COMPOSITION OF MAGMATIC FLUIDS IN THE HARNEY PEAK GRANITE, BLACK HILLS, SOUTH DAKOTA

Mark L. Grzovic

Advisor: Peter I. Nabelek

ABSTRACT

Fluid inclusions are potential trapped samples of magmatic fluids, and they therefore provide a way to directly measure the composition of magmatic fluids. Understanding the composition of magmatic fluids is important because the fluids can influence the differentiation of magmas and the mobility of elements within igneous systems. The composite Harney Peak granite-pegmatite pluton (HPG) in the Black Hills, South Dakota, is a good location to study the composition of trapped magmatic fluids because of its unaltered and simple mineralogy. The core of the HPG consists of sills and dikes with biotite as the dominant ferromagnesian mineral, whereas tourmaline is dominant ferromagnesian mineral in the perimeter. In this investigation, fluid inclusions in quartz were measured by microthermometry and laser ablation (LA) ICP-MS to determine the composition of the magmatic fluids in the HPG system. Samples were collected from three locations within the HPG system: the core, the perimeter, and from a tourmaline-poor pegmatite, called the "New" pegmatite. Three types of fluid inclusions were identified: inclusions with H_2O+CO_2+salts, inclusions with H_2O+salts, and CO_2-rich inclusions.

Compositions of the inclusions show that magmatic fluids emanating from the HPG and pegmatites contained significant concentrations of Na, K, and Li, but variable concentrations of B. In the tourmaline- and biotite-bearing granites, magmatic fluids contained a significant amount of Na, K, and Li, but little or no B. In comparison with the binary NaCl-H_2O system, many inclusions of these fluids have depressed eutectic and freezing point depression temperatures, which show their complex compositions. In contrast, fluids in the "New" pegmatite contained relatively little Na, but abundant Li, K and B. These inclusions have elevated eutectic and freezing point depression temperatures. Therefore, the data provides strong evidence that in the tourmaline-bearing granites B was retained in the tourmaline whereas in the "New" pegmatite, B was scavenged from the magma by the low salinity fluid and caused tourmaline growth in its wall rocks. The data supports previous inferences that Li enrichments in contact aureoles of pegmatites in the Black Hills were caused by metasomatism from fluids emanating from the HPG.