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Vanadium isotope fractionation during magma differentiation in the Gangdese batholith, southern Tibet

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Vanadium (V) isotope compositions of igneous rocks have the potential to constrain variations of physico-chemical conditions, especially oxidation states during a number of geological processes, such as the accretion of the silicate Earth, partial melting of the upper mantle, formation of magmatic ore, and magma evolution. However, the mechanism of V isotope fractionation during magmatic differentiation is still challenging to be constrained, which hinders V isotopes as a tracer for the above processes. Here, we present V isotope data (reported as $\delta^{51}V = 1000 \times [(^{51}V/^{50}V_{sample}/^{51}V/^{50}V_{AA})-1]‰$) for 25 fresh igneous rocks (ranging from gabbroic to granitic compositions) from Gangdese magmatic arc in the Himalaya-Tibetan orogenic belt. These samples have SiO_2 contents ranging from 37.9 wt.% to 68.1 wt.%, MgO contents from 1.4 wt.% to 16.7 wt.%, and V from 89 ppm to 661 ppm. Cretaceous samples with MgO > 6.5 wt.% are mostly hornblendite cumulate with $\delta^{51}V$ shifting to slightly higher values from -0.97‰ to -0.68‰. Such fractionation is likely driven by the change of cumulate compositions, such as crystallization of Fe-Ti oxides. Except for one Oligocene sample with the highest MgO content, the rest of the samples contain MgO < 6.5 wt.% and whole rock $\delta^{51}V$ range from -0.83‰ to -0.58‰, revealing a substantially heavier average V isotopic composition (-0.69‰ ± 0.14‰) than the bulk silicate Earth (BSE; -0.91‰ ± 0.09‰) and mid-ocean ridge basalts (MORB; -0.84‰ ± 0.10‰) [1, 2]. The results suggest that magma differentiation from the lower crust to upward will leave the rocks with significantly heavier V isotopic composition.

[1] Wu et al. (2018), *EPSL* 493, 128-139. [2] Qi et al. (2019), *GCA* 259, 288-301.