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Dyke Emplacement in the Narmada Rift Zone and Implications for the Evolution of Deccan Traps

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Dykes are primarily extensional fractures that form perpendicular to the minimum principal compressive stress, which have been extensively studied in the world during the past decades for various reasons including the reconstruction of supercontinents/paleocontinents. Deccan Large Igneous Province (DLIP) of India is the product of fissure eruptions with vast lava fields and dyke-sill networks. The DLIP is associated with some rift zones of peninsular India, which reflect the pre-existing weaknesses in the Indian lithosphere (Fig. 1). In rift-zone eruptions, magma is normally transported to the surface via dykes. However, some injected dykes do not reach the surface but are arrested at certain depths in the rift zone due to the mechanical heterogeneity and anisotropy, or

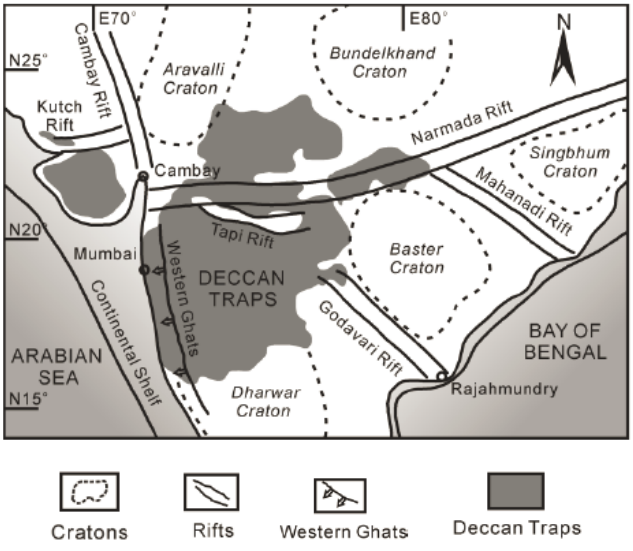

Fig. 1. Geological map showing the rifts and cratons in India.

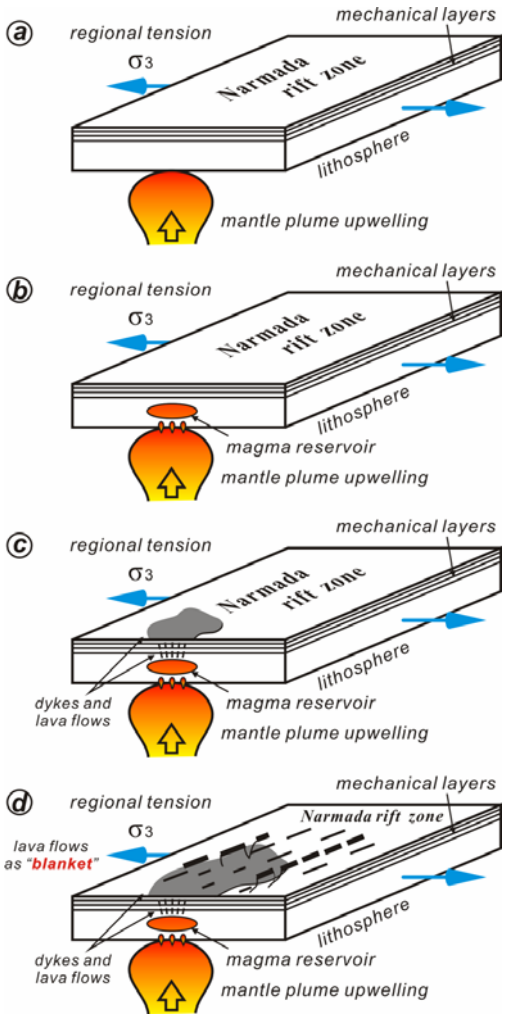

Fig. 2. Schematic illustration of the evolutionary processes and dyke emplacement in the Narmada rift zone. (a) arrival of mantle plume and pre-volcanic extension; (b) formation of shallow magma chambers; (c) vertical dyke injection and fissure eruption, and (d), the "blanket effect" and occurrence of lateral dyke propagation.

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insufficient magma pressure.

In the present study, the effects of mechanical layering and regional tension on dyke emplacement in the Narmada rift zone were studied with geomechanical models and the results indicated that the distribution of the maximum principal tensile stresses was changed by the mechanical layering and/or regional tension, which led to the variations in the potential pathways of dyke propagation. In addition, the studies on dyke evolution and emplacement processes in the Narmada rift zone of India indicated four evolutionary stages as follows (Fig. 2): stage I – the arrival of plume and pre-volcanic extension, stage II – the formation of shallow magma chambers, stage III – vertical dyke injection and fissure eruption, and stage IV – the “blanket effect” and the generation of lateral dyke propagation.