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Utility of combined aeromagnetic and Shuttle Radar Topographic Mission data for geological and structural mapping in the Mesozoic Kutch rift basin, India.

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Kutch is an east-west oriented pericratonic rift basin at the western most periphery of the Indian craton. It is widely believed that the formation of the Kutch rift basin is associated with the breakup of Gondwanaland into Eastern and western in the Mesozoic. In general, the rift basins are found on all the passive continental margins and they provide a record of the early stages of the continental breakup. The architecture of the basins and the basin fill sediments strongly depend on the bounding faults and their displacement geometry, which can be extracted from the sedimentary record. The Kutch rift basin conspicuously featured by the uplifts surrounded by lowlands. It has a distinctive asymmetric structure, having a southward tilt. The uplifts are bounded by major faults at least on one side. Subsurface information is limited in the featureless planes and the basin configuration has been studied only using surface geological data and available geophysical data collected along sparsely spaced profiles. A major challenge in acquiring ground based data over the region is the inaccessibility in the salt covered marshlands of the Great Rann of Kutch and the little Rann of Kutch. To overcome this difficulty and to have a better understanding of the structural configuration of the basin a semi detailed high resolution aeromagnetic data was acquired over the basin. Delineation of the structural lineaments from the crustal magnetic anomaly map is conducted and has been correlated with the available geology of the region. The featureless Banni plain displays long wavelength anomalies indicating the presence of thick sediments and deeper sources. High frequency anomalies present in the south and southwestern part of the basin indicate the presence of trap flows of Deccan event beneath the exposed sediment cover. One major finding is the presence of trap flows to the northwest of Kutch Mainland Fault which has not been previously reported. Different edge detection techniques like analytic signal method, horizontal gradient magnitude and Euler 3D are collectively used for the demarcation of the magnetic/lithologic boundaries, based on which we have identified fourteen major and intermediate lineaments of which very few have surface expressions. The major lineaments are E–W, NE-SW and NW–SE, which represent structural trends associated with different stages of evolution of this rift basin. The deep seated NW-SE lineaments may be associated with the initial rifting of India from Africa, while the NE-SW trends are interpreted to represent the imprints left behind by the interaction of the Indian lithosphere with the Reunion Plume during its northward drifting following Gondwana breakup. Many of these lineaments may have been reactivated many times in the past and may have manifestation up to the surface. Combing aero magnetic data with the digital elevation model extracted from the Shuttle Radar Topography Mission (SRTM) data, we make an attempt to characterize the growth and propagation of these major faults. We have also tried to analyze the seismic activities of the Kutch basin associated with the newly identified active lineaments.