Thermal diffusion in the laser heated diamond anvil cell sample

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We widely investigated the chemical heterogeneity caused by thermal diffusion effect in the laser heated diamond anvil cell (LHDAC) sample. Fe bearing perovskite, (Fe,Al) bearing perovskite, (Mg,Fe)O ferropericlase, $(Mg,Fe)_2SiO_4$ composition, pyrolitic composition and granitic composition were tested with various cell assemblage. The heating was conducted with double sided heating technique and achieved temperature was below solidus. Recovered samples were chemically analyzed by field-emission-type electron probe microanalyzer (FE-EPMA, JXA-8500F). The results demonstrate that (1) synthesized perovskite is more chemically heterogeneous than annealed ferropericlase, (2) strong and complicated chemical heterogeneity is generated in multi phase system, (3) the cations with larger ionic radius (such as Mg, Fe and K) favor cold end, (4) strong heterogeneity is generated in the sample with powder laser absorber, (5) the heterogeneity is well restrained by the foil laser absorber. The chemical heterogeneity may be a result of large temperature gradient in the LHDAC sample especially along compressional axis (up to several ten kelvin per micrometer), and it can be reduced by more homogeneous temperature distribution achieved by foil laser absorber. The results suggest that the inconsistency between previous LHDAC studies about thermoelastic parameter or element partitioning coefficient may be a result of chemical heterogeneity in the sample. It should be reexamined with careful treatment of chemical heterogeneity.