LARGE-MAGNITUDE EXTENSION OF THE DEATH VALLEY DETACHMENT SYSTEM AND EVOLUTION OF THE GARLOCK FAULT

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The Death Valley extensional system has been variously interpreted as having extreme to moderate extension. Large-magnitude slip is based mainly on reconstruction of the Miocene Eagle Mountain Formation in the Nopah Range to a location near the Hunter Mountain batholith in the Cottonwood Mountains for ~100 km of displacement (Niemi et al., 2001). The applicability of the Eagle Mountain Formation as a piercing point was questioned by Christie-Blick et al. (2007). An additional piercing point for the Death Valley detachment system is needed to support, refine, or refute the reconstruction using the Eagle Mountain Formation.

Another possible feature for reconstructing the displacement on the Death Valley detachment system is a set of Miocene rapakivi granites. The Little Chief stock (LCS) of the Panamint Range is in the hanging wall of the detachment system, whereas the granite of Kingston Peak (GKP) in the Kingston Range is in the footwall. These two plutons are distinctive and have similar ages, intrusive structures, and geochemical signatures (Calzia and Ramo, 2005). A possible difference between these plutons is their relative depth of emplacement: the GKP is interpreted to have been emplaced at or less than 4 km depth (Calzia and Ramo, 2005) and the LCS at 1.2 to 2.7 km (McDowell, 1967). Both plutons intrude similar facies Proterozoic Pahrump Group rocks (Prave, 1997), and in part, the GKP intrudes somewhat structurally deeper rocks. Reconstruction of these two plutons into a single intrusive body yields a displacement vector of ~105 km to the WNW, very similar to that from reconstruction of the Eagle Mountain Formation.

This extension model has implications for the evolution of the Garlock fault. The reconstruction of the LCS over the GKP and restoration of the left-lateral slip on the Garlock fault places the Nipton fault in Ivanpah Valley, as an eastern extension of the Garlock fault. The Nipton fault has ~15 km of left-lateral slip (Mahan et al., 2009) and may preserve the early slip history of the Garlock fault. If this interpretation is correct, then the Garlock and Nipton faults were offset by ~90 km of right-slip on the Southern Death Valley fault zone. The timing and details of this scenario may elucidate the evolution of slip on the Garlock and its interactions with the bend of the San Andreas fault.