History Carved Out of the DECCAN TRAPS

Photo: Rasool Sorkhabi

Ancient cave temples carved out of the Deccan basalts are some of the best places to view both the world-renowned Deccan Traps and the Indian mythology narrated on these rocks.

This statue of Shiva depicts four faces representing Mahadeva (the calm "great lord," central figure), Aghora (the frightful or destructive aspect of Shiva, on the left), Uma (the beautiful feminine aspect, on the right), and Nandin (the sacred bull as the mouth or doorkeeper of Shiva, not visible). This sculpture is in Cave No. 1 on Elephanta Island.

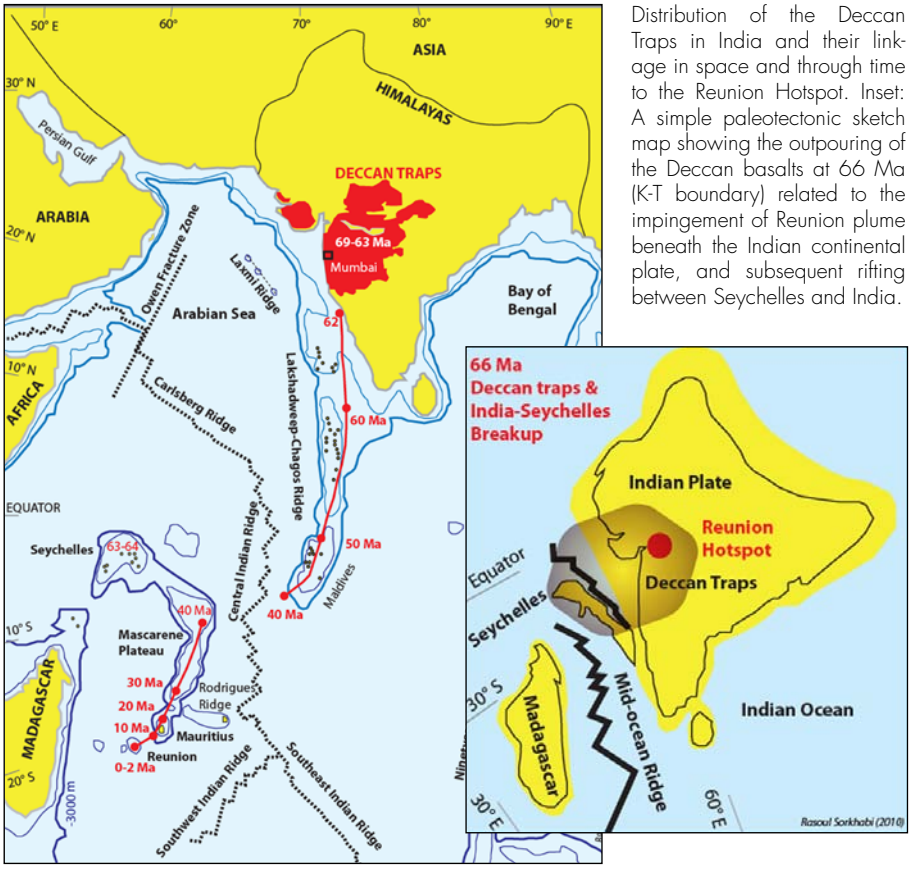
The Deccan Traps, one of the Earth's largest igneous provinces, cover over 500,000 km^2 of west-central India. Erupted about 66 million years during the extinction of the dinosaurs, these flood basalts, in cooperation with the sea, rains and rivers, have shaped the landscape of west-central India. Ancient cave temples have been carved out of the Deccan basalts in many places and the Elephanta Caves located on a small island offshore Mumbai (Bombay) is one such place.

FLOOD BASALTS IN CENTRAL INDIA

The triangular peninsula of India is largely a Precambrian shield, with a central flat area, the so-called Deccan Plateau, surrounded by the mountain ranges of the Eastern and Western Ghats. The name Deccan is derived from the Sanskrit word 'dâkshin', meaning "south." The west-central parts of the Indian peninsula are dominated by flood basalts which form a prominent terraced landscape; this form of flood basalt is called 'trap', after the Dutch-Swedish word 'trappa', meaning 'stairs'.

A large number of geochronological data have been reported from the Deccan Traps over the past four decades, and the data cluster between 69 and 63 Ma (corresponding to the magnetic polarity epochs of 31 Reverse and 28 Normal) suggests that the main phase of eruption was at 66.9 ±0.2 Ma, shortly before the Cretaceous-Tertiary (K-T) boundary at 65.5 ±0.2 Ma. This age range is also consistent with paleontological data from the interbedded sediments. Aside from terraces, the Deccan basalts also form numerous dikes, some of which represent the youngest phase of the volcanic activity. While some scientists support a several million year duration for this volcanic activity, others have argued that the eruption occurred within a million years at the K-T boundary.

The original extent of the Deccan Traps has been estimated as 1.5 million km^3, but the latter is highly imprecise as erosion on land and undersea subsidence on the western Indian margin have altered the rock volume accessible to us. The Deccan Traps are thickest on the Western Ghat Range (over 2,000 km thick) or in fault-bounded grabens in west-central India, but become thinner (less than 100 m) close to the margin of the trap province. Over 95% of these lavas are tholeiitic basalts ▶



Distribution of the Deccan Traps in India and their linkage in space and through time to the Reunion Hotspot. Inset: A simple paleotectonic sketch map showing the outpouring of the Deccan basalts at 66 Ma (K-T boundary) related to the impingement of Reunion plume beneath the Indian continental plate, and subsequent rifting between Seychelles and India.

Image: Rasoul Sorkhabi

(tholeiite, named after Tholey, Germany is a type of basalt rich in silica). Mantle xenoliths in the Deccan Traps have been reported from a few places.

Most scientists believe that the Deccan Traps poured out as the Indian plate, on its northward journey after the Gondwana breakup, passed over the Reunion hotspot, a still active volcanic island located in the south-west Indian Ocean. Coeval with (or probably as a result of) this event, there was also a continental rift-drift between India and the Seychelles Islands. Indeed, flood basalts of similar age also occur on the Seychelles. (For Seychelles see the article "An Oil Prone Frontier Basin," *GEO ExPro*, Vol. 4, No. 3). The occurrence of petroleum reservoirs below the Deccan Traps remains unexplored.

Photo: Rasoul Sorkhabi

A view of two of the caves on Elephanta Island. The Deccan basalts are prominently seen in the photo.

CAVE TEMPLES IN DECCAN TRAPS

One can see exposures of the Deccan Traps in the Indian states of Gujarat, Madhya Pradesh, and Maharashtra in India, but vegetation, soil cover, and land development often mask these rocks. Cliffs of lavas on the Western Ghats and hill caves in Maharashtra perhaps provide the best outcrops to examine these formations. The hill caves are particularly important as many of these are also ancient Hindu or Buddhist temples, centuries old and portraying the Indian myths on rocks.

Some of the best known Deccan Trap caves are close to Mumbai (Bombay), including Ajanta (perhaps the oldest one dating back to 200 B.C.), Mandapesvara Caves, Kanheri Caves, Jogeshwari Caves, Mahakali Caves, and of course, the Elephanta Caves, which are our subject here.

Cave No. 1 or the Great Cave is the largest and most celebrated of all the Elephanta caves. This cave temple (restored in the 1970s) contains many statutes and sculptures of Lord Shiva and his life stories in Hindu mythology.

Photo: Rasoul Sorkhabi

ELEPHANTA ISLAND

The Elephanta Caves are located on Elephanta Island, offshore Mumbai, precisely 11 km north-west of Apollo Bunder near the Gateway of India, where numerous ferries take visitors to the island daily. The entire island, about 2.5 km long and 7 km in circumference, is made up of the Deccan basalts, covered with trees and bushes. Three villages on the island house a few thousand people engaged in farming, fishing, and tourism.

Through centuries, the island has come under the rule of various Indian dynasties. In 1534, the Portuguese occupied it. In 1661, when Charles II of England married Catherine of Braganza, daughter of King John IV of Portugal, Elephanta Island was given to the British royal court as a marriage dowry, thus beginning British control of the island until 1947, when India gained independence.

The native name for the island is "Gharapuri" – the "town of Ghari priests (those priests belonging to the Shudra or laborer and artisan class, and devoted to Lord Shiva). But the Portuguese called it Fontis (Elephanta) after a huge elephant statute that once stood on the island.

There are seven temple caves. The first five, on the western part of the island, are Hindu temples dedicated to Shiva, a deity which along with Brahma ('creator') and Vishnu ('preserver') forms the supreme Hindu pantheon. Shiva - literally the 'Auspicious One'- is often translated as the 'lord of destruction' but as one observes his various sculptures in Elephanta Caves he plays a far more varied role in Hindu mythology. The rock architecture of these Hindu caves has been dated between the 5th and 8th centuries.

The other two caves are Buddhist temples dating back to the 3rd century or even older and are not open to visitors. The Buddhist Stupa on the eastern part of the island is on the highest point of the island; it is called the Stupa Hill and is about 173m in elevation.

The Elephanta Caves were originally colour-painted but today only traces remain on the bare rock. Much damage has been done to the caves through centuries of weathering but also by the Portuguese soldiers who fired shots into the caves (to test the echo of their big guns), thus breaking some sculptures and pillars. In 1909, the Elephanta Caves came under the authority of the Archaeological Survey of India, and in 1987 UNESCO included it in the World Heritage list.

A trip to Mumbai is not complete without a visit to the amazing Elephanta Islands, where a portion of India's ancient history and mythology are preserved and displayed by the Deccan basalts – a fine sight, especially for geologists.

The stepped nature of the layered basalts of the Deccan Traps is clearly seen inland at Matheran, 90 km from Mumbai