REE and Nd isotopic composition of martian crust: implications for the depth of magma ocean on Mars

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The composition of martian enriched reservoir (crust) is investigated by petrological and geochemical modeling based on model mineralogy of martian mantle and isotopic and rare earth elements (REE) compositions of shergottites. The geochemical modeling suggests that Shergotty had contaminated by martian crust of which e-Nd is -12 ˜-20 and CI chondrite normalized La and Lu concentrations are from 35 ˜120 and 15 ˜35, respectively. The petrological modeling is conducted for the martian primordial crusts that are solidified from 100 km, 250 km, 500 km and 1000 km depth of magma ocean. The model is consist of three processes; (1) early melting event of primitive martian mantle to produce magma ocean, (2) precipitation and separation of crystals in the magma ocean and (3) solidification of final residual magma ocean to produce primordial martian crust. The results suggest that most likely martian primordial crust composition is -18 of e-Nd, 92 and 15 of CI normalized La and Lu concentrations, respectively. This result is quite consistent with the result from the geochemical modeling, confirming the martian crust composition. The consistency further suggest that the depth of martian magma ocean could be ca. 250 km and thickness of martian primordial crust could be about half of present day average crustal thickness.