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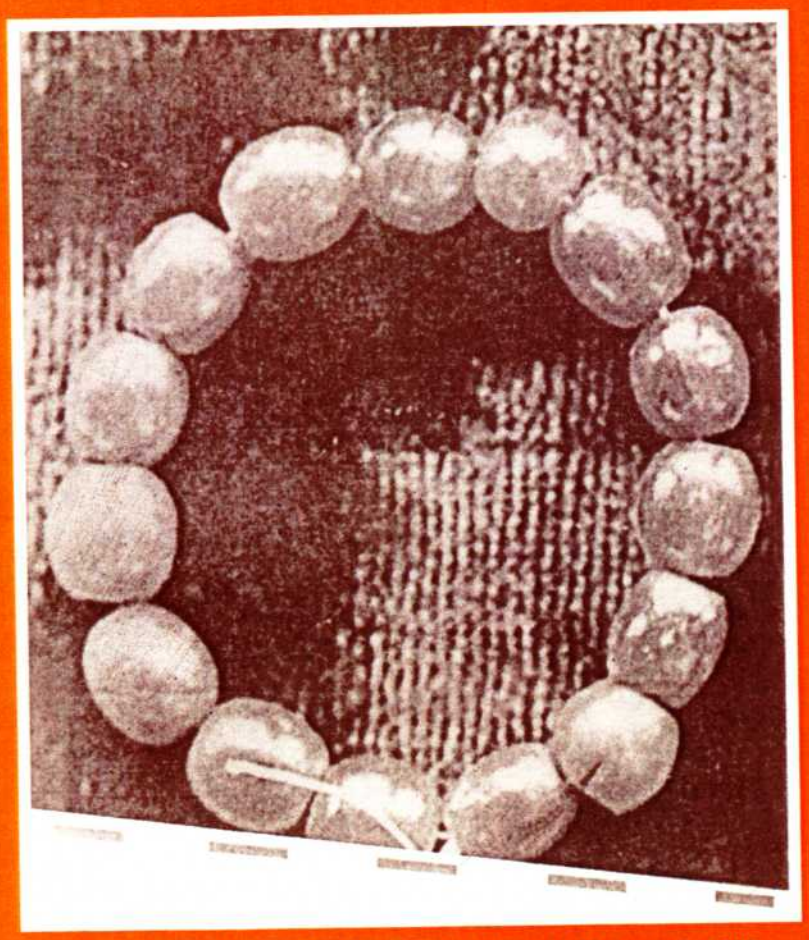

Carnelian bead collected from the megalithic burial at Kodumanal, p. 393

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HISTORICAL NOTES

Deep-sea Volcanoes and Their Associated Hydrothermal Vents

Research in ancient and medieval Indian manuscripts dating as far back as 1500 BC to 17th c. AD, has unearthed many extraordinary descriptions, producing a stunning image of a submerged volcanic edifice with an associated hydrothermal vent system. Fifteen such instances have been identified which ancient Indians were aware of a submarine volcanic structure, and deduced further, at least, about its physical features and hydrothermal system – its internal structure, plumbing, dynamics and chemical effects on the ocean water. Furthermore, all the descriptions of the submarine fire found in the texts are coherent. The descriptions pertain to its: a) Submarine Location, b) Volcanism, c) Plumbing, d) Chemistry, e) Appearance, f) Location in the Arabian Sea, off India's northwestern continental margin.

A single parallel description may be discarded as a fluke coincidence, but 15 parallel descriptions become much harder to ignore as because they have been found in what was previously interpreted to be purely 'mythological' texts. The large number of real patterns and parallels found in these texts (which are seven in total) suggests the existence of authentic discoveries which might later have been mixed with mythology.

In 1971, Clive Lister of the University of Washington and Jack Corliss of Oregon State University published papers predicting the presence of hot seawater springs at oceanic ridges. Their postulation was that some seawater might enter the seabed, get superheated, rise and again emerge from openings in the seabed. Later, in 1977, scientists dived down 2,500 meters on the Galapagos axis near the Galapagos Islands in the Pacific Ocean in the Alvin. They discovered warm hydrothermal solutions gushing out from the seafloor. Later discoveries revealed that vents can also occur in much shallower waters on the tops of rising submarine volcanoes such as around the hot spot islands of Iceland and the Azores. They have also been found at the Kurile Islands, Russia. It is not unreasonable to assume that such springs exist, and have existed, above

all the oceanic hot spots around the world.[1] This includes India's northwestern continental margin – which has had a remarkable history of volcanism – may be more than any other place on earth.

Medieval and ancient scholars in India have described in detail what appears to be a deep-sea structure, they called the 1) *Vāḍvānal*, 2) *Vāḍavā*, 3) *Jvālā mukh*, 4) *Jvālāmālā* and 5) *Agni*. The first two words unequivocally mean "Submarine Fire" (Sir M. Monier-Williams, *Sanskrit-English Dictionary*, Revised edition, Oxford University Press, 1989). The third and fourth words clearly mean "Volcano" (Monier-Williams) and "Chain of Fire" (Monier-Williams) respectively. The fifth word also clearly means "Fire" (Monier-Williams). The above descriptions – and many more – have been discovered in various ancient texts written in Sanskrit texts such as the *Skandamahāpurāṇam*, *Brahmamahāpurāṇam* and *Śivamahāpurāṇam* – estimated by western scholars to date back between 4th century to 7th century AD. However, some other estimates have put them between AD 500 and AD 1000. Other astonishing descriptions of the Submarine Fire have been found recorded in Gujarati texts, such as the *Vacanāmṛtam* texts that date back to AD 1819-1829.

More surprisingly, references to the Submarine Fire have been found in even more ancient Indian epics (in Sanskrit – the *Mahābhārata*, which dates back to at least 300 BC and the Śrī Vālmikī *Rāmāyaṇa*, which dates back to a similar period, if not earlier. Most astonishingly, references to the Submarine Fire can also be found in the *Ṛgveda*, which dates back to 1500-1200 BC.[2]

Following is a compilation of what the ancients described:
The unconventional nature of this research has forced the author to adopt a presentation that does not fully follow the format of conventional papers. The classification of the ancient descriptions into clear categories has however pressed constraints on presenting the texts chronologically.

Early Description And Sources On Volcanic Submarine Fire

Submarine Location of Fire

1. The fire is located in the ocean (*agnim samudra vāsasam – Ṛgveda*, 8.102-4)
2. The fire was elongated and arose from the ocean ('*uddyannityut yan samudrāt*' – *Yajurveda, Taittirīya Saṃhitā,* Hymn 4.6.7)

3. The fire is not just submarine, but submerged in the ocean (*'adrasyaha sāgare krutaha'* – *Skandamahāpūrāṇam*, 29.93), i.e. it had once grown above sea level, but then submerged or disappeared later due to subsidence of the seabed, or erosion by waves, or sinking under its own weight, or all three.

Volcanism

4. The (submerged) submarine fire is clearly stated to be gentle volcano (*'saumya jvālāmukham'* – *Śivamahāpūrāṇam*, 20.7), and not a fiery (*'abhidipitaha* – *Śivamahāpūrāṇam*, 20.21), somewhat spread out like a coalesced, volcanic ridge.
5. The fire did not exist at just one spot, but is described as a chain of fire (*'jvālāmālā'* – *Śivamahāpūrāṇam*, 20.21) somewhat spread out like a coalesced, volcanic ridge.
6. It is a structure that vomits (*'udgirad'* – *Mahābhārata*, 1.22) fire. The verb 'vomit' is extremely appropriate for emerging liquid magma under hydrostatic pressure.
7. The structure has a fire chamber(*'aditaha'* – *Brahmamahāpūrāṇam*, verse 201), i.e. from the earliest origins of the earth.
8. The fire is identified to be primordial (*'aditaha'* – *Brahmamahāpūrāṇam*, verse 201), i.e. from the earliest origins of the earth.

Plumbing

9. The object is accurately described – amazingly – to be a structure that has two other types of openings related to its plumbing: 1. From where it takes in water and another from where it ejects water! The process by which the water enters the object is accurately described as being drawn in (*'pibate'* – *Skandamahāpūrāṇam*, 29.96), rather than merely percolated into.
10. The process by which the water leaves the object is also accurately described as being ejected (*'kadhi nakhe che'* – *Vacanāmṛtam*, Gadhada section 1, sermon no. 72, 9th April, 1820), rather than just exiting.
11. The openings through which the structure draws in water are accurately described to be the size of a pinpoint mouth (*'sūcī*

vaktraha' – *Skandamahāpurāṇam*, 29.96), i.e. minute pores in the basalt seabed or in the flanks of the oceanic structure.

12. The oceanic structure is accurately described as drinking water very slowly ('*śanaihi, śanaihi*' – *Brahmamahāpurāṇam*, verse 211).

13. The openings through which water is drawn into the structure are accurately described to shrink ('*krutam ghaṭikāpurāṇam*' – *Skandamahāpurāṇam*, 29.95-96) to the width of a needle-hole or the neck of an hourglass i.e., the constriction of capillaries and veins due to precipitation of minerals from the seawater and sedimentation from above.

Chemistry

14. The progression of the sea water through the hot oceanic structure is also accurately described – amazingly – to remove certain salts and pollutants ('*pāni mithu thai che*' – *Vacanāmṛtam*, Gadhada section 1, no. 72) from the water, making it depleted to some extent, as is shown to happen when magnesium salts, amongst others, react with the hot rocks in the sea bed and when the vent plumes react with the cold seawater above.

Appearance

15. The oceanic structure is described as having an enormous body ('*mahākāyaha*'– *Skandamahāpurāṇam*, 29.96) as volcanic edifices usually are.

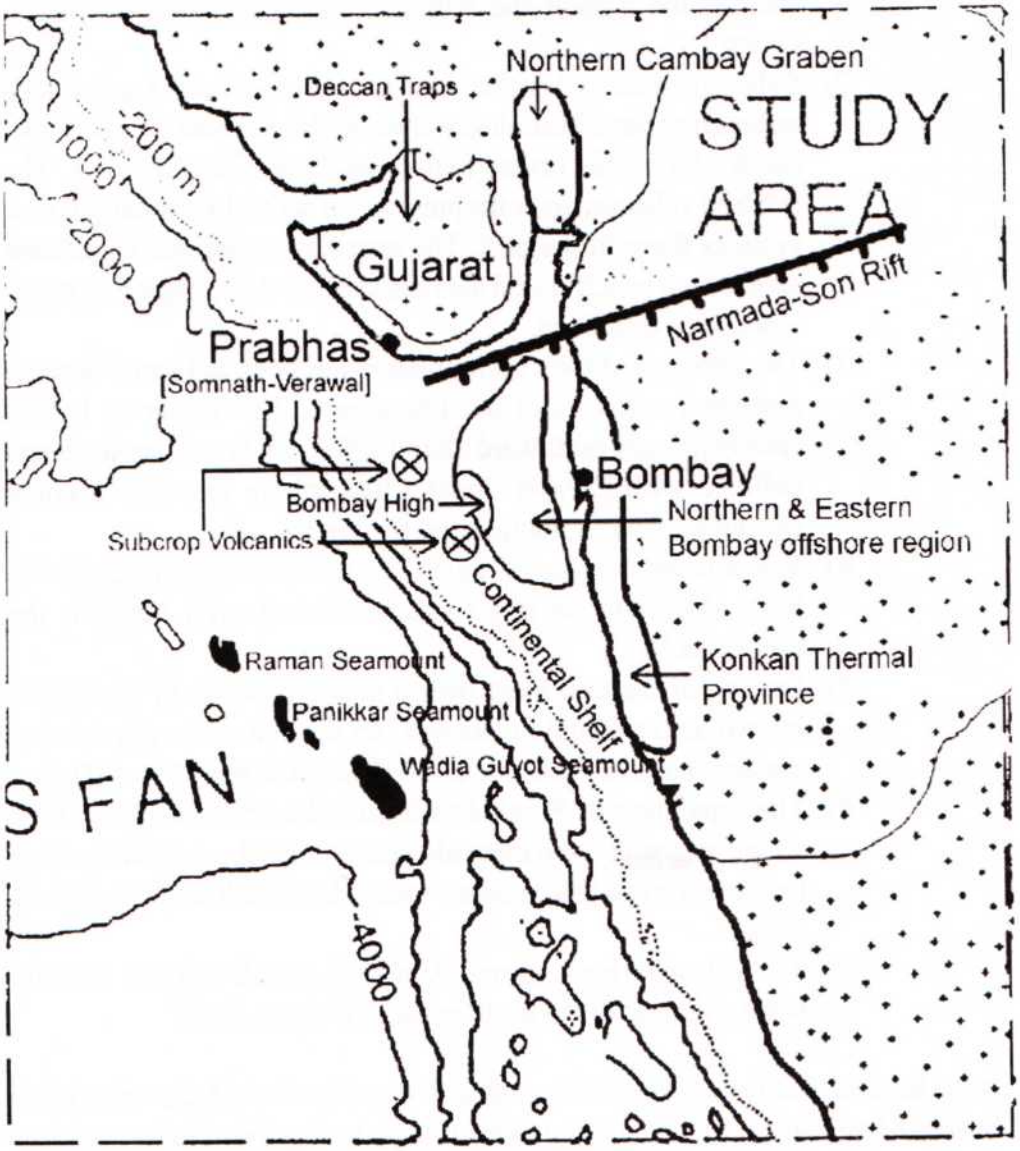
16. The oceanic structure is described as appearing golden and glittery ('*śāta*' - *Skandamahāpurāṇam* 29.95), i.e. covered with shiny metal sulphides and pyrites.

Location

17. The submerged volcano(es) and associated vents were close to India's northwestern continental margin, south of Prabhāsa, Gujarat ('*prabhāse*' – *Brahmamahāpurāṇa*, verse 210, and *śrīsomesād dakṣiṇātaha*' - The *Skandamahāpurāṇam*, 29.97). Indeed, there is enormous geophysical evidence to suggest their past existence in the area stated:

1) Seamounts and guyots have been discovered south of Gujarat such as the Raman and Pannikar Seamounts and the Wadia Guyot.[3]
2) Subcrop volcanics[4] (volcanic structures now buried under deep sediments) have been discovered on the Arabian Sea bed, just south of Prabhās (today known as "Somnāth-Veraval"). The subcrop volcanics infer the presence of active hydrothermal vent systems there in the past. The area has undergone significant subsidence which would also account for the submerging of the volcano as described.
3) The presence of melt accumulation has been indicated beneath a sheared and thinned out lithosphere. This is due to India's speedy journey northward after it split from Gondwanaland and collided with Eurasia. India's lithosphere has thus become exceedingly weak, faulted and fractured.[5]
4) Volcanic up-warping of India's western continental margin has been shown to be due to accumulated melt beneath the lithospher.[6]
5) Passing of western India over a massive plume in the mantle known as the Reunion Hotspot, 65 million years ago causing massive basaltic, volcanic floods known as the Deccan Traps.
6) The separation of Seychelles from India about the same time which suggests there must also have existed a spreading ridge between the two landmasses – today identifiable as the Carlsberg Ridge.
7) The volcanic (but aseismic) Chagos-Laccadive Ridge runs far north, right up to the south coast of Gujarat, India.

It can be seen clearly that the seabed south of Gujarat has had a truly remarkable history of volcanism in the past and extending up to Bombay High, still has a high heat flow anomaly even today (Fig.1).[7] Observed geothermal gradients in these areas are still high (36°-78°C/km), indicating high crustal temperatures (e.g. 890°-1060°C at 30 km). The entire Bombay offshore region is associated with moderate seismicity and in large sections, uplifting and vertical/lateral motions are still taking place.[8]



Enlarged Map of Study Area Along India's Western Continental Margin

Fig.1.

Concluding Remarks

It appears that ancient and medieval scholars were aware of submarine volcanoes and hydrothermal processes in the deep oceans even as far back as 1500 BC. They might actually have seen such a structure several thousands of years ago, in the Arabian Sea, towering above sea-level. Or, how else could they have given such an involved and coherent picture? The structure they had seen must then have undergone sea wave and weather erosion and possibly, anomalous, rapid subsidence over a localized area. This would have submerged the structure over a period of a few thousands years – or possibly even over a few hundred years, or even a few decades.

A simple, pointed illustration is that of the volcanic island of Surtsey, Iceland. It is an island that grew rapidly from an eruption 130 meters below sea level in 1963 to 170 meters above sea level and measured some 2.7 sq km. Today, erosion has worn away the island by almost 50 percent, leaving only 1.4 sq km. Thousands of Icelanders witnessed the natural event with their own eyes. After the formation of the hot, lava island, various scientists have visited it regularly, since it lies only 33 km south of the Icelandic coast. Another 55-60 volcanic islands in Surtsey's vicinity have been completely weathered away and have already disappeared beneath the water surface.

Our data collection research shows that similar volcanic events ages ago must indeed have occurred near the northwestern continental margin of India – with the probable emergence of volcanic islands from beneath the sea and subsequent erosion of the islands by the ocean waves together with subsidence of the seabed. Other discoveries have also revealed the expertise and passion for sea travel of ancient Indian mariners – as supported by the recent discovery[9] of the legendary Lothal Naval Dockyard – probably the world's first – at the head of the Gulf of Khambhat (Cambay) (21° N; 74° E), dated 2500 BC, close to the south coast of Gujarat, along India's northwestern continental margin.

Indians inhabiting the area might have witnessed the birth of a volcanic island and later its erosion and submergence – like Icelanders witnessed the birth and erosion of Surtsey. India's ancient mariners (and scholars) could have traveled to the island (like those of Surtsey and the Kurile Islanders) from Lothal

when it was above sea level and even later, when it was only slightly submerged. Thus, they were in a position to make first-hand observations and discoveries as pointed out in this paper.

REFERENCES

1. Rachel Carson, *The Sea Around Us*, Oxford University Press, 2003, p.xxxv
2. Smith, Noel W., The evolution of psychophysical dualism in ancient India: from the *Ṛgveda* to the Sūtras, *Mankind Quarterly*,31.1-2 (1990) 0025-2344, September 1.
3. G. C. Bhattacharya, G. P. S. Murthy, K. Srinivas, A. K. Chaubey, T. Sudhakar, R. R. Nair, " Swath Bathymetric Investigation of the Seamounts Located in the Laxmi Basin, Eastern Arabian Sea", *Marine Geodesy*, 17, p.169.
4. Sastri, V. N. Obervations on age of the Deccan Traps and related trap activity in India. In: K. V. Subbarao and R. N. Sukheswala (Eds.), Deccan Volcanism and Related basalt Provinces in Other Parts of the World. *Mem. Geol. Soc. India*, 3 (1981) 296-299.
5. Negi, J. G., Agrwal, P. K. Singh, A. P. and Pandey, O. P. "Bombay gravity high and eruption of Deccan flood basalts (India) from a shallow secondary plume", *Tectonophysics*, 206 (1992) 341-350
6. O. P. Pandey and P. K. Agrawal, "Nature of lithospheric deformation beneath the western continental margin of India", *Journal Geological Society of India*, 57 (June 2001), 499
7. Negi, J. G., Agrwal, P. K. Singh, A. P. and Pandey, O. P., 1992, (Ref. 4)
8. Pandey, Agrawal and Negi, "Geothermal fields of India: a latest update", Proceedings of the World Geothermal Congress, 1, (1995), Florence, Italy, 18-31 May 1995, 163
9. R. Nigam, "Was the large rectangular structure at Lothal (Harappan settlement) a 'dockyard' or an 'irrigation tank'?", *Marine Archealogy of Indian Ocean Countries*, 20-21

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