

# Petrology, geochemistry and paleomagnetism of the earliest magmatic rocks of Deccan Volcanic Province, Kutch, Northwest India

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## Abstract

Tholeiites and alkali basalts occurring in the southern coastal belt of Kutch rift basin, Gujarat are the northernmost on-land exposure of Deccan Traps. Further north, mafic dykes, sill and a differentiated alkaline plutonic complex occur along deep-seated rift-related faults. The major rift-related faults provided the channel ways for the emplacement of the magmas to the surface. These magmatic rocks have been classified into three Groups on the basis of spatial distribution, mode of occurrence and petrochemistry. Petrological, geochemical and paleomagnetic data for the representative samples of the volcanic and intrusive rocks from Kutch region are presented. The alkali basalts are enriched in LILE and LREE compared to the Deccan tholeiitic basalts. Paleomagnetic investigations of thirty magmatic bodies of Kutch yield a Virtual Geomagnetic Pole (VGP) at 33.7°N and 81.2°W ( $dp/dm=5.81/9.18$ ). This obtained pole is statistically concordant with that of the Deccan Super Pole (36.9°N:78.7°W). The magmatic rocks of the Kutch basin are broadly contemporaneous straddling 30N–29R–29N chrons. It is suggested that the magmatic rocks of Kutch were generated by the impact of the Réunion plume on the Kutch lithosphere under extensional setting.

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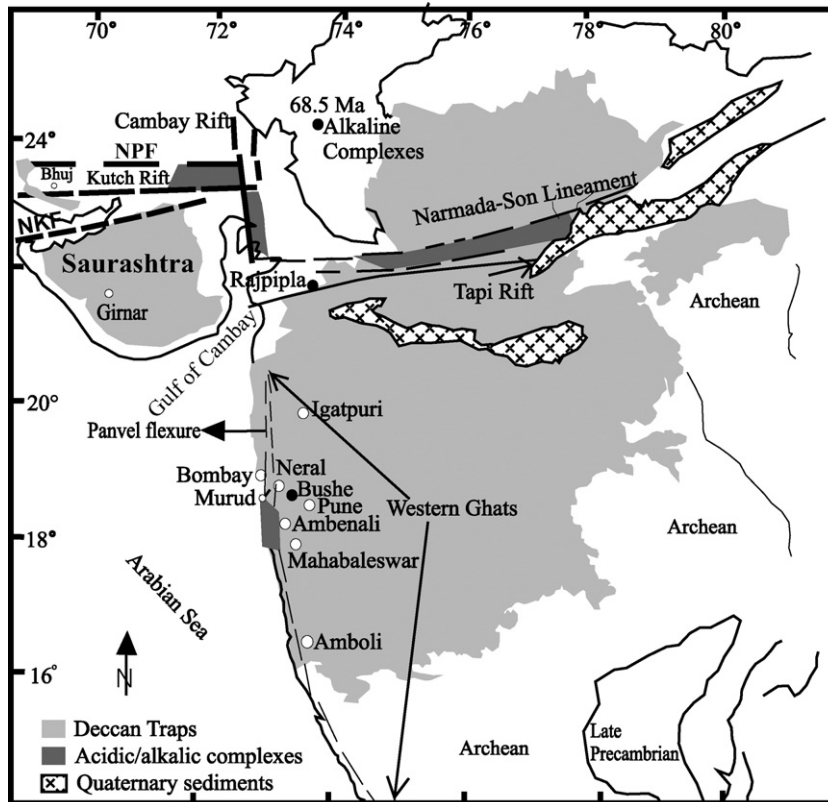
## 1. Introduction

The Deccan Traps cover an area of about 500,000 sq. km in Western India (Fig. 1). Considerable thickness of Deccan Trap flows also extends over the continental shelf almost up to the 68° E longitude. To the north, the flows extend up to the southern part of Kutch District of Gujarat across the Gulf of Kutch. The magmatic rocks of Kutch mark the northern limit of the Deccan Trap volcanic activities that took place during Late Creta-

ceous–Early Paleocene period across the K–T boundary (Shukla et al., 2001), when the Indian plate passed over the Réunion hot spot. Some of the oldest flows of the Deccan volcanic activity are exposed along the coastal belt of the Gulf of Kutch. Further north, the Deccan Traps thin out against the Mesozoic rocks and were eroded away barring a few outliers. The erosion of the Trap cover exposed several feeder plugs and other intrusives and a few volcanic vents. Besides, the petrochemical comparison of the Deccan Traps of north-western India (including Kutch region) and the well-studied sections of the Western Ghats make the rocks of Kutch particularly interesting to study.

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NPF - Nagar Parkar Fault  
NKF - North Kathiawar Fault

Fig. 1. Map of western India showing the location of the Deccan Volcanic Province (DVP) (light shaded area), the Son-Narmada lineament, the Cambay and Kutch rifts. Distribution of alkaline complexes in the DVP is also shown (dark shaded area). Location of Bhuj, area of the present study, is in the north western corner.

## 1.1. Geological setting

### 1.1.1. Tectonic framework and structure

The Kutch Basin located at the western margin of the Indian craton, is an east-west oriented pericratonic rift-basin (Biswas, 2002). The Nagar Parkar Fault (NPF) bounds the rift on the north and the North Kathiawar Fault (NKF) limits it to the south (Fig. 2a). The rift basin is featured by intra-basin tilted fault blocks and intervening half-grabens (Fig. 2b). The uplifts stand out conspicuously as highlands amidst the extensive mud and salt flat over the intervening structural lows-Rann Graben (RG), Banni Half-Graben (BHG) and Gulf of Kutch Half-Graben (GOK). Rocks are exposed in the highlands whereas the flatlands are covered by Holocene sediments. Three uplifts occur along parallel strike faults forming ridges of varying dimensions. These east-west trending uplifts are (Fig. 2a): the Island Belt Uplift (IBU) to the north, the Kutch Mainland Uplift (KMU) in the south with the Wagad Uplift (WU) in the central

part. The “Island Belt” is a metaphorical name given to an E–W chain of highlands standing like “islands” on the vast expanse of the mud and salt flat. The Island Belt Uplift along the E–W master fault consists of four smaller uplifts separated by NE–SW wrench faults, viz., Pachham Uplift (PU), Khadir Uplift (KU), Bela Uplift (BU) and Chorar Uplift (CU) (Fig. 2a) forming a chain of “islands”. The highland representing the largest uplift and the southern segment of the rift basin adjacent to the Gulf of Kutch is known as the “Kutch Mainland”.

A first order meridional basement high called Median High (MH) extends across the uplifts and the half-grabens (Fig. 2a). This High divides the Kutch Mainland Uplift symmetrically and the Pachham Uplift is situated on it. On the east, the rift basin terminates against the NW–SE trending Radhanpur–Barmer basement Arch that separates this E–W rift and the NW–SE Cambay rift (Fig. 1).

The rifting of the Kutch basin started during the early phase of India–Africa separation in Late Triassic–Early

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