THE EFFECT OF MELT COMPOSITION ON THE PARTITIONING OF TRACE ELEMENTS BETWEEN TITANITE AND SILICATE MELTS

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The aim of this study is to systematically investigate the influence of melt composition on the partitioning of trace elements between titanite and different silicate melts. Titanite was chosen because of its important role as an accessory mineral, particularly with regard to intermediate to silicic alkaline and calc-alkaline magmas [e.g. 1] and of its relative constant mineral composition over a wide range of bulk compositions. Experiments at atmospheric pressure were performed at temperatures between 1150°C and 1050°C. Bulk compositions were chosen to represent a basaltic andesite (SH3 - 53% SiO2), a dacite (SH2 - 65 SiO2) and a rhyolite (SH1 - 71% SiO2). Furthermore, two additional experimental series were conducted to investigate the effect of Al-Na and the Na-K ratio of melts on partitioning. Starting materials consisted of glasses that were doped with 23 trace elements including some selected rare earth elements (La, Ce, Pr, Sm, Gd, Lu), high field strength elements (Zr, Hf, Nb, Ta) and large ion lithophile elements (Cs, Rb, Ba) and Th and U. The experimental run products were analysed for trace elements using secondary ion mass spectrometry at Heidelberg University.

Preliminary results indicate a strong effect of melt composition on trace element partition coefficients. Partition coefficients for rare-earth elements uniformly show a convex-upward shape [2, 3], since titanite accommodates the middle rare-earth elements more readily than the light rare-earth elements or the heavy rare-earth elements. Partition coefficients for the rare-earth elements follow a parabolic trend when plotted against ionic radius. The shape of the parabola is very similar for all studied bulk compositions, the position of the parabola, however, is strongly dependent on bulk composition. For example, isothermal rare-earth element partition coefficients (such as La) are incompatible (D<1) in alkali-rich silicate melts and
strongly compatible (D >> 1) in alkali-poor melt compositions. From our experimental data we present an model that combines the influence of the crystal lattice on partitioning with the effect of melt composition on trace element partition coefficients.