Zr, Nb, Ta and Th indicate that depleted (DM), enriched (EM) and hydrated (HM) mantle are not diagnostic of plate tectonics. Unlike the mantles of Mars, Vesta and the angrite parent body (APB), the terrestrial mantle was well mixed by 4 Ga, and only after 3 Ga did plate-tectonic mantle reservoirs begin to develop. EM was present on Mars and perhaps on Earth before 4 Ga, but did not become widespread on Earth until 2 and 3 Ga, and it is not present in the Moon, Vesta or APB. On Mars, EM represents mantle heterogeneity from magma ocean crystallization (MOC), whereas on Earth most EM reflects subduction of largely mafic crust into the mantle beginning about 3 Ga. Evidence for HM is not found on Mars, the Moon, Vesta or APB. However, HM does not appear to require subduction in that it is present in Earth by 4 Ga. DM is present on all bodies except the Moon and APB. The strongest geochemical signature in HEDs and volcanic angrites is that of MOC. Low Nb/Ta ratios (14-16) in the mantles of Earth and the Moon probably result from Nb loss to core-forming Fe melts during the early stages of planetary evolution when the bodies were reducing; plutonic angrites and depleted shergottites also show this effect, but HEDs show no evidence of Nb removal during core formation.