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Geochronology and geochemistry of Early Cretaceous volcanic sequences in Northwestern Peru: implications for Farallon Plate subduction

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ABSTRACT

The Early Cretaceous geology of Northwestern (NW) Peru was characterized by emplacement of voluminous felsic volcanic rocks (e.g. the Oyotún Fm.), which have important implications for the understanding of Early Cretaceous crust-mantle interactions in the Central Andes. We present U-Pb-Hf isotopic compositions and whole-rock and trace elemental compositions of a series of Early Cretaceous volcanic rocks from the Western Cordillera and the Eastern Cordillera of the Central Andes. The volcanic rocks outcrop sporadically with limited thickness and uniform volcanic lithofacies in the western region, while the eastern region has distributions of larger scale volcanic rocks with more complex volcanic lithofacies. LA-ICP-MS zircon U-Pb dating defines the age of the Oyotún Fm. range from 138.8 Ma to 131.0 Ma in the Western Cordillera, and from 139.7 Ma to 132.3 Ma in the Eastern Cordillera. In situ Hf isotope analysis on dated zircon yield an $\varepsilon_{Hf}(t)$ range of +3.37 to +8.42 and a T_{DM2}(Hf) range from 983 Ma to 650 Ma with a peak at ca. 840 Ma. The Early Cretaceous felsic magmas are predominantly dacites and rhyolites with minor components of basalt and andesite, and show relatively homogeneous Hf isotopic compositions of zircon in single samples. Both the $\varepsilon_{Hf}(t)$ of zircons and the magma temperature increase from the bottom to the top of the Early Cretaceous volcanic rocks in each studied area. All these facts imply an increasing contribution of contemporaneous underplated hot and dry mantle-derived magmas with time, both as a heat source inducing crustal melting and a source of material (melt) that variably mixed with the ancient continental crustal materials.

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Introduction

The volcanic rocks of the Late Mesozoic in South America recorded the early Andean subduction system (Jurassic to Lower Cretaceous), due to the oblique subduction of the dense and cold Farallon Plate (Jaillard *et al*. 1990; Scheuber and González 1999). The Central Andes is a typical active continental margin of ocean-continental convergence and a hotspot of modern continental crust growth. Northwestern (NW) Peru is an important part of the Central Andes and is characterized by the voluminous eruption of volcanic rocks. The volcanism in this area resulted from the Farallon Plate subducting and accreting towards the South American Plate since the Early Palaeozoic, causing a continental growth of the Coast Range of up to 70 km (Ramos 1999; Ramos *et al*. 2014). Due to the subduction of the Farallon Plate, the intermediate-acidic volcanism in the Central Andes of NW Peru started from ~550 Ma (Cawood 2005) and reached the most intense activity in the Late Mesozoic, which formed a long-term active continental marginal arc (Chew *et al*. 2007).

The Early Cretaceous volcanic rocks in the Central Andes have received much less attention than the contemporaneous volcanic rocks of the Northern Andes in Colombia (Cardona *et al*. 2010; Villagómez *et al*. 2011), Ecuador (Barragána *et al*. 2005) and the Southern Andes in Chile (Parada *et al*. 1999). The volcanic rocks are developed quite well and distributed widely in NW Peru and form an important part of the Coast Range and a crucial element of the Wilson Cycle of the palaeo-Pacific plate (MMBME, 1984). Since these volcanic rocks resulted from the Farallon Plate subducting beneath the South American Plate, they may contain important insights into the detailed geodynamic evolution of this subduction process. Furthermore, the role of crust-mantle interaction is critical for an understanding of the recycling and redistribution processes of crustal components. This study will contribute to the further understanding of the continental crust growth and its material cycle in the Andean region, as well as provide details of the subduction of the Mesozoic Farallon Plate below the South American Plate.

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