Review Of Literature On Geology Of Silica Sands

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Abstract: Silica is the name given to a group of minerals composed of silicon and oxygen, the two most abundant elements in the earth's crust. Silica is found commonly in the crystalline state and rarely in an amorphous state. It is composed of one atom of silicon and two atoms of oxygen resulting in the chemical formula SiO2. Sand consists of small grains or particles of mineral and rock fragments. Although these grains may be of any mineral composition, the dominant component of sand is the mineral quartz, which is composed of silica (silicon dioxide). Other components may include aluminum, feldspar and iron-bearing minerals. Sand with particularly high silica levels that is used for purposes other than construction is referred to as silica sand or industrial sand. Two general types of sand: 1-Naturally bonded (bank sand) 2-synthetic (lake sand) For a particular source of sand to be suitable for glassmaking, it must not only contain a very high proportion of silica but also should not contain more than strictly limited amounts of certain metallic elements. Silica sand is also normally required to be well-sorted, i.e. to have grains of an approximately uniform size. Most sources of sand used by the construction industry do not satisfy these requirements and are not, therefore, suitable for glassmaking. Industrial uses of silica sand depend on its purity and physical characteristics. Some of the more important physical properties are: grain size and distribution, grain shape, sphericity, grain strength and refractoriness.

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Introduction

Silica sands, one of the mineral resources of the coastal zone of Tamilnadu calls for an intensive study on their distribution, modes of occurrence, chemistry of the deposits available in the region. The deposits have a potential to contribute to the development of the industrial economy of the state (Indian Mineral Year Book, 1999). The deposits are confined to the surface in the coastal area with a uniform width, limited overburden and only with minor variations. Sands of a specific grain size and composition are concentrated in these locales are unique. Development of civilization goes hand in hand with the knowledge about our earth. The geological processes play a great role in carving the face of earth bringing out volumes and volumes of earth history as igneous, sedimentary and metamorphic rocks. The rocks, as the pages of a book formed by geological processes have both economical and geoscientific values. Not only the well formulated layered sediments but also the detrital particles do assume a separate body of deposition proving them to be worth enough for study purposes and economic feasibility.

The light minerals constitute primarily of quartz, feldspars and lithic fragments. These detrital light minerals experience a long transportation resulting in the predominance of quartz sand (Silica) and fewer amounts of feldspars, with formation of altered clays as accessory. Generally, feldspars lack the strength of being stable enough to protect themselves from long-term weathering and transportation. Silica, a cent percent qualified detrital mineral is in abundance as sand with almost 100% purity, proves to be the rich resource for glass industries. Eventhough the deposits are situated along the coastal region a close physical, chemical and geological investigation proves that the sediments to be either of marine process or of others. In this study an attempt is made to understand the relationship between the geomorphic features and the deposits, the depositional environment, chemistry and the origin of the deposits

The duration of each of this geological process (pertaining to formation of silica sand) has a significant role and effect on the sedimentary deposits resulted. Rapid erosion, transportation and deposition will not greatly enhance the concentration of quartz in the sedimentary deposits, nor will they greatly affect the shape of a quartz grain. Prolonged chemical weathering at the source coupled with transport of that sedimentary detritus in a long fluvial system and extensive mechanical reworking at the site of deposition as beach, etc., would greatly enhance the concentration as well as the shape (roundness) of the detrital quartz grain. The formation of a viable ore

body is mostly nonachievable in one erosional and depositional cycle.

Cuddalore sandstone is a Mio-Pliocene formation found to occur in detached patches from Marakkanam to Sivaganga (Southern Tamilnadu), in the western margin of the Cauvery sedimentary basin, and also in the area north of Madras, which extends into the adjoining Andhrapradesh state. These Cuddalore sandstones develop uplands invariably in all their locations with or without laterite capping. These uplands are formed due to differential erosion that results in the occurrence of laterite capping which is more resistant to erosion than the adjoining formations. The laterites are resistant to erosion because they become hard like a brick, when exposed to rain and sun, alternately. In the study area Cuddalore sandstone uplands are found to occur in the north and northwest of Kaliveli lagoon, and its height ranges from 10 m to 80 m. The removal of laterite from these uplands during anthropogenic activity makes this upland subject to fast erosion and as a result, deep gullies and badland topography have been developed in some places. The top of this upland is, generally, horizontal to gently sloping towards east.

Review of Literature:

Research works are proliferating in the fields of sedimentology and sedimentary petrology as a whole. Enormous descriptions, valuable ideas and excellent research works are pouring in on delineating the physical, chemical, petrological and geological aspects of sedimentary rocks, right from the normal sedimentary classifications to the till dated instant computer classification. Analyzing the environment of rock formation possesses to be the main study of geology under any branch, can unlock various puzzles about the geology of the area and especially about the rock like their parent rock, mode of weathering, medium of transportation, distance of transport with the environmental settling and setting. Grain size analysis even though was introduced during earlier part of 20th century attained its maximum usage during later half of the century.

Environmental information has been drawn from grain size analysis by the pioneer researchers, like Udden 23 (1914) and Wentworth (1929); with others like, Krumbein (1936), Otto, (1939); Keller, (1945); Douglass, (1946); Van Andel and Poole, (1960); Inman and Chamberlain, (1955); Davadarini et. al., (1977) have described the major factors of differentiation of sedimentary materials in relation to grain size analysis. Passega, (1957 & 1977) has proposed CM pattern to distinguish the mode of transportation from the values of first percentile and median. By means of sub-process like rolling, saltation and suspension within the sediments deposited, Visher, (1969) has suggested the method of using the lognormal curves for classifying the various environment of deposition of sediments. Friedman (1961 & 1967) has attempted to discriminate the varying environments like dune, beach and river by using textural parameters. Friedman (1979) has delineated the population of particle among the sands of various origin is also a factor to be studied by their difference in their size distribution.

Martin (1965) has illustrated by comparison of skewness and kurtosis of any area, interpreted various paleo environmental setting for the sediments. Mason and Folk (1958) have proposed the plot of skewness Vs kurtosis to differentiate the beach coastal dune and aeolian flat sands. 24 In order to find out the mode of transportation and the energy level of the sediments during transportation and deposition, CM pattern was prepared by using median and first percentile (Passega, 1964 & 1977). Visher (1969) has proposed log probability curve, in order to identify the various depositional processes using grain size distribution pertaining to the different sedimentary landforms. In India, many leading works have been accomplished using grain size studies. Rajamanickam and Gujar (1984 & 1988) have envisaged beach to dune type of environment for Kalbadevi bay: beach to barrier island type in Mirya bay and river to lagoon type of environment for Ratnagiri bay. Rajamanickam and Gujar (1985) have discussed elaborately the deviation of CM pattern from the ideal pattern proposed by Passega (1964). The role of Bhatia river in the deposition of recent sediments in the Ratnagiri bay in uniform suspension and retention of preHolocene depositional characters by graded suspension.

Rajamanickam et. al., (1986) have suggested probable riverine environment for Jaigad bay, beach environment for Ambwah bay and dune environment for Varvada bay. Patro (1993) has studied the size frequency distribution of quartz sand particle in untransported sediments and identified the origin of the sands. Karikalan (1996) has reported that the Quaternary formations consisting sediments of fluvial, fluvio-marine and marine regime using the grain size distribution. 25 Angusamy and Rajamanickam (2006) carried out Grain size studies of sediments from beaches in the region from Mandapam to Kanyakumari, divided into sectors, found out the beach, riverine and dune environments with low to high energy conditions. Chandrasekar and Rajamanickam (1999) have identified the three different types of environment of deposition from the grain size studies of the sediments of Central Tamil Nadu coast. Rajesh et.al (2007) analyzed the Grain size distribution of Silica sands in and around Marakkanam Coast of Tamilnadu, classified the three different groups of grain size regions. They found out the Fluviatile and the aeolian origin for the silica sand

deposits in this area. Selvaraj and Ramasamy (1998) have made an attempt to find out the depositional environment of Cuddalore sandstone formation, Tamilnadu, with the help of sedimentological and geochemical study. Anbarasu (1994) has stated that the present coastal configuration and the paleo coastal configuration could be studied in detail using the grain size distribution analysis from the sedimentary particles obtained through various landforms. Udayaganesan and Rajamanickam (1995) have inferred the depositional environment of Vaippar basin using the grain size distribution of the sediments in the basin.

Angusamy et. al., (1993) have endorsed that the distribution of grains in the beaches are restricted according to their grain size. 26 Anbarasu and Rajamanickam (1997) have brought out the inherent relations between the channel shifting and neo-tectonism which is exhibited by the disposition of abandoned channels of rivers flowing through the northern Tamil Nadu. Loveson and Rajamanickam (1998) have studied the geomorphic evolution of Rameswaram Island in Southern Coast of Tamilnadu. Mohan et. al., (1998) have reported the presence of Holocene sea level oscillation during the late Quaternary after studying the distribution of grain size. Baskran et.al (2003) have identified some of the geomorphological features as the suitable places for mangrove afforestation in Rameshwaram Island. Loveson and Rajamanickam (1987) have attempted an coastal geomorphological assessment for sustaining the resources using remote sensing as a tool for their study along the southeastern coast of Tamil Nadu. Baskaran, et.al., (2004) have reported the geomorphology of lagoons present in and around Marakkanam area. The stages of formation of lagoons also discussed. Baskaran, et.al., (2005) have found out the relationship between geomorphology with silica sand deposits in Marakkanam area. The study reveals that palaeo barriers, as container for silicasand deposits in the Marakkanam area. Karikalan et. al., (2001) have undertaken a study on evolution of coastal landforms of the Porto Novo region South Arcot district. From the 27 study, it is inferred that the coastal landforms are formed under the depositional condition. Mohan et. al., (2000) have classified Quaternary landforms into inland, beach and offshore regions and also attributed the extension of beaches even up to 25 km inland. Mohan and Rajamanickam (2001) have discussed the depositional environment of Mahabalipuram beach ridges from the core samples and concluded that these sediments might have been the product of palaeo-shallow marine environments having hydrodynamic conditions of deposition similar to fluvio-monsoonal channel conditions. Blatt (1967) has studied the durability of feldspar and quartz index and explained the clastic quartz grains in detail. Bokman (1952) has classified grains with respect to the axial ratio of quartz to indicate the maturity index. Narayana et. al., (1991) have identified silica sands of south Kanara coast and the silica content to be medium sized fraction, and the associated concentration of Al, Fe, Ti forms the finer constituents. Gopal (1983) has studied the silica sand occurrences in Tamilnadu especially, at Marakkanam region and has suggested beneficiation measures for the silica sand to upgrade the quality to reach I and II grade sand as per Indian Standards specification for glass making

Silica sand is used largely in glass, foundry, ferro-silica alloy and cement industries besides being used in many other industries like ceramic, fertilizer, alloy steel, abrasives, chemical, coal washery, electrode, insecticide, paint, rubber, textile, water filtration, brick, mortar, etc. The natural silica sand is preferred in glass industries, but in cases 4 when silica deposits are located far away, crushed quartz is used. The silica sand should be fairly free from contaminations like clay material, pebbles and extraneous matter and should not contain more than 4% moisture. Depending upon the type of glass to be manufactured, silica sands have been classified into four grades (IS 488-1980), namely: Special grade: high grade colourless glass, such as crystal glass, tableware and decorated ware, Grade-I: decolourised glass ware, such as containerware, lampware etc., Grade-II: glassware where slight tint is permissible, and Grade-III: undecolouried and coloured glasses. The grades (IS 1987-1974) for foundries are Grade A, Grade B and Grade C with respect to the silica content. Depending upon the transparency, two grades have been classified namely Grade 1 and Grade 2, in ceramic industries (IS 11464-1985).

In the wake of depletion of mineral resources, conservation and exploration of mineral deposits alone may workout fruitfully for future economical development; India needs to search for new mineral deposits - fuel, metallic, non-metallic. Even though number of institutes like Dept. of Atomic Energy, National Institute of Oceanography, Mineral Exploration Corporation Ltd., and Geological Survey of India, etc., are working for the exploration and exploitation of minerals, upcoming research work may shower some direct light to the economic mineral deposits with reference to the specific sectors like Oceans, Coasts etc.

Realizing the importance of placer deposits it is really impossible for geologists to get themselves absconded off from the economic-presence and viability of any detrital minerals. They naturally form an evergreen source to the varied mineral deposits - right from Diamond and Gold to as low as Silica sands. If based on economic viability the detrital minerals along with

placer deposits, silica sand may stand at the doorsteps, even then their rarity makes them an important raw material in light mineral industries such as: Glass, Cement, Crucibles, Foundries, etc.

The indiscriminate nature of quartz as being present in all major rock groups, exemplary physical and chemical characters (mechanical and chemical durability), its abnormal location selections (dune, beach and shallow offshore marine deposits, etc.), its absolute purity sandwiched with rarity, also their methodical expression of its paleo environmental setting bounded with the economical status and societal usage (cement & glass industries) enhanced the researcher's interest. The silica sands economical status and societal usage enthused the researcher with overwhelming interest to study them, its geological setting in the study area. References were sought from the silica sand geology of the adjoining states of India and from the foreign countries.

The Gingee hills are located in the southwest of Gingee to an altitude of 280 m. The rocks are gently dipping in the eastern part of the hills but in the western part they are steeply dipping. The Kalrayans to an altitude of 840 m, rocks are gently dipping in the southeastern part of the hills but in the northwestern part they are steeply dipping. Kalrayans divide the South Arcot from the Salem district is seen at the extreme west of Kallakkurichi taluk. Besides these, there are number of small isolated hills among which the Tiyaga Durg and Permukkal are of great historical importance by the famous forts on them. The greater part of the study area is a flat plain sloping gently from west to east, towards the sea and also from north to south.

As per Valdiya's (1987) soil classification of India, the soils in the east coast of Tamilnadu mainly belong to oxisols i.e., the residual accumulation of inactive sediments. Laterites are distributed in the southern part of the study area. It enables to produce a type of soil known as laterosols i.e., the ultimate residue of clays and sandstones, which have undergone chemical weathering. The laterites also produce another type of soil, called as nitosols rich in Fe and Al content. Thin layers of inceptisols of a type of deltaic sediment found near Kaliveli lagoon areas are composed of humus material.

Silica is found invariably in almost all the states of India irrespective of their amount. Indian silica sands maximally are said to be of fluviatile origin Anbarasu, K. (1994). Andhra Pradesh possesses strong rich sand deposits in Kurnool, Nellore, Prakasam district and also along the Bapatla-Chinnaganjam, Vijayanagaram areas. In Karnataka, silica sands are restricted to 15 Belgaum, Dakshin Kannada, Dhawar, Gulbarga, Haveri, Uttar Kanada and Udupi districts which establish their supremacy as the chief silica sand bearing areas. Maharashtra contributes a considerable amount of deposits in the total silica sand outcome from Ratnagiri and Sindhudurg districts (Indian Mineral Year Book, 2000). Other than this Rajasthan records silica sands around Barmer, Bharatpur, Bundi, Chittorgarh, Dausa, Jaipur and Jaisalmer. Uttar Pradesh records silica sand around Charakha, Mizapur district and Pathraur Sonbhandra district. Madhya Pradesh too possesses some considerable amount of deposits which are distributed in Bastar, Bilaspur, Chhatarpur, Chhindwara, Patia, Gwalior, Jhabua, Mandla, Rewa, etc. (Indian Mineral Year Book, 2000). Tamilnadu, Gujarat and Bihar too are found to be of major contributors for silica sand with some rich and pure deposits. The Kerala sand possesses considerable amount of feldspars, which make them impure when compared to that of other state deposits. When compared to the other mineral deposits workable silica sand is very limited in the North Eastern states. Among which the Meghalaya proves to be a potential source of Quartz sands in areas like Laitryngew, Umstew and Kreit in Khasi hills and Tura in Garo hills. Since the sand contains a high proportion of iron, it losses merit to be used in first grade glassware. North Eastern states like Meghalaya, Arunachal Pradesh and Tripura posses silica sand deposits

Granulometric study is an essential part to understand the mode of transportation and depositional environment of sediments. Using graphic (Folk and Ward, 1957) and moment methods (Friedman, 1961, 1967 & 1979) the weight percentage data of 41 samples were processed in AT486 personal computer by using the modified programme of Schlee and Webster's (1967) procedure. From the statistical parameters, frequency curves, mean, standard deviation, skewness, kurtosis, CM diagram, bivariant plots and Visher's log probability curves, a comparative statement was drawn for the analysis proceedings.

The sieved fractions of white sands have been made into light and heavy mineral fractions by following the procedure mentioned in the Muller (1967). The individual fractions have been grouped into three different fractions coarse, medium and fine for heavy mineral separation. The set method has been carried out using bromoform as shown in the Milner (1962). For those fractions likely to be clogged in the standard separating funnel, filtering funnel fitted with transparent non-corrosive tube clipped by pinchcock is used. After the settlement of heavies' pinchcock has been opened to drain them into filter paper kept on the funnel. Then the lighter grains have been washed into another filter paper provided with separate funnel. Bromoform has been filtered in the separate container for further use. Then the grains have been washed first by using methyl alcohol and 20 then with distilled

water. The each and every fraction has been dried in a hot air oven with a mild temperature of 600 C until the moisture has been fully removed. The dried fractions have been weighed and the weights have been noted down.

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