Experimental study of monazite/melt partitioning

A.S. STEPANOV, J. HERMANN AND D. RUBATTO[1]

The Australian National University, Research School of Earth Sciences, Canberra, Australia

Monazite (LREE, Th)PO_4 is a common accessory mineral and the major host of LREE, Th and U in the Earth's continental crust. Monazite is stable to high temperatures and pressures and is thus a key phase for trace element redistribution during partial melting of crustal rocks. We performed monazite-melt partitioning experiments in a piston-cylinder press over the temperature range 750 to 1200°C and pressures of 10-50 kbar. The starting composition was a synthetic granite mix with about 8 wt% H_2O that was doped with trace elements corresponding to 0.5-3 wt. % of monazite.

Experiments at temperature >800°C and pressure <30 kbar produced melt with monazite. At lower temperatures quartz and plagioclase also formed. At higher pressures, kyanite, coesite, jadeite, apatite, zircon and epidote group mineral start to crystallize. Monazite was produced in all experiments and formed small grains (<5μm across). Laser ablation-ICP-MS analyses of monazite-melt mixes were performed and the monazite composition was calculated using regression analysis. The concentration of some elements was also obtained with Electron Microprobe analysis. These analyses were in good agreement with the monazite compositions obtained by the regression method.

The LREE and Th concentrations of melts coexisting with monazite strongly increase with increasing temperature. The melt composition has less influence on these concentrations. Monazite solubility decreases by 30-40 % with increasing pressure. REE, Th, U, Y and As strongly partition into monazite, whereas other trace elements (Li, Be, B, Sc, Ti, V, Mn, Sr, Zr, Nb, Ba, Hf, Ta, Pb) have monazite/melt partition coefficients lower than 10. Monazite has the highest preference for LREE from La to Nd, with a decrease in partition coefficients for Sm, MREE and HREE. Difference in partitioning of of LREE and HREE tend to decreases with increase of temperature and decrease with increase of pressure. Th partition coffecients are 30 % higher than those for LREE and are indipendent of pressure and temperature. Partition coefficients for U are much lower than for Th and LREE.

The new experimental data provide a basis for calculation of factionation of LREE, Th and U during fractional cristalization and melting in the presence of monazite at crustal conditions and in subduction zones.

Aerosol, clouds, precipitation, radiation, and climate; A global perspective

GRAEME L. STEPHENS

Jet Propulsion Laboratory California Institute of Technology 4800 Oak Grove Dr Pasadena, CA, 91109

The cloud systems of our planet fundamentally shape our climate in the way they affect the flow of radiation in and out of the planet and in the way they connect key processes together to form the hydrological cycle. Despite the many years of cloud observations from space, we have not gained much insight into these key roles. Information about cloud particle size from satellite radiometers, for example, has been derived now for more than two decades but we still have not convincingly determined if this information is in fact related to real cloud physical properties. Nevertheless correlation between this remote sensing particle size information and aerosol content now serves as a basis for parameterization of the so-called indirect effects in climate models, a key tuning knob of climate model sensitivity. Similarly we have also observed precipitation from space for many years but have not been able to tie these observations to actual cloud physical processes and thus precipitation observations alone offer little real insight into how precipitation is likely to be shaped by the broader environment in which it forms. In this talk, we demonstrate that new observations now available for Earth orbiting satellites, when combined together, are advancing our understanding of the processes that connect aerosol, cloud and precipitation together and in turn provide a unique view on how these processes alter the planet's radiation balance. New insights on the effects of aerosol on cloud physical properties will be described as well as how these in turn affect both the water and energy balance of planetary cloud systems. The relevance of these new insights to the climate system and climate change will be emphasized.