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The Gravitational Impact of the Sun and the Moon on Heavy Mineral Deposits and Dust Particles in Low Gravity Regions of the Earth

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Abstract**—**The Earth's gravity is not uniform. The satellite imageries of the Earth's surface from NASA reveal a number of different gravity anomaly regions all over the globe. When the moon rotates around the earth, its gravity has a major physical influence on a number of regions on the earth. This physical change can be seen by the tides. The tides make sea levels high and low in coastal regions. During high tide, the gravitational force of the Moon pulls the Earth's gravity so that the total gravitational intensity of Earth is reduced; it is further reduced in the low gravity regions of Earth. This reduction in gravity helps keep the suspended particles such as dust in the atmosphere, sand grains in the sea water for longer. Dramatic differences can be seen from the floating dust in the low gravity regions when compared with other regions. The above phenomena can be demonstrated from experiments. The experiments have to be done in high and low gravity regions of the earth during high and low tide, which will assist in comparing the final results. One of the experiments that can be done is by using a water filled cylinder about 80 cm tall, a few particles, which have the same density and same diameter (about 1 mm) and a stop watch. The selected particles were dropped from the surface of the water in the cylinder and the time taken for the particles to reach the bottom of the cylinder was measured using the stop watch. The times of high and low tide charts can be obtained from the regional government authorities. This concept is demonstrated by the particle drop times taken at high and low tides. The result of the experiment shows that the particle settlement time is less in low tide and high in high tide. The experiment for dust particles in air can be collected on filters, which are cellulose ester membranes and using a vacuum pump. The dust on filters can be used to make slides according to the NOHSC method. Counting the dust particles on the slides can be done using a phase contrast microscope. The results show that the concentration of dust is high at high tide and low in low tide. As a result of the high tides, a high concentration of heavy minerals deposit on placer deposits and dust particles retain in the atmosphere for longer in low gravity regions. These conditions are remarkably exhibited in the lowest low gravity region of the earth, mainly in the regions of India, Sri Lanka and in the middle part of the Indian Ocean. The biggest heavy mineral placer deposits are found in coastal regions of India and Sri Lanka and heavy dust particles are found in the atmosphere of India, particularly in the Delhi region.

Keywords**—**Dust particles, high and low tides, heavy minerals. low gravity.

I. Introduction

THE gravity of earth is not uniformly distributed on the surface of the earth due to various reasons (Fig. 1). This anomaly has not been widely used scientifically, as significant differences cannot be seen in nature. It is a known fact that large heavy mineral deposits can be seen in placer deposits in low gravity anomaly regions [9]. However, significant movement can be seen from the suspension of particles in sea water and in the atmosphere during tidal change. Due to this effect, very high heavy mineral deposits can be deposited in low gravity regions (Fig. 4). Further, due to the gravity of the Moon and the Sun during high tide, particles are suspended for a greater time in water and air before they settle down. Therefore, more heavy minerals can deposit on placer in low gravity regions and dust particles in the atmosphere retain for a greater period of time before settling. The air pollution with suspended dust particles can be seen in the Delhi region (Figs. 2 and 3) of India and the largest heavy mineral deposits reported are found in the sub-continent of India and Sri Lanka (Fig. 4). Furthermore, recently it has been found that Kandy, situated in the central province of Sri Lanka, is one of the highest air polluted cities in the world [4].

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II. Purpose and Scope

The main purpose was to evaluate the benefits and difficulties which occur in low gravity regions from the change in tides. One of the benefits is large heavy mineral deposition during high tide, especially in low gravity regions. One difficulty is that more dust is retained in the atmosphere during high tide, in low gravity regions. Further, during high tide heavy minerals can deposit on placer. Greater study of this natural process will help in improving the methods of heavy mineral collection and exploration.

III. Method and Experiments

A simple experiment that can be done is by choosing two different locations with high and low gravity. Then a few uniform solid particles (about 1 mm in diameter) are dropped from the top of a 80-cm glass cylinder filled with water. The time taken for the particles to reach the bottom of the cylinder is measured using a stop watch (Fig. 7). The measurements must be taken during high and low tide, at the two chosen locations. The experiment has to be done for a few days to get a good reading of the drop times. Finally, the results of the drop times in the experiment can be compared to find the difference in high and low tide (Figs. 9-11). This experiment was done in Colombo, Sri Lanka and in Melbourne, Australia.

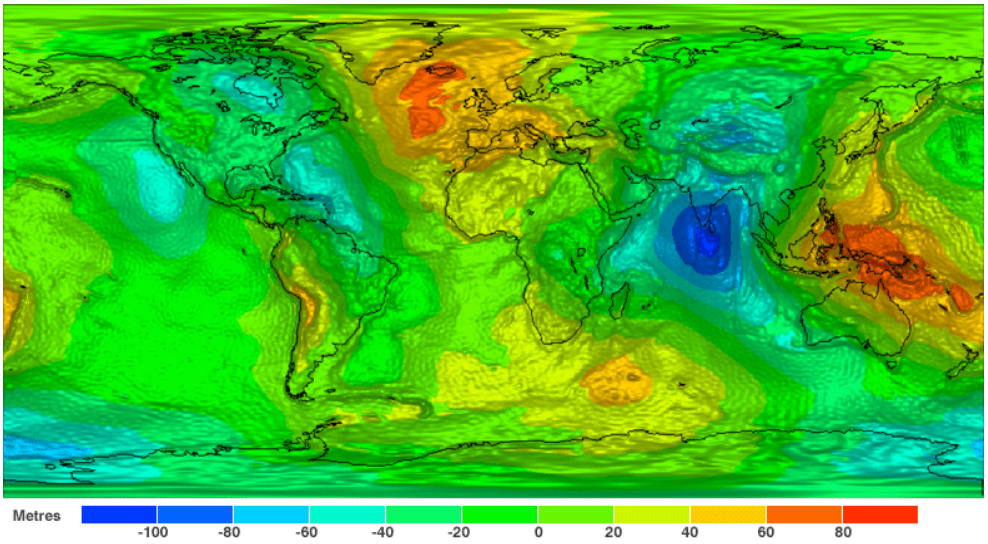

Fig. 1 Grace Gravity Anomaly of Earth (Dark blue –Low Gravity and red – High Gravity) [3]

Fig. 2 Air Pollution, Birds eye view of the Delhi area in India [1]

Fig. 3 Air pollution Delhi City, India, Birds eye view [2]

Fig. 4 Heavy mineral deposits of Pulmodia, Sri Lanka, after high tide had retreated [5]

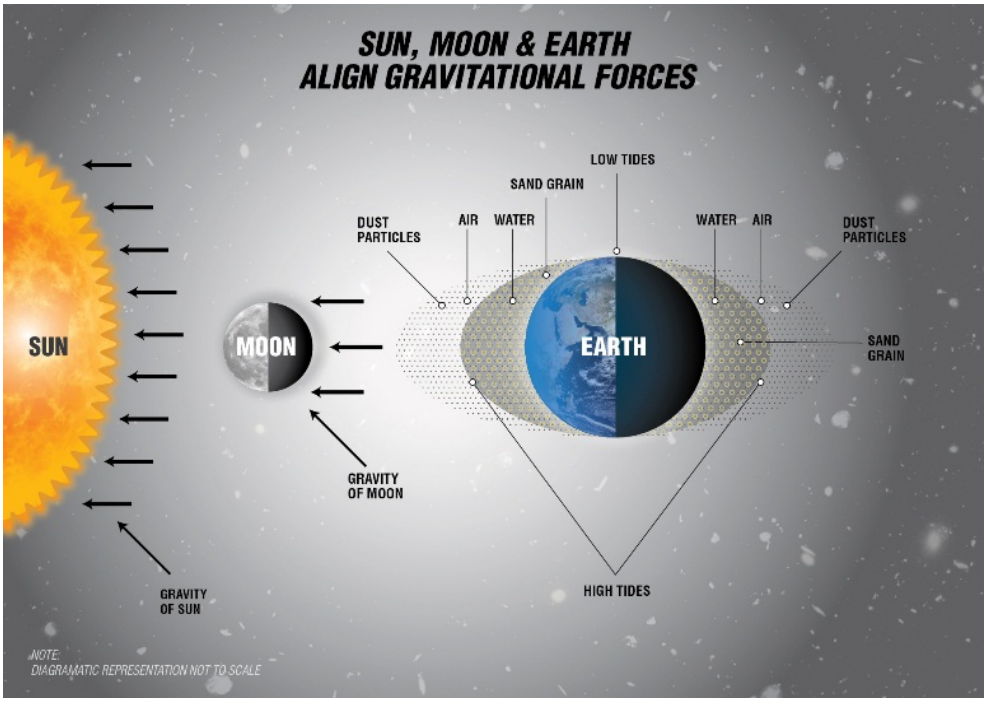

Fig. 5 The Sun, the Moon and the Earth aligned (Particles are uplifted in air and water during high tide)

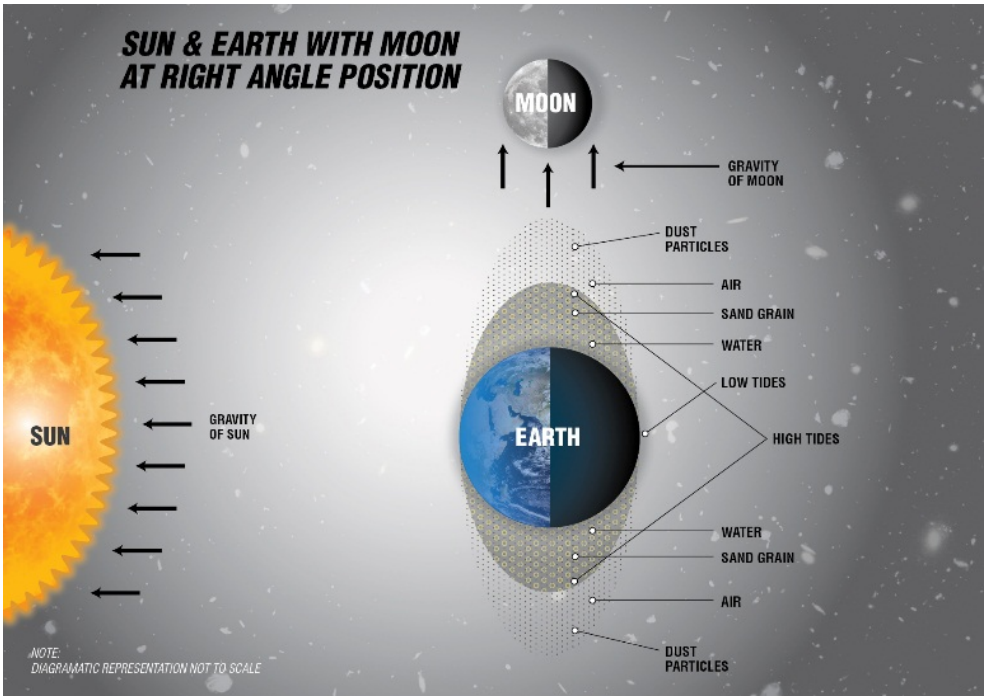

Fig. 6 The Sun and the Earth at right angle to the Moon (Particles are uplifted in air and water during high tide)

The gravitational forces of the Sun and the Moon dramatically lift water up in the ocean. In this situation, the Earth's atmosphere also follows this same change. The water level change in the ocean is known as high and low tide.

In the atmosphere, the suspended dust particles behave dramatically different, this is due to a large number of physical changes such as wind, rain, moisture, pressure and elevation and finally last but not least the high and low tide periods. For the dust sample collection, a number of directions need to be followed according to the NOHSC method [8]. Dust particles can be collected using air particle collecting filters, which are specially manufactured mixed cellulose ester (MCE)

membranes. A small vacuum pump is used to collect the dust on the filters. The filter mounts inside a 25 mm cassette which is attached to air pumps. This experiment should be done in a very stable condition; there must be no wind flow.

Fig. 7 80 cm high water filled cylinder with stop watch

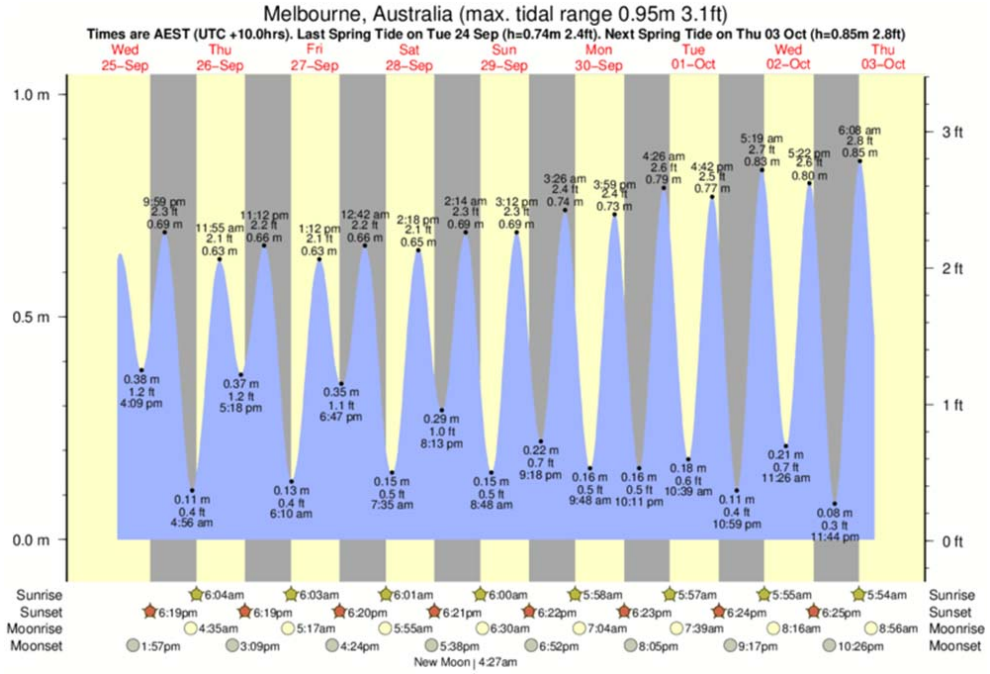

Fig. 8 High and low tide graphs of Melbourne, Australia [6]

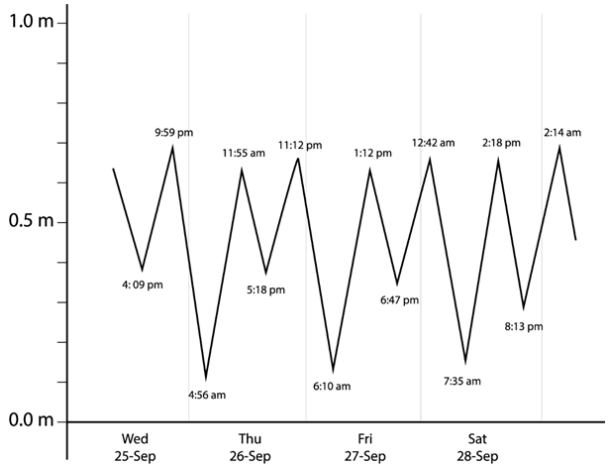

Fig. 9 Data of the experiment done in Melbourne from 25 September to 28 September, 2019

		25 Sep	26 Sep	27 Sep	28 Sep
Low tides	Time	4.09 pm	4.56 am	6.10 am	-
	Time to settle	0.0399 min	0.0380 min	0.0385 min	-
High tides	Time	9.59 pm	11.55 am	1.12 pm	12.42 am
	Time to settle	0.0427 min	0.0415 min	0.0419 min	0.0423 min
Low tides	Time	-	5.18 pm	6.47 pm	7.35 am
	Time to settle	-	0.0400 min	0.0392 min	0.0382 min
High tides	Time	-	11.12 pm	-	2.18 pm
	Time to settle	-	0.0420 min	-	0.0413 min

Fig. 10 Data of the experiment done in Melbourne from 25 September to 28 September, 2019

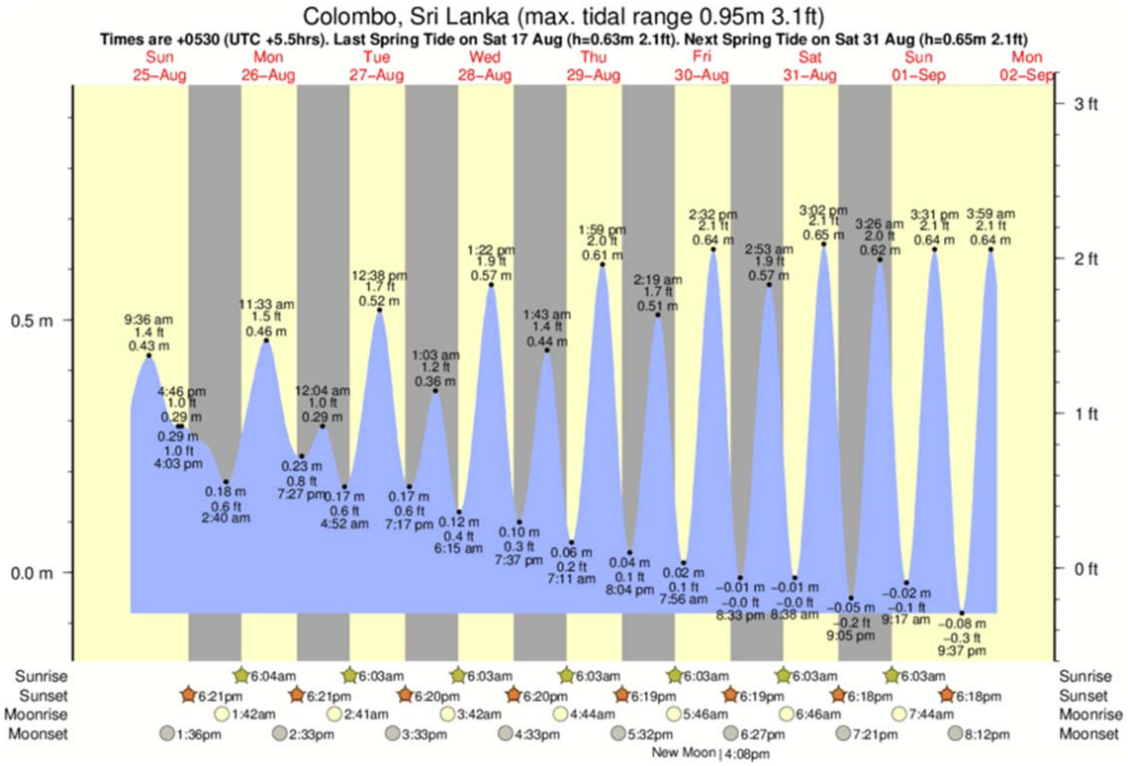

Fig. 11 High and low tide graph, Colombo, Sri Lanka [7]

		25 Aug	26 Aug	27 Aug	28 Aug
Low tides	Time	-	2.40 am	4.52 am	-
	Time to settle	-	0.0395 min	0.0385 min	-
High tides	Time	9.36 am	11.33 am	12.38 am	1.03 am
	Time to settle	0.0490 min	0.0501 min	0.0512 min	0.0450 min
Low tides	Time	-	-	7.17 pm	6.15 am
	Time to settle	-	-	0.0380 min	0.0375 min
High tides	Time	-	-	-	1.22 pm
	Time to settle	-	-	-	0.0530 min

Fig. 12 Data of the experiment done in Sri Lanka from 25 August to 28 August, 2019

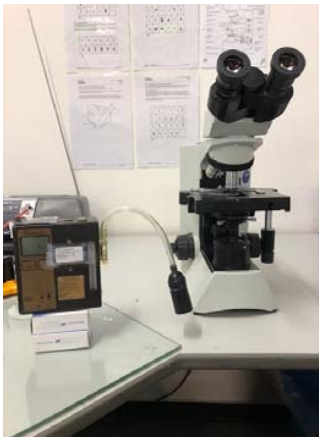

Fig. 13 The air monitoring pump and a filter attached

IV. Conclusion

The experiments show that there is a significant difference in the drop times during high and low tide. The high and low tides are created from the gravitational effect of the Sun and the Moon. This has a significant effect on the movement of suspended particles in air and water. The experiment indicates that during high tide, the particle drop time is higher than during low tide. The particles take a bit longer to settle down during high tide. This small-time difference is enough to keep particles floating for longer in sea water, till they reach the shore. This is the reason why very large heavy mineral deposits are found in low gravity regions of the Earth, particularly in the coastal area of Sri Lanka and the Indian Peninsula [4]. Low gravity and tidal effects on suspended particles should be further studied for mineral exploration. Also, the problem of suspended particles in the atmosphere, mainly in low gravity regions should be further discussed for solutions. Given that it is possible to derive heavy minerals during high tide, an economical heavy mineral exploration method can be designed for commercial purpose.

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