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Diffusion of Co, Mo in FeNi alloy at high pressure
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Seismic observations have shown that the PKIKP waves propagate faster in the north-south direction than in the equatorial plan (Poupinet et al., 1983), which might be caused by dislocation creep (Van Orman, 2004). On the other hand, observation of the seismic velocity structure at the top of the Earth inner core shows that the the eastern hemisphere is faster than in the western hemisphere (Niu & Wen, 2001), and they proposed that this might be caused by intrinsic chemical heterogeneity during inner core formation or temperature heterogeneity at the base of outer core. Siderophile elements (SEs) can partition into the inner core during the inner core-forming processes and its distribution can cause the chemical heterogeneity. Iron?nickel alloys are the principal constituents of the Earth core, and their chemical diffusion properties are important for understanding physical and chemical processes in the Earth inner core. If we could obtain diffusivity of SEs in Fe-Ni alloy, the chemical heterogeneity in the inner core and creep mechanism might be solved.

In this study, we measured diffusion coefficients of Mo, Co in fcc FeNi alloy at different conditions to determine pressure dependence on diffusivity. We conducted the experiments in four steps: 1) Synthesis of the Fe-Ni alloys of starting materials by piston cylinder (PC) apparatus at 1400 degree C and 1 GPa. 2) Diffusion runs by the piston cylinder at 1 GPa, and the Kawai-type multi-anvil apparatus (KMA) at different conditions of 7 GPa ,15 GPa and 22GPa and at different temperature conditions of 1200, 1400, 1600 degree C for 1˜30 hours. 3) Analysis of diffusion profiles by electron probe micro-analyzer (EPMA). 4) Determination of the diffusion coefficient by fitting the diffusion profiles to Crank function using non-linear least squares method.

Our results show that: 1) Pressure has a negative effect on diffusivity of Co and Mo, and activation volumes are similar to those of Pd, Re and Au. 2) Temperature has a large positive effect on diffusivity, and activation energies are larger than those of Pd, Re and Au. 3) Atomic number has no effect on diffusivity of SEs, and diffusion coefficients of different SEs keep in same level. 4) Diffusion can not make the original heterogeneity of inner core became homogeneous.

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