# Crustal evolution on the terrestrial planets: Contrasts in style, timing and composition

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The composition and evolution of planetary crusts are characterized more by differences than similarities. Rather than the terrestrial planetary crusts representing points on a continuum of evolutionary style, crustal evolution is governed largely by stochastic processes that influenced the origin and evolution of the planets themselves.

The Earth's crust is well understood. The continental crust - oceanic crust dichotomy, temporal changes in composition and evolution, role of plume volcanism and growth history of continental crust are larely consequences of evolving plate-tectonic processes.

Mercury is a small, Fe-rich, heavily cratered body with an ancient crust that appears to have a composition and age more similar to the lunar highland than any other planetary surface. The Fe-rich nature of Mercury is likely due to a major late stage impact that disrupted the planet and resulted in preferential accumulation of an iron core and possibly a refractory-rich mantle. No chemical data are available from the mercurian surface but reflectance spectroscopy is consistent with a largely anorthositic crust that is more sodic than lunar highland.

The size and composition of Venus is similar to the Earth, but its geological evolution is very different. Venus is a one-plate planet with an anhydrous near surface environment. The current surface provides limited insight because the planet was resurfaced by basaltic magmatism at about 1 Ga. This young crust is enriched in incompatible elements, with K ranging from 0.1 – 4.0%, suggesting alkaline-rich basaltic compositions. However, low levels of $^{40}$Ar in the atmosphere indicates that mantle differentiation to form the bulk crust resulted in a smaller fraction (about factor of three) of incompatible elements being removed from the mantle, compared to the Earth.

The martian crust is mostly ancient (>3.5 Ga) but volcanism persisted to ~250 Ma. Although proposals of early plate tectonics persist, the weight of evidence suggests that Mars is a one plate planet. The crust, at about 50 km thick, represents 3-4% of the planet and, even with the modest levels of incompatible elements (K~4000 ppm), has had >50% of the incompatible elements removed from the mantle during early crustal differentiation. Young basaltic volcanism, (i.e., SNC meteorites) are derived from highly depleted mantle sources and orbital gamma-ray spectroscopy suggests that there may be secular variations in crustal composition.