

## Feldspars and feldspathoids VIII: The limits of interstitial cations

The plot at right suggests a possible control on the compositions of feldspars and feldspathoids, in that the dashed diagonal line separates the field of known feldspar and feldspathoid compositions (in black) from analogous compositions that have not been found in nature (in gray). The apparent explanation of that boundary is that increasing Al<sup>3+</sup> substitution for Si<sup>4+</sup> (on the horizontal axis) lessens the density of positive charge in tetrahedral sites and thus allows inclusion of interstitial cations of increasing ionic potential or charge density (on the vertical axis). According to this logic, a Mg<sup>2+</sup> or Be<sup>2+</sup> feldspar or feldspathoid could not exist because of the mutual repulsion between the interstitial cation and the tetrahedral cations, whereas cations of lesser ionic potential engender sufficiently little repulsion to allow a stable configuration. Ca<sup>2+</sup> falls somewhere in the middle, able to enter an anhydrous tectosilicate when Al<sup>3+</sup> substitutes for Si<sup>4+</sup> in half the tetrahedral sites but otherwise only able to enter tectosilicates where H<sub>2</sub>O buffers the repulsion of the cations.

One result of all this is that there is no Mg<sup>2+</sup>-bearing feldspar or feldspathoid. Mg is one of Earth's most abundant elements, and feldspars and feldspathoids are collectively among Earth's most abundant minerals, so one might expect there to be an Mg-feldspar. The larger neighbors of Mg<sup>2+</sup> in the periodic table, Na<sup>+</sup> and Ca<sup>2+</sup>, form feldspars, and its smaller neighbor, Li<sup>+</sup>, enters two minerals consisting of Al<sup>3+</sup> and Si<sup>4+</sup> tetrahedra, so size alone fails to explain the absence of an Mg<sup>2+</sup>-bearing tectosilicate. Instead, it appears that the cation-cation

repulsion that Mg<sup>2+</sup> would cause precludes its entry into feldspars and feldspathoids.

Li <sup>+</sup>	Be <sup>2+</sup>	B <sup>3+</sup>	C <sup>4+</sup>
Na <sup>+</sup>	Mg <sup>2+</sup>	Al <sup>3+</sup>	Si <sup>4+</sup>
K <sup>+</sup>	Ca <sup>2+</sup>	Sc <sup>3+</sup>	Ti <sup>4+</sup>
Rb <sup>+</sup>	Sr <sup>2+</sup>		
Cs <sup>+</sup>	Ba <sup>2+</sup>		

