

The effect of pressure on tetrahedral tilting in feldspars

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Feldspars are framework aluminosilicates that comprise approximately 60 percent of the Earth's crust. The defining features of the feldspar framework are corner-sharing TO_4 tetrahedra connected into chains of 4-rings that run parallel to a-axis and b-axis. These 4-rings are connected by their corners and form a 'double-crankshaft' chain parallel to the d (100).

The response of the feldspar structure to pressure is very anisotropic with approximately 60-70% of the volume compression attributed to the length of the crystallographic direction d (100) [1]. It is of interest to undermine the details of this anisotropy and to predict thermodynamic properties and phenomena such as elastic softening for petrologic and geophysical investigations. Previous attempts to predict structural behavior of feldspars have been focused on individual T-O-T angles [2, 3], but this has been unsuccessful in describing structural reasons for either changes or the thermodynamic properties. Megaw (1974) [4] proposed a model that considers four independent tilt systems derived and 2 of the four tilt systems effect the length of the d (100).

Single crystal X-ray diffraction was performed on an ordered plagioclase crystal of 20% anorthite content and structures were determined from 0 – 9.221 GPa. The effect of high pressure on these four different tilt systems have been studied on Na-rich plagioclase from this study and previously measured samples from 0 - 37 % anorthite. I found that 3 of the 4 tilt systems change similarly until 5-6 GPa. After this pressure range, these three tilt systems change behavior. Interestingly, these are the approximate pressures that there is elastic softening seen in the volumes for Na-rich feldspars. The systematics found from this current study are being investigated to see if tetrahedral tilting is a useful tool for predicting the thermodynamic properties and behavior of feldspars at high pressure.

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A new statistical method for modeling mixing of mantle end-members for global MORB and OIB isotopic data

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Long-lived isotopic ratios have been used to identify reservoirs of chemically distinct material in the Earth's interior, typically labeled DMM, EM1, EM2 and HIMU [1, 2]. We have developed a new statistical method that allows us to find best-fitting mixing curves and surfaces for binary and ternary systems, respectively, and we apply this method to global compilations of isotopic ratios ($^{87}Sr/^{86}Sr$, $^{143}Nd/^{144}Nd$, $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$, $^{208}Pb/^{204}Pb$) for MORB and OIB samples in order to rigorously test various mixing hypotheses. The method also allows us to refine isotopic ratio estimates for the putative mantle end-member components, and quantify the misfit between a given dataset and an arbitrary mixing model.

We find that the global suite of MORB data requires at least three end-member components, one of which is DMM, a second that is similar to EM1 but with distinct Pb isotopes defined by samples from the South Atlantic, and a third that is similar to, but nevertheless distinct from, HIMU, defined by samples from the equatorial Atlantic. The global suite of OIB data, on the other hand, requires at least five end-member components, four of which appear to mix with the common component FOZO [3, and references therein]. Some OIB sample sets (e.g. Hawaii, Iceland), however, are difficult to distinguish statistically from the MORB field.

Our mixing analysis focuses on finding the simplest model that fits the MORB and OIB isotopic data and is consistent with the wider body of geochemical evidence. This type of rigorous statistical method is indispensable for analyzing large amounts of complex geochemical data, and it provides an objective means for discriminating between competing models of mantle mixing through formal hypothesis testing.

[1] Zindler & Hart (1986) *Ann. Rev. Earth & Planet. Sci.* **14**, 493–571. [2] Hart, S. R. (1988) *EPSL* **90**, 273–296. [3] Hart *et al.* (1992) *Science* **256**, 517–520.