# How does galactic chemical evolution affect terrestrial planet composition and tectonics?

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The exoplanet catalogue of terrestrial planets has grown enormously in the past decade, but our ability to characterise these bodies had not. A key unknown is the compositional variation in Earth-scale planets, and how factors such as the evolution of galactic reservoirs may have systematically impacted the composition of planets. Galactic chemical evolution models (GCEs) have been used to calculate the evolution of the interstellar media over time, and have suggested systematic trends in the availability of geophysically-critical elements, such as Fe (relative to Si), and heat producing elements (HPEs) U, Th And K, suggesting a systematic diluting of heat producing elements over time, and an increase in Fe/Si due to increased Type Ia supernova activity since galaxy formation.

Here we test the consequences of these trends for terrestrial planet behaviour, assuming solar:Earth element partitioning for terrestrial Earth-sized exoplanets. The concentration of the geophysically-critical elements determine core size, gravity, and internal temperatures, and govern the geodynamics of these systems. We have varied the Fe/Si ratios/core size of simulated planets, and use a mineral physics package to calculate internal structures, physical properties, and gravity. We then use the mantle convection code Aspect to simulate their evolution. Planets forming early in the Milky Way's history tend to have low Fe/Si ratios, and thus small cores, although elevated HPE budgets. The convection configuration and lower temperature in planets that have large mantle fractions relative to the Earth tends to promote high stress in the lithosphere and cause tectonic activity. Together with weaker surface faults due to lower gravity, such small-core planets show enhanced plate tectonic behaviour. In contrast, currently forming planets have large Fe/Si, core size, higher gravity, and a lower propensity to plate tectonics. Our results suggest a strong tendency towards plate tectonics on Earth-sized planets early in galactic history, with the tendency for tectonics diminishing as the galaxy has evolved.