*American Mineralogist, Volume 84, pages 1693–1710, 1999*

# PRESIDENTIAL ADDRESS

# Lithologic partitioning of fluids and melts

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## ABSTRACT

Under conditions of mechanical equilibrium, the grain-scale distribution of fluid or melt in a lithologically complex system is governed by the relative energies of the mineral-fluid interfaces and the grain boundaries. Accordingly, spatial changes in mineralogy imply accompanying changes in the connectivity and even the amount of fluid (or melt) present at equilibrium. The hypothesized phenomenon of local variation in fluid or melt abundance with spatial changes in mineralogy is referred to here as *lithologic partitioning* of fluid or melt. The phenomenon is potentially important because it could lead to the existence of highly permeable (or impermeable) zones in lithologically complex regions of the crust and upper mantle.

To verify and evaluate the concept of lithologic partitioning of aqueous fluid, experiments were conducted in simple analog systems by annealing juxtaposed cylinders of two different rock types at 700–925 °C and 1.0–1.5 GPa. These polycrystalline fluid partition couples included the following rock pairs: calcite-fluorite, quartz-fluorite, and quartz-clinopyroxene, with overall aqueous fluid volume fractions ($\phi$) ranging from ~0.015 to 0.10. In calcite-fluorite couples, fluid is partitioned by a factor of ~1.5–5 into the fluorite (the actual value depends upon the chemical purity of the fluorite). In fluorite-quartz couples, the fluid is partitioned into the quartz by a factor of 2–5, and in quartz-clinopyroxene couples it is enriched in the clinopyroxene by a factor of ~3. Similar experiments were done in a partially molten mantle system by juxtaposing peridotite and orthopyroxenite cylinders in the presence of ~6% basaltic melt. In this case, however, no preference of the melt for one host rock relative to the other could be verified. In general, lithologic partitioning is a factor to be reckoned with as we seek understanding of fluid-related petrologic and geochemical phenomena: the effect is clearly capable of rapid and significant re-distribution and localization of fluids in mineralogically variable systems.