EGU22-9813
https://doi.org/10.5194/egusphere-egu22-9813
EGU General Assembly 2022

The architecture of the lithospheric mantle controlled the emplacement of the Central Atlantic Magmatic Province

Andrea Boscaini[1], Andrea Marzoli[2], Hervé Bertrand[3], Massimo Chiaradia[4], Fred Jourdan[5], Manuele Faccenda[1], Christine Meyzen[1], Sara Callegaro[6], and Lina Serrano Durán[7]

[1]Dipartimento di Geoscienze, Università di Padova, 35131 Padova, Italy (andrea.boscaini@phd.unipd.it)
[2]Dipartimento Territorio e Sistemi Agro-Forestali, Università di Padova, 35020 Legnaro, Italy
[3]Univ Lyon, ENSL, Univ Lyon 1, CNRS, LGL-TPE, F-69007 Lyon, France
[4]Département des Sciences de la Terre, Université de Genève, Rue des Maraichers 13, 1205 Genève, Switzerland
[5]Western Australian Argon Isotope Facility, School of Earth and Planetary Sciences & JdL Centre & SSTC & TIGeR, Curtin University, GPO Box U1987, Perth, WA 6845, Australia
[6]Centre for Earth Evolution and Dynamics, University of Oslo, Oslo, 0371, Norway
[7]ALO Advisors, 7823 Alhambra Drive Bradenton, FL 34209, USA

Large Igneous Provinces (LIPs) represent exceptionally brief (<1 Ma) voluminous magmatic events that punctuate Earth history, frequently leading to continental break-up, global climate changes and, eventually, mass extinctions. Most LIPs emplaced in continental settings are located near cratons, begging the question of a potential control of thick lithosphere on mantle melting dynamics. In this study we discuss the case of the Central Atlantic Magmatic Province (CAMP), emplaced in the vicinity of the thick lithospheric keels of the Precambrian cratons forming the central portion of Pangea prior to the opening of the Central Atlantic Ocean. In particular, we focus on CAMP magmas of the Prevalent group, ubiquitous all over the province, and of the Tiourjdal and High-Ti groups, emplaced (respectively) at the edges of the Reguibat and Leo-Man shields in north-western Africa, and the Amazonian and São Luis cratons in South America. As imaged by recent tomographic studies, there is a strong spatial correlation between most CAMP outcrops at surface and the edges of the thick cratonic keels. Geochemical modelling of trace element and isotopic compositions of CAMP basalts suggests a derivation by partial melting of a Depleted MORB Mantle (DMM) source enriched by recycled continental crust (1-4%) beneath a lithosphere of ca. 80 km. Melting under a significantly thicker lithosphere (>110 km) cannot produce magmas with chemical compositions similar to those of CAMP basalts. Therefore, our results suggest that CAMP magmatism was produced by asthenospheric upwelling along the deep cratonic keels and subsequent decompression-induced partial melting in correspondence with thinner lithosphere. Afterwards, lateral transport of magma along dykes or sills led to the formation of shallow intrusions and lava flows at considerable distances from the source region, possibly straddling the edges of the cratonic lithosphere at depth. Overall, the variations of the lithospheric thickness (i.e., the presence of stable thick cratonic keels juxtaposed to relatively thinner lithosphere) appear to play a primary role for localizing mantle upwelling and partial melting during large-scale magmatic events like the CAMP.