Sedimentary Geology 336 (2016) 138–146

Contents lists available at ScienceDirect

Sedimentary Geology

journal homepage: www.elsevier.com/locate/sedgeo

Petrography of volcaniclastic rocks in intra-arc volcano-bounded to fault-bounded basins of the Rosario segment of the Lower Cretaceous Alisitos oceanic arc, Baja California, Mexico

K.M. Marsaglia [a,*], M. Barone [b], S. Critelli [b], C. Busby [c], B. Fackler-Adams [d]

[a] Department of Geological Sciences, California State University Northridge, 18111 Nordhoff St, Northridge, CA 91330-8266, USA
[b] Dipartimento di Biologia, Ecologia e Scienze della Terra, Università degli Studi della Calabria, I-87036 Arcavacata di Rende (CS), Italy
[c] Department of Earth and Planetary Sciences, University of California, Davis, CA 95616, USA
[d] Skagit Valley College, 2405 E. College Way, Mount Vernon, WA 98273, USA

A R T I C L E I N F O

Article history:
Received 18 August 2015
Received in revised form 4 November 2015
Accepted 6 November 2015
Available online 2 December 2015

Keywords:
Cretaceous
Baja California
Magmatic arc basin
Volcaniclastic/tuffaceous sandstones
Compositional modes

A B S T R A C T

The Rosario segment of the Early Cretaceous Alisitos oceanic magmatic arc in Baja California displays a record of arc-axis sedimentation and volcanism that is well preserved in outcrops within a southern volcano-bounded and a northern fault-bounded basin that flanked an intervening subaerial edifice. This record includes volcanic and volcaniclastic rocks that range from felsic to mafic in composition. Volcaniclastic/tuffaceous sandstone samples from two previously published measured sections are mainly composed of volcanic clasts with moderate plagioclase content. Locally quartz and/or potassium feldspar are present in trace to moderate amounts. The proportions of volcanic lithic types exhibiting vitric, microlitic, lathwork, and felsitic textures are highly variable with no distinct stratigraphic trends, likely as a function of the mixed styles of eruption and magma compositions that produced pyroclasts, as well as erosion-produced epiclastic debris. The volcaniclastic fill of the basins is consistent with an oceanic arc setting, except for the relatively high felsitic volcanic lithic content, likely associated with subaerial, as opposed to the more common submarine felsic magmatism associated with arc extension in oceanic settings. There are no major differences in compositional modes of tuff and sandstone between the fault-bounded and volcano-bounded basin strata, even though they exhibit distinctly different volcaniclastic facies. This suggests that proximal arc-axis basins of varying types around a single major subaerial edifice provide a faithful record of volcanic trends in the arc segment, regardless of variation in transport and depositional processes.

1. Introduction

Intra-arc basins can be discriminated from forearc and backarc basins in the rock record partly on the presence of arc-axis volcanic and related intrusive rocks (e.g., Smith and Landis, 1995). Smith and Landis (1995) classified intra-arc basins on the arc platform as volcano-bounded or fault-bounded, the former being bordered by constructional volcanic edifices and the latter bounded by normal or oblique-slip faults. They also discussed hybrid varieties with aspects of both types. Previous workers have contrasted compositional modes of volcaniclastic successions associated with forearc and backarc basins, as well as nascent backarc basins (e.g., Dickinson and Suczek, 1979; Dickinson et al., 1983; Marsaglia, 1992; Marsaglia and Ingersoll, 1992; Marsaglia and Devaney, 1995; Critelli et al., 2002; Caracciolo et al., 2011; Cavazza et al., 2013), but none has examined compositional differences in proximal basins along the arc axis, where drilling recovery in modern settings is limited (Marsaglia, 1995).

This paper compares volcaniclastic compositional modes of samples taken from a shallow-marine volcano-bounded basin and a largely deep-marine fault-bounded basin on either side of a subaerial edifice, along a 60 km-long segment of the Alisitos arc mapped in detail by Busby et al. (2006), in Baja California, Mexico (Fig. 1). The fill of these two basin types contrasts markedly in volcanic and volcaniclastic lithofacies, reflecting differing transport and depositional processes in the two basins types, as shown by detailed maps and measured sections (Busby et al., 2006), and discussed further below. We show in this paper that despite the differences in basin types and associated transport and depositional processes, the detrital modes do not vary significantly, suggesting that proximal arc-axis basins of varying types around a single major subaerial edifice provide a faithful record of volcanic trends in the arc segment, regardless of transport and depositional processes.

* Corresponding author.
E-mail addresses: kathie.marsaglia@csun.edu (K.M. Marsaglia), bamirko@libero.it (M. Barone), salvatore.critelli@unical.it (S. Critelli), cjbusby@ucdavis.edu (C. Busby), Ben.Fackler-Adams@skagit.edu (B. Fackler-Adams).

http://dx.doi.org/10.1016/j.sedgeo.2015.11.008
0037-0738/

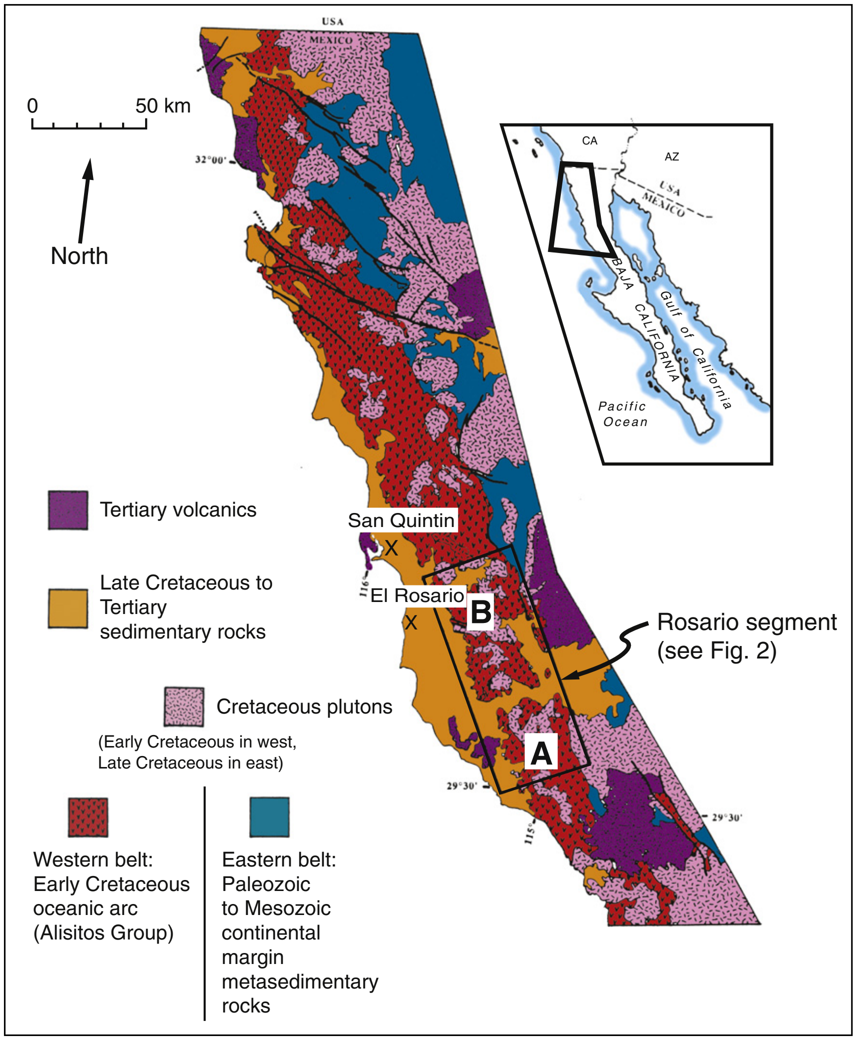

Fig. 1. Location map of study area from Busby et al. (2006) showing the regional geologic setting of the Alisitos arc with respect to the western Peninsular Ranges of Baja California, Mexico. The positions of measured sections shown in Fig. 2 are marked at "A" and "B."

2. Previous work

Development of the Alisitos extensional oceanic arc (ca. 140–100 Ma) was preceded by, and is partly floored by, strongly extensional oceanic arc-ophiolite systems (ca. 220–130 Ma), including the Gran Canon Formation of Cedros Island (Busby, 2004). Together, these oceanic arc terranes were accreted to the Mexican margin at 105–100 Ma, where ongoing subduction produced a high-standing continental arc (ca. 100–50 Ma) that lies to the east of the accreted oceanic arc rocks. The stratigraphy of the Gran Canon Formation was interpreted to record rifting of an oceanic arc to form a backarc basin undergoing seafloor spreading, followed by progradation of a backarc apron onto a backarc seafloor spreading center (Busby and Boles, 1988; Busby-Spera, 1988). Later work on detrital modes of volcaniclastic/tuffaceous sandstones demonstrated a second arc rifting event, recorded by silicic pyroclastic flows and mafic lavas, typical of extension in modern oceanic arcs such as the Izu–Bonin arc (Taylor et al., 1990); this was followed by epiclastic sedimentation in the newly formed remnant arc basin (Critelli et al., 2002). Herein, we report petrographic data from the Rosario segment of the oceanic extensional Alisitos arc (Fig. 1; Busby et al., 2006), using similar techniques, with a similar goal of elucidating this later phase of magmatic-arc history, as well as comparing and contrasting compositional modes in a volcano-bounded and a fault-bounded basin on either side of a subaerial edifice along the arc axis.

The Early Cretaceous Alisitos arc crops out extensively along the western half of Baja California Norte, in a belt 30 km wide and 300 km long (Fig. 1). The geologic history of the Alisitos arc is closely related to that of the Mexican mainland for the same time frame (Wetmore, 2002; Wetmore et al., 2003; Centeno-Garcia et al., 2011). The Alisitos arc (also referred to as Alisitos Group) consists of dominantly intermediate-composition volcanic and volcaniclastic rocks, and lesser mafic and silicic volcanic rocks, with abundant marine fossils, and associated hypabyssal and plutonic rocks (Silver et al., 1963; Fackler-Adams and Busby, 1998; Busby, 2004; Busby et al., 2006). The Alisitos arc was accreted to the North American plate at about 110–100 Ma (e.g., Dickinson and Lawton, 2001; Busby, 2004; Alsleben et al., 2012). Recent publications have provided more detail regarding arc evolution by focusing on the plutonic rock record in Baja California (Morton and Miller, 2014, and papers therein).

U-Pb zircon dates on volcanic and plutonic rocks of the Rosario segment of the Alisitos arc (Figs. 1, 2) indicate that the entire 4 km-thick upper to middle crustal section formed in only 1.5 million years, at ~111–110 Ma, in an extensional environment (Busby et al., 2006). Superior exposure, widespread pyroclastic units, and a lack of post-volcanic deformation in the Rosario segment of the Alisitos arc allowed Busby et al. (2006) to divide its 1.5 my of growth into four time slices, grouped into two tectonic phases (Fig. 2). Phase 1 (time slices 1 through 3, Fig. 2) constitutes over three-fourths of the stratigraphic section and consists of intermediate to silicic lava flows, lava domes, and primary