Early Jurassic Dikes as Tectonic Features in Northeastern North America

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Five great dolerite dike systems extend for hundreds of km through northeastern North America. Each dike system contains a distinct tholeiite magma that was generated during the massive igneous paroxysm of 201 Ma (near the Tr-J boundary), and which is part of the enormous central Atlantic magmatic province (CAMP) that preceded the breakup of Pangaea. The individual dike basalts formed via mantle melting and fractionation processes that remain somewhat mysterious, but magmatic pulses of more than 50,000 km3 are evidenced by surface lavas, sills, and large dikes. The dikes crossed several active Mesozoic rift basins and interacted with some extensional basin faults, and they also produced large sills and lava flows within and above Triassic basin strata. Both the basins and the dikes show local trend changes that apparently reflect lithospheric-orogenic fabrics and/or Mesozoic stress systems, as understood from surface observations (maps and measurements). However, the regional trends and distribution of the dikes do not correspond well with the geography and geometry of basin structures.

How can rift-dike fractures be independent of contemporaneous rift-basin faults? Unlike the upper-crustal structures that are mapped as basin controls, the dikes represent much deeper lithospheric fractures that were initiated by upper-mantle dynamics. The process of dike propagation should be similar to hydrofracturing, in which the confining stress pattern is more influential than the anisotropy of the surrounding rock. The dikes intruded both vertically and laterally through the lithosphere as their infilling magmas moved rapidly from individual (?) mantle or deep-lithospheric source zones, a process rarely observed but which is modelled through geophysics and experimental petrology. Despite only small age differences, North American dike systems formed in overlapping swarms with variable trends from NW-SE to N-S to NE-SW along 2500 km of eastern North America. These trends must reflect patterns of mantle movement and shear stress (and perhaps mantle fabrics), which controlled the propagation of fresh extensional dike fractures without regard to crustal