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Unraveling processes responsible for early Earth crustal generation using stable titanium isotopes - *F.W. Clarke Medal Lecture*

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Plate subduction shapes the physical and chemical characteristics of Earth's surface and deep interior, yet the timing of when this process initiated is debated because rocks are continuously recycled and destroyed through the rock cycle. Researchers have used the geochemical composition of detrital sediments to place constraints on when this process may have started, with estimates spanning nearly all of Earth's history. Stable titanium (Ti) isotopes were recently applied to the detrital sediment record to place constraints on the mafic versus felsic character of exposed continental crust through time, which was possible because of the unique fractionation Ti isotopes experience with differentiation. This study concluded that plate tectonics has been active since the Archean. Since then, a series of studies have probed the mechanism behind this fractionation in magmatic rocks, the influence of physical and chemical weathering on the Ti isotopic composition of detrital sediments, and the role of geodynamic setting on the magnitude and trajectory of Ti isotopic fractionation with respect to magmatic differentiation. Using data from rocks that span the Hadean to early Archean, we show a transition in Ti isotopes from a tholeiitic to calc-alkaline trend similar to what is produced in modern convergent arcs. This trend may demonstrate a shift in continental crust formation from a plume to a subduction-like setting within the craton. One complication with this interpretation is that the effects of partial melting on measured Ti isotopic compositions is not well known. I will then briefly discuss how pressure and temperature may influence Ti partitioning and isotopic fractionation into mineral phases, which may prove even more useful in distinguishing the processes responsible for the generation of Earth's early crust.