution types of the grain-size components in the sample. It has long been recognized that the grain-size distributions of most hydraulic and aeolian sediments were bimodal or polymodal and represent different transport or depositional processes (Bagnold and Barndorff, 1980). Cumulative curves observed in these boreholes AH_2 and AH_3 suggest that it is bimodal and low energy fluvial sand deposition in dominant. Cumulative curves observed for silica sand deposits in the augur holes of AH_4 and AH_5 were recorded in the entire sigmoidal curves (Fig.3), which are identical for wind-blown deposits whereas black peaty sands recorded significant bi-convex curves (with break in S-shaped curve), which implied the sediments contain the material graded to two sizes. The sand deposits found in peaty layers may have been derived from wind-blown deposits and later occur as low energy fluvial sand deposits. The absence of very fine particles from the composition of sediments indicates energetic sedimentation conditions which prevented these particles from depositing.

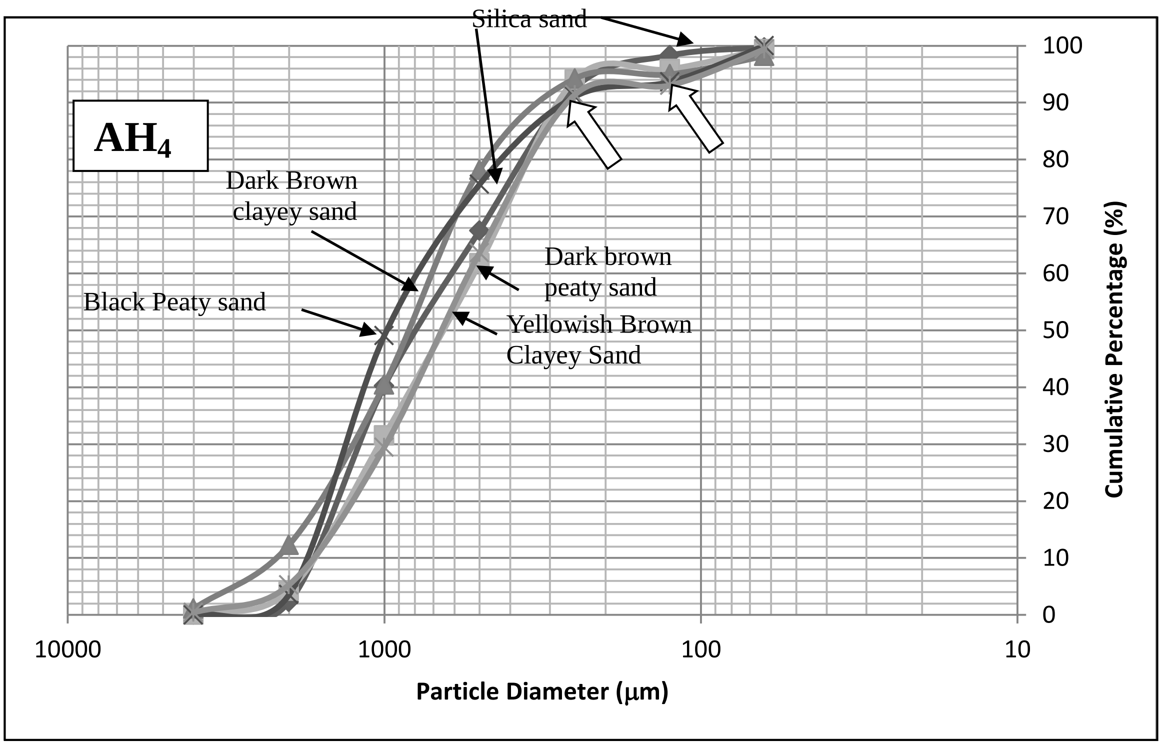

Fig. 3: Frequency Cumulative Curves for sediments in the Augur Hole AH_4 ***(Large open arrows are these 'breaks' assuming overlapping Normal distributions)***

Here, all the silica sand samples which were analysed were possitively or fine skewed. Aeolian deposits (wind-blown deposits) show positive skewness due to the partial winnowing of finest grains out of the deposits (Tucker, 1981). Therefore it is inferred that these sand deposits should have initially an aeolian origin and later subjected to action of water in the lagoon environment. It is shown that grain-size data from samples from the transition of fluvial facies to wind-blown deposits in sediments of Ekala Air Force premises.

More than 95% of quartz contributed to the total mineral composition of silica sand. It inferred that the purity of the samples was in a sufficient level to be utilized commercially. The other silica sand deposits which have been found along the western coastal belt namely Naththandiya, Maravila, Madampe and Rathmalana has shown identical characteristics as Ekala deposit. All of these silica sand deposits are associated with mashlands, swamps and lagoonal environments, for instance, the well known Muthurajawela swamp, which extends towards Negombo in the north and towards Kalutara in the south. It is said that at time when land is inundated due to sea level rose within the last 10,000- 30,000 years (Senaratne & Dissanayake, 1990), sulphate in the sea water get mixed with land sediments containing iron oxides and organic matter forming acid sulphate soils. Here in this study, it was observed that the occurrence of a peaty sand layers just beneath the silica sand layer. Being silica sand at the top of peaty layer is an evidence to infer that silica sand deposition had been occurred after the derivation or authogenic creation of peat layer. Thus silica sand layers get a great chance to get washed out with acidic water i.e. by the diluted sulphuric acid, resulted by acid sulphate soils of the place. There is a very shallow water table in the area which is just about 2 m depth from the surface even during the dry season. Often the water level fluctuates with the precipitation and consequently rises up even to higher levels. During this time water logged condition are created which is further facilitated by swampy environment in the area. Thus silica sand layers get a great chance to get washed out with acidic water i.e. by the diluted sulphuric acid, resulted by acid sulphate soils of the place. Usually, iron oxides in silica sand dissolve when they are rinsed with acids to appear as pure white colour characteristic to pure quartz. The process was experimentally demonstrated at the laboratory at the Geological Survey & Mines Bureau. Incidentally, silica sand deposits found in Ampan-Wallipuram in northern Jaffna Peninsula are brown coloured, like beach sand deposits, because of the absence of peaty layers or acid sulphate soils to remove the iron coating of sand grains.

CONCLUSIONS

These results infer that the silica sand deposits located at the Sri Lanka Air Force Premises in Ekala are aeolian in origin and later was subjected to reworking in the lagoonal environment and its typical white colour is resulted by the continuous washout if the iron coatings of the grain with the acidic water created due to the presence of peat beneath silica deposits. Finally, it can be satisfied with the purity of the deposits which meet the necessary requirement to be utilized commercially.

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ACKNOWLEGMENT

Authors wish to thank the chemical and petrological laboratories of the Geological Survey and Mines Bureau for providing analytical facilities.