American Mineralogist, Volume 109, pages 2127–2141, 2024

Geochemical characteristics of mineral inclusions in the Luobusa chromitite (Southern Tibet): Implications for an intricate geological setting

Fahui Xiong[1,2,*], Basem Zoheir[3,*,†], Xiangzhen Xu[1], Guolin Guo[4], Matthias Frische[5], and Jingsui Yang[1,2]

[1]Center for Advanced Research on the Mantle (CARMA), Key Laboratory of Deep-Earth Dynamics of Ministry of Land and Resources, SinoProbe Laboratory, Institute of Geology, Chinese Academy of Geological Sciences, Beijing 100037, China
[2]Research Center of Continental Dynamics, College of Earth Science and Engineering, Shandong University of Science and Technology, Qingdao, China
[3]Department of Geosciences, King Fahd University of Petroleum and Minerals, Dhahran 31261, Saudi Arabia
[4]School of earth sciences, East China University of Technology, Nanchang, 330013, Jiangxi, China
[5]GEOMAR Helmholtz Centre for Ocean Research Kiel, Wischhofstr. 1-3, 24148 Kiel, Germany

Abstract

The Luobusa chromitite and ophiolite present a captivating geological feature marked by peculiar mineralogical and geochemical characteristics. Abundant platinum-group minerals (PGM), base-metal sulfides (BMS), and PGE-sulfides and alloys in the chromitite reveal a multistage genesis, encompassing partial mantle melting, melt-rock interactions, and dynamic shifts in oxygen and sulfur fugacities (f_{O_2}, f_{S_2}). The geochemical signatures and PGE patterns of these mineral inclusions elucidate the evolutionary process of the Luobusa ophiolite, tracing its transition from a sub-ridge environment to a sub-arc setting. The variable ΣPGE values (40–334 ppb) in chromitite, coupled with notably lower ΣPGE values (10–63 ppb) in dunite imply extensive melt fractionation and melt-rock interactions. Coexisting well-crystallized Os-Ir alloys alongside interstitial BMS likely reflect low f_{S_2} and high temperatures during the early formational stages, whereas abundant anhedral or irregular sulfarsenide and pyrite inclusions in chromite point to lower temperatures and higher f_{S_2} during the late stages. The trace element composition of pyrite inclusions displays some of the characteristics of mid-ocean ridge (MOR) and oceanic island rocks, manifesting the interplay of diverse magmatic sources during the evolution of the Luobusa ophiolite.

Keywords: Luobusa ophiolite, SW Tibet, chromitite, PGM and BMS inclusions, genetic model