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Composition and Textual Characterization of Platinum-group Mineral (PGM) in Chromites from Zedang Ophiolite in Tibet, China

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1 Introduction

Platinum-group elements (PGE) are mainly concentrated in some specific minerals known as PGMs, which commonly occur in podiform chromites of ophiolites. In-situ PGM assemblages in chromites can provide valuable information on the physico-chemical nature of the parental melt(s) from which chromitite crystallized (Melcher et al., 1997), and used as a significant petrogenetic indicator.

Recent experiments (Barnes et al., 2001; Stockman et al., 1984) also demonstrated that temperature and fS2 are the main factors controlling the formation of laurite and/or IPGE alloys at the initial magmatic stage. This present work firstly reports the distribution of PGMs in ZeDang ophiolitic chromitites by electron microprobe in-situ investigation of polished sections, with the aim to explore significance of the PGM assemblages and to identify the petrogenetic nature of the parental melt of chromitites. *

2 Textual and Mineralogical Assemblage Characterization of PGM

The distribution of PGM within chromitite is inhomogeneous in the Zedang ophiolite. The results suggest that PGMs occur as inclusions or as small interstitial granules between chromitites, most of which are less than 10 μm in size and vary in shape from euhedral through subhedral to anhedral. They can be in the form of both single and composite (biphase or polyphase) grains composed of PGM solely, or PGM associated with silicate grains. Os-, Ir-, and Ru-rich PGMs are the common species and Pt-, Pd-, and Rh-rich varieties are not identified. Voluminous PGM inclusions including erlichmanite $(Os,Ru)S_2$, laurite $(Ru,Os)S_2$, irarsite (Ir,Os,Ru,Rh)AsS as well as native osmium Os(Ir) and BMS inclusions, including millerite NiS, heazlewoodite Ni_3S_2, covellite CuS, and digenite Cu_3S_2, and native iron, have been identified in chromitites from the Zedang ophiolite through petrological observations and electron microprobe analyses.

There was a great variety of BMS associated with PGM in current work. These, mainly consisted of the following minerals with decreasing order of abundance: heazlewoodite (Ni_3S_2), millerite (NiS), covellite (CuS), digenite (Cu_3S_2) and iron (Fe). Those BMS minerals are usually anhedral and have a range of 10-20μm in grain size, of which are usually intergrown with altered silicate intergranule in chromian spinel.

3 Significance of Platinum-group Mineral and Geodynamic Setting

Sulfur fugacity and temperature are the primary factors controlling PGE mineralogy in the initial stages of crystallization of the host chromitite in the upper mantle. PGM associated with chromitites are generally controlled by the sulphur fugacity and the temperature of the magma (Augé et al., 1988). Experiment results show that Os-rich laurite is stable at high sulfur fugacity and low temperature, whereas Os-Ir alloys are stable at relatively lower sulfur fugacity and higher temperature (Uysal et al., 2015). The PGM assemblage of Zedang ophiolitic chromites is dominated by Ru-Os-Ir-bearing mineral phases (erlichmanite, laurite, irarsite and osmium) with BMS and silicate inclusions. The formation of diverse

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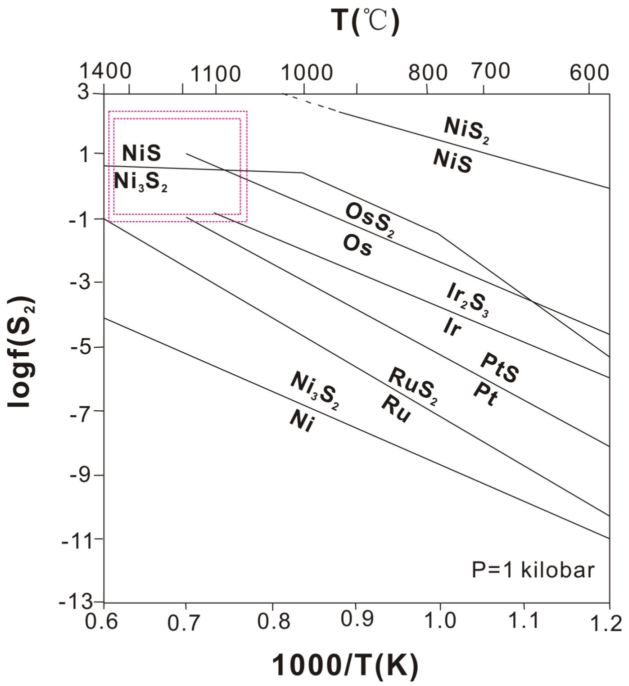

Fig. 1. Metal-sulphide equilibrium curves for Ru-Ir-Pt-Os and Ni as a function of sulphur fugacity (expressed as log fS_2) and temperatures (T).
The rectangle shows the proposed magmatic trend of fS_2-(T) in Zedang chromitites after (Stockman and Hlava, 1984)

PGM assemblages, suggesting that the PGM formed in a range of temperatures and fS_2 (Fig.1). In the early stages, euhedral alloys formed in high temperature and low fS_2 physicochemical conditions (1300-1000℃, 10^{-1} to 10^{-3} atm). During progressively uprising mantle with decreasing temperature and increasing fS_2, the sulfides-sulfarsenides and BMS formed in order. Interstitial BMS sulfides are usually anhedral or amoeboid, indicating that they have been trapped as liquids during chromitite formation. This is consistent with the composition of chromian spinel and their inferred primitive parent magmas, which have boninitic affinities that relate an arc environment at the last stage. Therefore, the primary platinum group minerals (PGM) assemblages in chromitites represent pristine magmatic phases, trapped in crystallizing chromite at high temperatures. These can provide valuable petrogenetic information regarding the physicochemical nature of the parental melt(s).

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