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# Role of Chemosynthetic Thermophilic Communities on the Biogeochemical Cycles of Minerals in the Orca Seamount Area, Antarctica

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**ABSTRACT**

The Orca Seamount is a submarine volcanic structure, located in a tectonic area of the Bransfield Strait, characterized by cortical extension and roll back-type subduction. Recent investigations have described the presence of hydrothermal activity and thermophilic microorganisms in this submarine volcano, raising questions regarding the role these microorganisms might play in the environment. The presence of hydrothermal activity interacting with cold Antarctic marine waters has probably exerted a great impact on the chemistry of the Orca Seamount area, providing different types of substrates capable to support complex microbial communities. In this work, we further study the Orca Seamount area with respect to the mineralogy present in this environment and the role microorganisms might play in the biogeochemical cycles. Here we show that the assemblage of minerals detected in the Orca Seamount area is like those commonly found in other hydrothermal environments, consistent with previous investigations reporting hydrothermal activity in this zone. Sulfur- and iron-bearing minerals in addition to inorganic soluble compounds are able to support chemosynthetic microbial communities inhabiting the Orca Seamount. The role of these microorganisms on the sulfur, iron, and carbon cycle is discussed and analyzed in the context of the mineralogy and conditions of the environment.

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## Introduction

Although Antarctica can be regarded as a cold continent, several areas with geothermal activity have been described including both terrestrial and marine thermal features (Flores et al. 2013) such as those located in the Bransfield Strait between the Antarctic Peninsula and the South Shetland Islands (Figure 1(a)). Their tectonic setting and geological evolution have defined the opening of the Bransfield Strait, through a back-arc basin rift, along with the development of active volcanism (Galindo-Zaldívar et al. 2004; Pedrera et al. 2012; Petersen et al. 2004; Solari et al. 2008; Somoza et al. 2004). Evidence of hydrothermal activity within the Bransfield Strait is associated with marine volcanic edifices such as Deception Island, a stratovolcano where both terrestrial and marine geothermal sites are present (Rey et al. 1995; Somoza et al. 2004). Recent studies on the Orca Seamount, an apparently inactive submarine volcano, demonstrated current activity of thermal fluids and magmatism, detected by means of standard conductivity, temperature and depth (CTD) sensors and beam transmission measurements (temperature anomaly and turbidity), gas measurements (Helium-3 isotope), microbiological analyses and seismic activity, around the volcanic structure (Kanao 2014; Rodrigo et al. 2018).

The detection of hydrothermal fluids is of paramount importance in ocean/earth sciences and environmental microbiology, not only because of its tectonic significance, but also due to its great impact on the chemistry of oceans (Dick et al. 2013), creating local environments characterized by redox gradients of inorganic compounds in conjunction with changing concentrations of soluble and insoluble substrates, affecting chemosynthetic microbial community compositions and activities (Price and Giovannelli 2017). Although previous investigations reported the presence of the thermophilic microorganism in the Orca Seamount area (Rodrigo et al. 2018), the potential role of these microorganisms in this environment is unknown. Moreover, the types of minerals capable of supporting microbial communities in this environment have not been reported before. In this work, we used an integrated set of analyses aiming to further improve the current knowledge on the potential role microorganisms inhabiting the Orca Seamount area might have on the biogeochemical cycle of minerals, discussing these results in the context of its environmental conditions and mineralogy.

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