



Estimation of the CO₂ flux from Furnas volcanic Lake (São Miguel, Azores)



César Andrade^{a,*}, Fátima Viveiros^a, J. Virgílio Cruz^a, Rui Coutinho^a, Catarina Silva^{a,b}

^a CVARG – Centre of Volcanology and Geological Risks Assessment

^b CIVISA – Centre for Information and Seismovolcanic Surveillance, Azores Department of Geosciences, University of the Azores Apartado, 1422 9501-801 Ponta Delgada, Portugal

ARTICLE INFO

Article history:

Received 26 October 2015

Accepted 9 February 2016

Available online 19 February 2016

Keywords:

Volcanic lakes
Diffuse CO₂ degassing
CO₂ flux
Island hydrology
Azores archipelago

ABSTRACT

A study on diffuse CO₂ degassing was undertaken at Furnas lake (São Miguel island, Azores) in order to estimate the total diffuse CO₂ output and identify anomalous degassing areas over the lake. Furnas lake is located in Furnas Volcano, the easternmost of the three active central volcanoes of the São Miguel island. The lake has an area of 1.87 km² and a maximum length and width equal to 2025 and 1600 m, respectively. The maximum depth of the water column is 15 m and the estimated water storage is 14×10^6 m³. Lake water temperature is cold, with temperature values between 13 °C and 15 °C in the winter period and 18.9 °C to 19.3 °C in early autumn, and the variation along the water column suggests a monomictic character. The major-ion relative composition is in decreasing order Na⁺ > K⁺ > Ca²⁺ > Mg²⁺ for cations and HCO₃⁻ > Cl⁻ > SO₄²⁻ for anions, and conductivity and pH measurements, respectively in the range of 152 to 165 μS cm⁻¹ and 5.3 to 8.7, suggests that Furnas has neutral-diluted waters and can be classified as a non-active lake. Diffuse CO₂ flux measurements were made using the accumulation chamber method with a total of 1537 and 2577 measurements performed in two different sampling campaigns. The total amount of diffuse CO₂ emitted to the atmosphere was estimated between 28 and 321 t km⁻² d⁻¹, respectively, in the second and first sampling campaigns, corresponding to ~52 and ~600 t d⁻¹. The main anomalous degassing area identified over the Furnas lake during both surveys is probably associated to a WNW–ESE trending tectonic structure. Other secondary areas are also suggested to be tectonically influenced. Identified anomalous areas showed similarities to the ones observed during previous soil CO₂ degassing studies.

© 2016 Elsevier B.V. All rights reserved.

1. Introduction

Volcanic lakes provide an insight into volcanic systems and present a large range of chemical characteristics, from high total dissolved solid (TDS) brines to meteoric waters (Christenson et al., 2015; Varekamp, 2015). The emission and dynamics of CO₂ in volcanic lakes have been studied worldwide in the last years in order to characterize active volcanic systems, representing an important potential volcanic hazard and contributing to improve the Earth carbon budget (Kusakabe et al., 2008; Padrón et al., 2008; Mazot and Taran, 2009; Hernández et al., 2011; Mazot et al., 2011; Pérez et al., 2011; Caudron et al., 2012; Chiodini et al., 2012; Arpa et al., 2013; Mazot and Bernard, 2015). As CO₂ is the predominant carbon species in volcanic gases the magmatic–hydrothermal environment is of great interest in studies regarding water chemistry in crater lakes located in active volcanoes, nevertheless keeping in mind other origins such as the meteoric and biogenic carbon sources (Christenson and Tassi, 2015).

As approximately 12% of the 714 Holocene-age volcanoes host crater lakes (Rowe et al., 1992; Simkin and Siebert, 1994) further characterization of the CO₂ flux in these water bodies is needed in order to constrain

diffuse CO₂ degassing estimates in volcanic areas. Nevertheless, following the first diffuse degassing measurements performed in crater lakes using the floating accumulation chamber technique (Kling et al., 1991), application to volcanic crater lake emissions were initiated afterwards (Bernard et al., 2004; Bernard and Mazot, 2004). Pérez et al. (2011) estimated a global CO₂ emission for worldwide volcanic lakes in 104 Mt yr⁻¹, a value similar to the one proposed by Burton et al. (2013; 94 Mt yr⁻¹). This latter value corresponds to about 18% of the total subaerial volcanic CO₂ emission (540 Mt yr⁻¹; Burton et al., 2013).

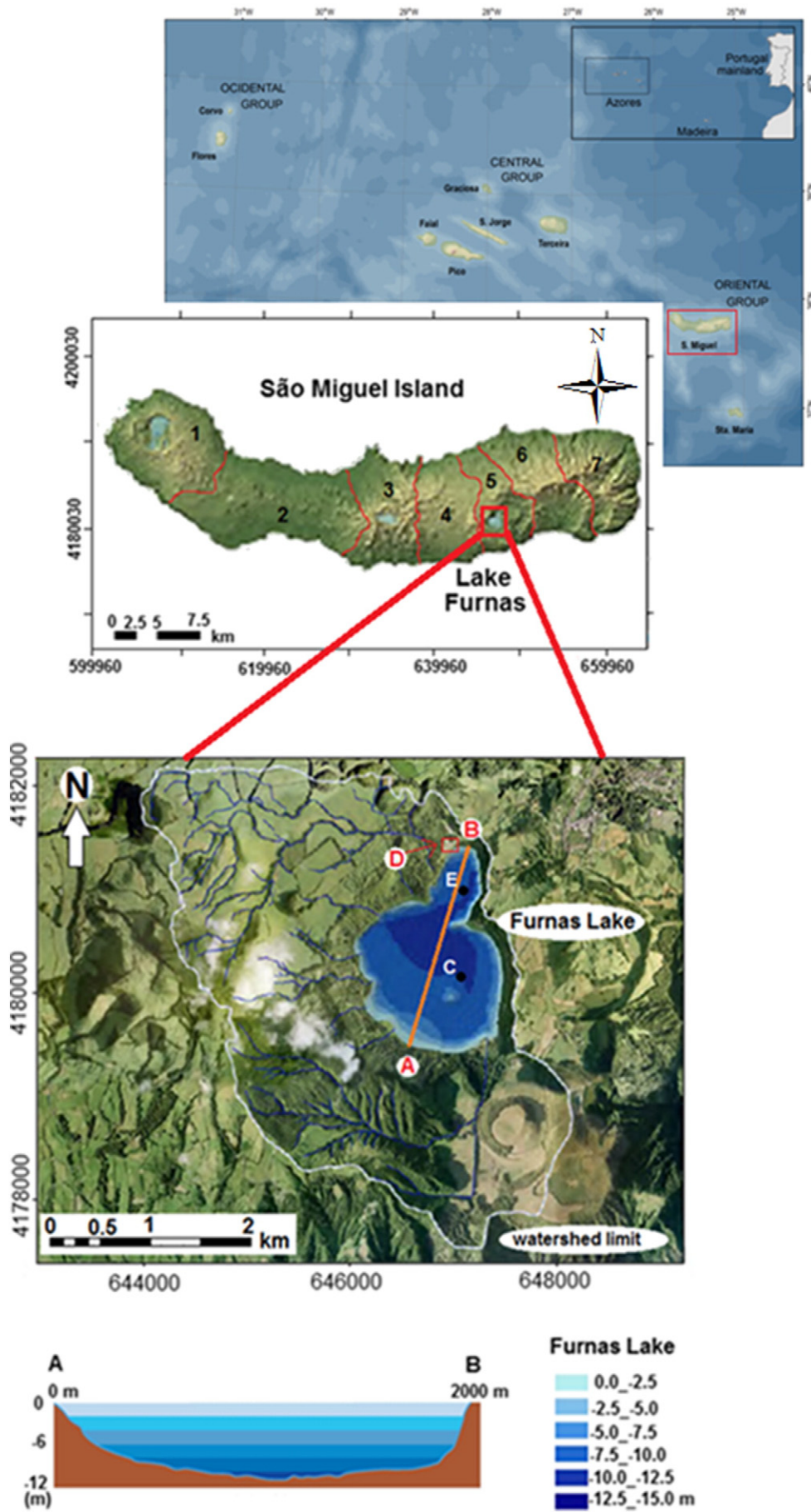
The present paper addresses the results of the first systematic study on diffuse CO₂ degassing in lakes from the Azores archipelago, through detailed flux measurements performed at Furnas lake (São Miguel island) during two separate surveys. The main objectives of the study are to characterize Furnas lake water chemistry, to estimate the total diffuse CO₂ flux and characterize the spatial pattern of the CO₂ degassing.

2. Study area

2.1. Azores archipelago location and lakes

The Azores archipelago is located in the North Atlantic Ocean between 37° to 40°N latitude and 25° to 31°W longitude, about 1500 km

* Corresponding author. Tel.: +351 296650147; fax: +351 296650142.
E-mail address: cesar.cc.andrade@azores.gov.pt (C. Andrade).



Download English Version:

<https://daneshyari.com/en/article/4714159>

Download Persian Version:

<https://daneshyari.com/article/4714159>

[Daneshyari.com](https://daneshyari.com)