American Mineralogist, Volume 105, pages 1609–1621, 2020

Parageneses of TiB_2 in corundum xenoliths from Mt. Carmel, Israel: Siderophile behavior of boron under reducing conditions

William L. Griffin[1,*,‡], Sarah E.M. Gain[1,2], Martin Saunders[2], Luca Bindi[3,†], Olivier Alard[1], Vered Toledo[4], and Suzanne Y. O'Reilly[1]

[1]ARC Centre of Excellence for Core to Crust Fluid Systems (CCFS) and GEMOC, Earth and Planetary Sciences, Macquarie University, New South Wales 2109, Australia
[2]Centre for Microscopy, Characterisation and Analysis, The University of Western Australia, Western Australia 6009, Australia
[3]Dipartimento di Scienze della Terra, Università di Firenze, Via La Pira 4, I-50121 Florence, Italy
[4]Shefa Gems, Netanya 4210602, Israel

Abstract

Titanium diboride (TiB_2) is a minor but common phase in melt pockets trapped in the corundum aggregates that occur as xenoliths in Cretaceous basaltic volcanoes on Mt. Carmel, north Israel. These melt pockets show extensive textural evidence of immiscibility between metallic (Fe-Ti-C-Si) melts, Ca-Al-Mg-Si-O melts, and Ti-(oxy)nitride melts. The metallic melts commonly form spherules in the coexisting oxide glass. Most of the observed TiB_2 crystallized from the Fe-Ti-C silicide melts and a smaller proportion from the oxide melts. The parageneses in the melt pockets of the xenoliths require $f_{O_2} \leq \Delta$IW-6, probably generated through interaction between evolved silicate melts and mantle-derived CH_4+H_2 fluids near the crust-mantle boundary. Under these highly reducing conditions boron, like carbon and nitrogen, behaved mainly as a siderophile element during the separation of immiscible metallic and oxide melts. These parageneses have implications for the residence of boron in the peridotitic mantle and for the occurrence of TiB_2 in other less well-constrained environments such as ophiolitic chromitites.

Keywords: Titanium boride, reducing conditions, siderophile element, Mt. Carmel, paragenetic studies; Lithium, Beryllium, and Boron: Quintessentially Crustal