Post-melting oxidation of highly primitive basalts from the southern Andes

Por: Tassara, S (Tassara, S.)[1,2,3,4]; Reich, M (Reich, M.)[1,2,3]; Cannatelli, C (Cannatelli, C.)[1,2,3]; Konecke, BA (Konecke, B. A.)[5,6]; Kausel, D (Kausel, D.)[1,2,3]; Morata, D (Morata, D.)[1,2,3]; Barra, F (Barra, F.)[1,2,3]; Simon, AC (Simon, A. C.)[5]; Fiege, A (Fiege, A.)[7]; Morgado, E (Morgado, E.)[8]; Leisen, M (Leisen, M.)[1,2,3] ...Menos

Ver número de ResearcherID y ORCID de Web of Science

GEOCHIMICA ET COSMOCHIMICA ACTA
Volumen: 273

Páginas: 291-312
DOI: 10.1016/j.gca.2020.01.042
Fecha de publicación: MAR 15 2020
Tipo de documento: Article

Ver impacto de la revista

Abstract

The oxygen fugacity (fO(2)) of the Earth's upper mantle and its melting products is an important parameter in the geochemical evolution of arc magmas and their connection with the continental crustal construction and growth. Several works have focused on the fO(2) of peridotite xenoliths, primitive melts in relatively young arc settings, and mid-ocean ridge basalts (MORB) but few studies have attempted to examine the early redox history of primitive magmas in mature arcs. Hence, our understanding of the nature and evolution of fO(2) during the subduction cycle remains limited. Here, we investigate the basaltic tephra from the Los Hornitos monogenetic cones in central-southern Chile, which are among the most primitive materials reported in the Southern Andes (olivine Mg# <= 92.5, and Ni <= 5000 mg.g(-1)). These features offer a unique opportunity to explore the fO(2) conditions below the Andean arc by studying olivine phenocrysts and their contained crystal and melt inclusions. We integrated EPMA, LA-ICP-MS, and m-XANES analyses to constrain the redox conditions recorded in the basaltic tephra by three different and self-reliant methods. First, we determined the fO(2) based on the olivine-spinel equilibrium, yielding average values DFMQ + 1.3 +/- 0.4 (1r). Second, we constrained the fO(2) conditions of melt inclusions using Fe m-XANES data and the redox dependent olivine-melt vanadium partitioning. After correcting for post-entrapment crystallization and diffusive iron loss, the Fe m-XANES data indicate that the melt inclusions were trapped in average at DFMQ +2.5 +/- 0.5 (1r). Results using the olivine-melt vanadium partitioning oxybarometer in melt inclusions are in agreement with Fe m-XANES data, yielding average DFMQ values of +2.6 +/- 0.3 (1r). In order to test the potential effects of other postentrapment modifications of the melt inclusions that could have affected the fO(2) prior to eruption, we assessed the residence time of these magmas using Mg-Fe interdiffusion modelling in olivine. The short residence times (<200 days) compared to vanadium re-equilibration models strongly suggest that the melt inclusions preserve the prevailing fO(2) conditions during their

entrapment. Correlations between melt inclusions major element composition and their fO(2) determined by Fe m-XANES, as well as V/Sc modelling reveal a case of post-melting oxidation of the LHC magmas. We argue that primitive arc magmas behave as an open system with respect to fO(2) during their early geochemical evolution. Our data indicate a complex fO(2) early history of primitive melts in the southern Andes and provide a cautionary note on the direct extrapolation of primitive melts fO(2) values to that of their mantle source. (C) 2020 Elsevier Ltd. All rights reserved.

Palabras clave

Palabras clave de autor: Melt inclusions; Arc basalts; Redox; Oxygen fugacity; XANES

KeyWords Plus:FE-MG DIFFUSION; SPINEL OXYGEN GEOBAROMETER; VOLCANIC ZONE; SUBDUCTION ZONES; OLIVINE-MELT; REDOX STATE; EXPERIMENTAL CALIBRATION; MAGMATIC PROCESSES; CONTINENTAL-CRUST; LOCAL ENVIRONMENT

Información del autor

Dirección para petición de copias: Tassara, S (autor para petición de copias)

+ Univ Chile, Fac Ciencias Eis & Matemat, Dept Geol, Plaza Ercilla 803, Santiago, Chile.

Direcciones:

+ [1] Univ Chile, Dept Geol, FCFM, Plaza Ercilla 803, Santiago, Chile
+ [2] Univ Chile, Andean Geothermal Ctr Excellence CEGA, FCFM, Plaza Ercilla 803, Santiago, Chile
+ [3] Univ Chile, FCFM, Millennium Nucleus Met Tracing Subduct, Plaza Ercilla 803, Santiago, Chile
+ [4] Yale Univ, Dept Geol & Geophys, POB 208109, New Haven, CT 06520 USA
+ [5] Univ Michigan, Dept Earth & Environm Sci, Ann Arbor, MI 48109 USA
+ [6] NASA, ARES, Johnson Space Ctr, Houston, TX 77058 USA
+ [7] Amer Museum Nat Hist, Dept Earth & Planetary Sci, New York, NY 10024 USA
+ [8] Univ Leeds, Sch Earth & Environm, Inst Geophys & Tecton, Leeds, W Yorkshire, England

Direcciones de correo electrónico:tassara.carlos.sant@ug.uchile.cl

Financiación

Entidad financiadora Mostrar más información	**Número de concesión**
Iniciativa Cientifica Milenio, through grant "Millennium Nucleus for Metal Tracing along Subduction"	
Comision Nacional de Investigacion Cientifica y Tecnologica (CONICYT) CONICYT FONDAP	15090013
CONICYT-FONDEQUIP grants	EQM120098 EQM140009

Comision Nacional de Investigacion Cientifica y Tecnologica (CONICYT)	21170857 72160268
United States Department of Energy (DOE)	DE-AC02-06CH11357
National Science Foundation (NSF)	EAR 1524394

Ver texto de financiación

Editorial

PERGAMON-ELSEVIER SCIENCE LTD, THE BOULEVARD, LANGFORD LANE, KIDLINGTON, OXFORD OX5 1GB, ENGLAND

Información de la revista

- **Impact Factor:** Journal Citation Reports

Categorías / Clasificación

Áreas de investigación: Geochemistry & Geophysics

Categorías de Web of Science: Geochemistry & Geophysics

Información del documento

Idioma: English

Número de acceso: WOS:000514832600017

ISSN: 0016-7037

eISSN: 1872-9533