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# マントルかんらん岩の温度圧力履歴の多様性とそのリソスフェア-アセノスフェア相互作用における意義
# Diversity in PT history of exhumed mantle peridotites and its implication in lithosphere-asthenosphere interaction

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Pressure and temperature history of exhumed mantle peridotites shows significant diversities, which may be attributed to several factors such as: (1) lithospheric thermal gradient before exhumation, (2) rate of tectonic motion and thermal and mechanical conditions during exhumation, (3) thermal perturbation shortly before or during exhumation of lithosphere such as episodic asthenospheric thermal convection with lithosphere erosion and related magma generation, and transportation, (4) lithosphere formation or growth from asthenosphere through melting and melt separation and subsequent exhumation. These factors may, conversely, be estimated from the mantle peridotites if each effect can be isolated from the others by considering tectonic environment where the mantle peridotite resided and exhumed. The first factor is recorded as the initial condition of exhumation potentially providing information on steady-state mantle heat flow. The second is recorded as compositional zoning of minerals in terms of elements sensitive to PT change. Among these factors, (3) and (4) represent direct thermal and mechanical interactions between lithosphere and asthenosphere and are examined by whole-rock compositions and its heterogeneity constraining thermal condition of melting and melt segregation processes if they were involved (e.g., abyssal peridotite exposed along mid-ocean ridges). The following cooling and thermal relaxation are recorded as compositional zoning in minerals and chemical heterogeneity in a composite lithology over the scale of more than a few centimeters.

These approaches are similarly applicable to any types of mantle peridotites such as orogenic peridotites, mantle section of ophiolites, and mantle xenoliths in alkali basalt and kimberlite. Xenoliths can provide instantaneous thermal states of the mantle up to the depth as deep as a few hundreds km, and is superior in examination of (1) and (3). Contrary to this, intrusive peridotites always underwent slow exhumation process more or less obscuring lithospheric information, and is superior in examination of (2) and (4).

Following the above strategy, thermal histories of three peridotite bodies from world orogenic belts are compared. These are the Horoman peridotite in the Hidaka belt, peridotite bodies in the Pyrenees, and Ronda in the Betic Cordillera. The common feature of these peridotites is that they were initially resided in the garnet stability field before decompression. There are, however, several distinctions: (1) garnet in any rock types is completely transformed into low pressure mineral assemblage (symplectite) in Horoman, garnet in pyroxenites remains but that in peridotites is completely transformed into symplectites in Pyrenees, and garnet remains in peridotites as well as in pyroxenites in Ronda, (2) orthopyroxene in garnet- or symplectite-bearing rocks shows remarkable M-shaped Al zoning in Horoman, weaker but distinct M-shaped in Pyrenees, and very weakly developed in Ronda, (3), orthopyroxene in peridotite and pyroxenites has a Ca-rich margin in Horoman, but such features are not common in Pyrenees and Ronda, and (4) topotaxy is always established in two-pyroxene spinel symplectite in Horoman (Odashima et al., 2008) but not so in Ronda (R. Nagashima, personal communication). These systematic relationships suggest that dP/dT was very small or even negative in Horoman (~adiabatic or heating during exhumation), moderate in Pyrenees (~adiabatic), and large in Ronda (effective cooling with decompression). It is inferred that exhumation accompanying active asthenospheric thermal perturbation took place in Horoman, passive exhumation in Pyrenees, and transportation towards the cooler region probably in a subduction environment in Ronda, in spite of the suggested asthenospheric thermal perturbation in the spinel and plagioclase facies in Ronda (Garrido et al., 2010).

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