# $^{87}Sr/^{86}Sr$ of apatites from Altay No.3 pegmatite and its implications

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Introduction: Up to now, there still exists a controversy if $^{87}Sr/^{86}Sr$ ratios in apatites have been perturbed in the alteration process. The purpose of this study is to reveal the variations of Sr isotope in pegmatitic system and its mechanism.

Discussion of the results: The apatites in this study yield high and variable $^{87}Sr/^{86}Sr$ ratios between 0.7922 and 1.2112. Fig.1 shows that the $^{87}Sr/^{86}Sr$ ratios of apatites scatter and have no correlation with their $^{87}Rb/^{86}Sr$ ratios, and data mainly distribute in three regions.

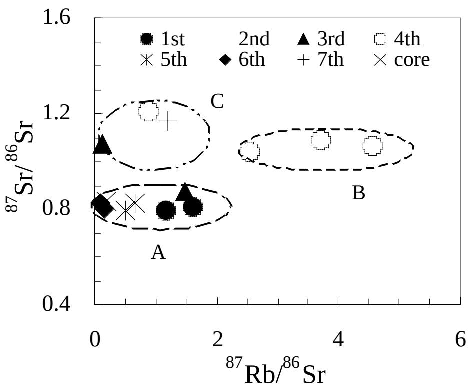


Fig.1. Plot of $^{87}Sr/^{86}Sr$ vs. $^{87}Rb/^{86}Sr$ ratios

The presence of the remarkable "M-type" REE tetrad effects in these apatites indicate they are magmatic in origin. As the $^{87}Sr/^{86}Sr$ of apatites show no correlations with Eu/Eu* and 1/Sr (Figures omitted), it implies that the variations of Sr isotope are independent of the magmatic evolution, and no other Sr sources were mixed during the evolution of magmatic system. So, this work takes into account that Sr isotopes of region C apatites result from isotopic exchange with muscovite, or K-feldspar through the pore fluids, and those of region B apatites are related to processes of dissolution or recrystallization of apatites in the Rb-rich fluid, whereas the $^{87}Sr/^{86}Sr$ ratios of region A apatites maintain a relative constant and may recorder the initial Sr isotope of magmatic system.

Conclusions: The mechanism controlling unusual high $^{87}Sr/^{86}Sr$ ratios in apatites are related to the isotope exchange, and dissolution or recrystallization of apatites in the exsolved magmatic fluid.

# Cooling rates and temperature in eruption columns inferred from the hydrous species geospeedometer

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As a volcanic eruption column ascends into the sky, what is the temperature distribution inside the column? We apply a geospeedometer previously developed in this lab (Zhang et al., 1995, 1997, 2000) to investigate cooling rates of pyroclasts in ash beds of the most recent (~1340 AD) eruptions of the Mono Craters (Sieh and Bursik, 1986). Then we use the cooling rates to estimate the temperature in the part of the eruption where and when the pyroclast cooled through its apparent equilibrium temperature ($T_{ae}$) (that is, when the hydrous species concentrations were frozen in).

Samples of pyroclasts were collected from the Mono Craters ash beds. Unbroken pyroclasts are selected and the size of each estimated. Each sample is then cut and doubly polished. The doubly polished section is analyzed by Fourier transform near-infrared spectroscopy. From each spectrum, the cooling rate at $T_{ae}$ is determined (Zhang et al., 2000).

After obtaining cooling rates as a function of pyroclast size, the results are compared with cooling of obsidian glass in "static" air, allowing us to infer whether the pyroclast cooled through $T_{ae}$ in the eruption column, in flight through air, or in a volcanic bed after deposition. If the pyroclasts cooled through $T_{ae}$ in volcanic beds after deposition, the cooling rates would be independent of clast size but dependent on the position in the beds. If they cooled through $T_{ae}$ in flight through ambient air, the cooling rates would be inversely correlated with clast size and greater than that in "static" air because airflow increases cooling rate. If they cooled through $T_{ae}$ in the eruption column with hot gas surrounding them, the cooling rate would be inversely correlated with clast size but can be less then those in "static" air because the temperature in the eruption column can be high.

Cooling rates of pyroclasts are inversely correlated with sample size and slower than but following a subparallel trend as those in air. Hence we infer that the pyroclasts cooled through $T_{ae}$ in the eruption column. (After cooling through $T_{ae}$, the pyroclasts cooled further in the column and ash bed to room temperature.) From the cooling rates, we can further infer eruption column temperature in the part of the eruption column where and when the pyroclast cooled through its $T_{ae}$. They are 230 to 560°C for the most recent eruptions of Mono Craters. The ability to estimate cooling rates and temperature in part of the eruption columns from eruptive products will provide much needed constraints for dynamic models to understand the eruption columns.