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Mg and K isotopic variation during the formation of marine glauconite: Insights into the potential of glauconite as the archive of seawater signals

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The potassium isotopic geochemistry of marine authigenic clay minerals has garnered significant attention over the past five years for the potential to reconstruct the marine potassium cycle and trace the temporal evolution of silicate weathering and reverse weathering, which are suggested to regulate long-term climatic changes. Glauconite, a typical marine authigenic clay mineral, contains high levels of magnesium and potassium. Its vibrant colors, ranging from deep green to emerald green, ferromagnetic properties, and relatively large particle size (up to 0.5 to 1 millimeter) distinguish marine glauconite from terrigenous clays. In this work, we study the Mg and K isotope systematics of glauconite-bearing limestone and dolostone to evaluate the potential of glauconite as an archive of seawater signals. Petrological and mineralogical observations reveal that glauconitization in carbonate rocks is characterized by the replacement of calcite by glauconite, whereas dolomites are less susceptible to glauconitization. During this process, Al, Fe, and K contents increase as Ca content decreases. The (Al+Fe+K)/Ca mole ratio is used to express the progress of glauconitization. δ^{26}Mg values rise from -3.5‰ to -0.3‰ as (Al+Fe+K)/Ca contents increase slightly from 0.08 to 0.2, then remain relatively stable despite further increases in (Al+Fe+K)/Ca ratios, ranging from 0.2 to 0.7. We infer that the Mg isotope compositions of glauconitized minerals closely follow a mixing trend between glauconite and calcite end members, resulting in relatively homogeneous δ^{26}Mg values around -0.3‰ when glauconite controls the Mg mass balance. This value is strikingly similar to the Mg isotope compositions of early Cambrian seawater (-0.25‰ to -0.35‰). Given the lack of potassium in calcite, it is assumed that the potassium in marine glauconite is derived from seawater; however, δ^{41}K values exhibit significant variability, ranging from -0.82‰ to -0.39‰.

Reference:

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