Draft Manuscript for Review

Are adakites slab melts or high-pressure fractionated mantle melts?

Journal:	*Journal of Petrology*
Manuscript ID:	Draft
Manuscript Type:	Original Manuscript
Date Submitted by the Author:	n/a
Complete List of Authors:	Ribeiro, Julia; Institut Universitaire Européen de la Mer, ; University of Texas at Dallas, Geoscience Department Maury, René; Institut Universitaire Européen de la Mer, Grégoire, Michel; Université Paul Sabatier-CNRS-IRD, GET
Keyword:	adakite, amphibole, magma, magma mixing, subduction, geobarometry

Are adakites slab melts or high-pressure fractionated mantle melts?

Julia M. Ribeiro [1,2], René C. Maury [1], Michel Grégoire [3]

[1] Institut Universitaire Européen de la Mer, Place N. Copernic, 29280 Plouzané, France

[2] Geosciences Department, University of Texas at Dallas, Richardson, TX 75083, USA

[3] GET, Université Paul Sabatier-CNRS-IRD, 14 av. Edouard Belin, 31400 Toulouse, France

ABSTRACT

Adakites are unusual felsic rocks commonly associated with asthenospheric slab window opening or fast subduction of young (< 25 Ma) oceanic plate that enable slab melting at shallow depths. Yet, genesis of adakites has remained largely debated, as they are observed in other geodynamic settings where thermal models do not permit slab melting in the forearc region. Here, we present a new approach that provides new constraints on adakite petrogenesis in hot subduction zones (the Philippines) and above an asthenospheric window (Baja California, Mexico). We use amphibole compositions to estimate the magma storage depths and the composition of the parental melts to test the hypothesis that adakites are pristine slab melts. We find that adakites from Baja California and Philippines formed by two distinct petrogenetic scenarios. In Baja California, hydrous mantle melts mixed/mingled with high-pressure (HP) adakite-type, slab melts within a lower crustal (~30 km depth) magma storage region before stalling into the upper arc crust (~7-15 km depth). In contrast, in the Philippines, primitive mantle melts stalled and crystallized within lower and upper crustal magma storage regions to produce silica-rich melts with an adakitic signature. Thereby, slab melting is not required to produce an adakitic

geochemical fingerprint in hot subduction zones. Yet, our results also suggest that the downgoing crust melted beneath Baja California.

Keywords: adakite, amphibole, slab melt, mantle melt, Philippines, Baja California, magma mixing, fractionation, geothermobarometry

INTRODUCTION

At subduction zones, thermal modeling predict that the shallow part of the downgoing oceanic crust (< 80 - 100 km depth to the slab) is usually too cold to cross the water-rich solidus and rarely melts beneath the forearc (Peacock *et al.*, 1994, Peacock, 2004, Plank *et al.*, 2009, Syracuse *et al.*, 2010, Van Keken *et al.*, 2011, Cooper *et al.*, 2012). Geochemistry of forearc lavas and exhumed serpentinized mantle rocks from the forearc wedge also show that the subducting plate dehydrates efficiently at shallow slab depths (e.g., Hyndman & Peacock, 2003, Savov *et al.*, 2007, Kendrick *et al.*, 2011, Ribeiro *et al.*, 2013a, Ribeiro *et al.*, 2015), and slab melting mostly occurs beneath the arc front (Johnson & Plank, 1999, Pearce *et al.*, 2005, Plank *et al.*, 2009, Cooper *et al.*, 2012). Yet, the occasional occurrence of adakites, commonly considered as slab melts, in the forearc region challenges our understanding of the shallow subduction processes (Kay, 1978, Defant & Drummond, 1990, Drummond & Defant, 1990). However, adakite petrogenesis has been largely debated over the past decades and several studies have proposed alternative models such as high-pressure fractionation of mantle melts and melting of under-plated mafic crust (e.g., Schiano *et al.*, 1995, Petford & Atherton, 1996, Sajona *et al.*, 2000a, Prouteau & Scaillet, 2003, Hou *et al.*, 2004, Macpherson *et al.*, 2006, Castillo *et al.*, 2007, Pallares *et al.*, 2007). Thereby, investigating adakite petrogenesis may provide important