

Ultrahigh-pressure podiform chromitites as a possible deep recycled material

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Ultrahigh-Pressure (UHP) Chromitites

Podiform chromitites, which appear in the Moho transition zone to upper mantle of ophiolites, have been considered to be of origin of low-pressure almost *in-situ* magmatic cumulates [1]. The discoveries of diamond and other UHP minerals (e.g., Robinson *et al.*, 2004) from chromitites of Tibet seriously requires us to reconsider the origin(s) of podiform chromitites. Various features of the UHP chromitites can be explained by recycling of the ordinary low-P chromitites (Fig. 1).

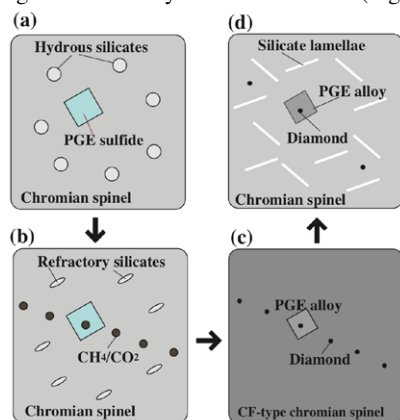


Figure 1: UHP signatures formed by deep recycling of low-P chromitites (Arai, 2010).

Chromitites from the Oman Ophiolite

Only concordant chromitites, which we examined at Wadi Hilti, the Oman ophiolite, have some UHP-like signatures, e.g., pyroxene lamellae in spinel (Fig. 1d). Discordant ones show features of low-P magmatic generation (Fig. 1a). The former possibly have a deep recycling origin.

[1] Arai & Yurimoto (1994) *Econ. Geol.* **89**, 1279-1288. [2] Robinson *et al.* (2004) *Geol. Soc. Spec. Pub.* **28**, 551-560. [3] Arai (2010) *J. Mineral. Petrol. Sci.* **105**, 280-285.

Time variation of He and Ar isotopic compositions in the Earth's atmosphere

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It is very important to study the origin and evolution of the Earth's atmosphere. Noble gas isotopes could be useful tools to trace the degassing history of the Earth. In this study, we have examined the time variation of helium and argon isotopic ratios in the Earth's atmosphere using our previous models on mantle degassing [1, 2, 3].

We thought that the Earth was initially uniform in isotopic compositions of noble gases but was divided into three separate reservoirs and that individual elements were carried by mass flow between reservoirs. The mass flow has decreased exponentially as a function of time. The details of the calculation and the isotopic ratios of He and Ar in the mantle are given in our previous papers [2, 3].

Our calculation for the terrestrial air shows that the $^{40}\text{Ar}/^{36}\text{Ar}$ ratio increased rapidly after the formation of the Earth and has been almost identical to the present value of 295.5 for the last 1 b.y. For the $^3\text{He}/^4\text{He}$ ratio calculation, we need to consider the escape of helium into the space. We put the escape terms for ^3He and ^4He amounts in air estimated from the present atmospheric He budget. In this case, we get a good agreement for the ^3He amount in the present air, but can not calculate the present ^4He content without a very low escape rate of ^4He . In our previous models [2, 3], we assumed that all the noble gases transferred into the continental crust remained there. However, if we assume that all the helium in the continental crust is released to the air as the helium is a tiny element, our calculation shows that both ^3He and ^4He concentrations (and, therefore, $^3\text{He}/^4\text{He}$ ratio) agree very well with the modern-day observed values. The calculated time variation of the $^3\text{He}/^4\text{He}$ ratio shows that the $^3\text{He}/^4\text{He}$ ratio in air is also constant since 0.1 b.y.

Thus we conclude that the detection of modern-day atmospheric ratio of He and Ar in the ancient terrestrial samples younger than 0.1 b.y. is not always due to the contamination by the modern-day atmosphere.

[1] Matsuda and Marty (1995) *Geophys. Res. Lett.*, **22**, 1937-1940. [2] Kamijo *et al.* (1998) *Geochim. Cosmochim. Acta*, **62**, 2311-2321. [3] Seta *et al.* (2001) *Earth Planet. Sci. Lett.*, **188**, 211-219.