The vanadium isotope evidence for emergence of felsic crust after 3 Ga

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The earth is different with other terrestrial planets in having evolved continental crust[1], a feature that is fundamental for evolution of the solid earth, the rise of atmospheric oxygen, and chemical cycling from the crust to the oceans to the mantle. Although it is well accepted that the oceanic crust forms by partial melting of the mantle and is subducted at convergent margins, the origin of the continental crust is still controversial. In particular, there has been recent debate regarding how and whether the continental crust composition has changed over time[2-4].

We measured V isotope compositions for arc lavas and ancient glacial diamictites[5] to constrain the temporal variation of average SiO_2 contents of the continental crust. Vanadium isotope ratios ($\delta^{51/50}V$) are positively correlated with wt.% SiO_2 in arc lavas and they are not obviously modified by alteration during weathering and fluid-rock interaction[6,7]. Therefore, $\delta^{51/50}V$ of glacial diamictites can be used as a reliable proxy for silica contents of the upper continental crust. The $\delta^{51/50}V$ of the diamictites increase from the Archean to the Paleozoic, suggesting that the silica contents of average upper continental crust increased from ~ 49 wt.% at 3.0 Ga to ~64 wt.% at 0.3 Ga. These data define the emergence of felsic continental crust after 3.0 Ga ago, which may have also marked the onset of plate tectonics.

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