

Olivine-melt partitioning and Henry's Law revisited...

K.J. GRANT AND B.J. WOOD

Department of Earth and Planetary Sciences, Macquarie University, Sydney, Australia

The applicability of Henry's Law to the crystal-liquid partitioning behaviour of trace elements has proved one of the most long-standing and controversial issues in the geological literature. Experimental studies indicate that there may be a lower concentration limit below which Henry's law is no longer obeyed. This observation, which has serious implications when applying partitioning data to natural systems, has never been fully explored. It was the focus of this experimental study.

Deviations from Henrian behaviour can imply that the mechanism by which impurity elements are incorporated changes with impurity concentration. We therefore measured the distribution of different dopant elements between olivine and melt as a function of concentration. Starting materials in Di-Fo and Alb-Fo systems were prepared and different concentrations of trace or major element dopants added. Olivine crystals were produced during crystallisation experiments in a 1atm furnace. Mineral and quenched melt compositions were determined in situ using electron microprobe and LA-ICPMS analyses.

Our results indicate that there is a lower limit to Henrian behaviour for every dopant element studied. We also show that for certain elements (e.g. Li, Ti, Sc) the limit of Henrian behaviour is marked by a sharp increase in distribution coefficient, whilst for others (e.g. Ga, Ni) a marked decrease is observed. Our observations also provide experimental criteria for the application of Henry's Law to the distribution of impurity elements in natural systems.