

Melting of the subcontinental lithospheric mantle by the Emeishan mantle plume; evidence from the basal alkaline basalts in Dongchuan, Yunnan, Southwestern China

Xie-Yan Song^{a,*}, Hua-Wen Qi^a, Paul T. Robinson^b, Mei-Fu Zhou^c,
Zhi-Min Cao^d, Lie-Meng Chen^a

^a State Key Laboratory of Ore Deposit Geochemistry, Institute of Geochemistry, Chinese Academy of Sciences,
46 Guanshui Road, Guiyang, 550002, PR China

^b Department of Earth Sciences, Dalhousie University, Halifax, Nova Scotia, Canada B3H 4J1

^c Department of Earth Sciences, The University of Hong Kong, Hong Kong, PR China

^d College of Earth Sciences, Ocean University of China, Qingdao, PR China

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Abstract

The Emeishan continental flood basalt (ECFB) sequence in Dongchuan, SW China comprises a basal tephrite unit overlain by an upper tholeiitic basalt unit. The upper basalts have high TiO₂ contents (3.2–5.2 wt.%), relatively high rare-earth element (REE) concentrations (40 to 60 ppm La, 12.5 to 16.5 ppm Sm, and 3 to 4 ppm Yb), moderate Zr/Nb and Nb/La ratios (9.3–10.2 and 0.6–0.9, respectively) and relatively high $\epsilon_{\text{Nd}(t)}$ values, ranging from –0.94 to 2.3, and are comparable to the high-Ti ECFB elsewhere. The tephrites have relatively high P₂O₅ (1.3–2.0 wt.%), low REE concentrations (e.g., 17 to 23 ppm La, 4 to 5.3 ppm Sm, and 2 to 3 ppm Yb), high Nb/La (2.0–3.9) ratios, low Zr/Nb ratios (2.3–4.2), and extremely low $\epsilon_{\text{Nd}(t)}$ values (mostly ranging from –10.6 to –11.1). The distinct compositional differences between the tephrites and the overlying tholeiitic basalts cannot be explained by either fractional crystallization or crustal contamination of a common parental magma. The tholeiitic basalts formed by partial melting of the Emeishan plume head at a depth where garnet was stable, perhaps >80 km. We propose that the tephrites were derived from magmas formed when the base of the previously metasomatized, volatile-mineral bearing subcontinental lithospheric mantle was heated by the upwelling mantle plume.

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Keywords: Emeishan flood basalts; Tephrite; Metasomatized subcontinental lithospheric mantle; Partial melting; Mantle plume

1. Introduction

The geochemistry of continental flood basalts can yield valuable information about the nature of the mantle sources from which they were derived and about the extent of plume–lithosphere interaction. The voluminous lavas in typical flood basalt provinces are generally considered to reflect asthenospheric melting

* Corresponding author. State Key Laboratory of Ore Deposit Geochemistry Institute of Geochemistry, Chinese Academy of Sciences 46 Guanshui Road, Guiyang, 550002, PR China. Tel./fax: +86 851 5895538.

E-mail address: songxieyan@vip.gyig.ac.cn (X.-Y. Song).

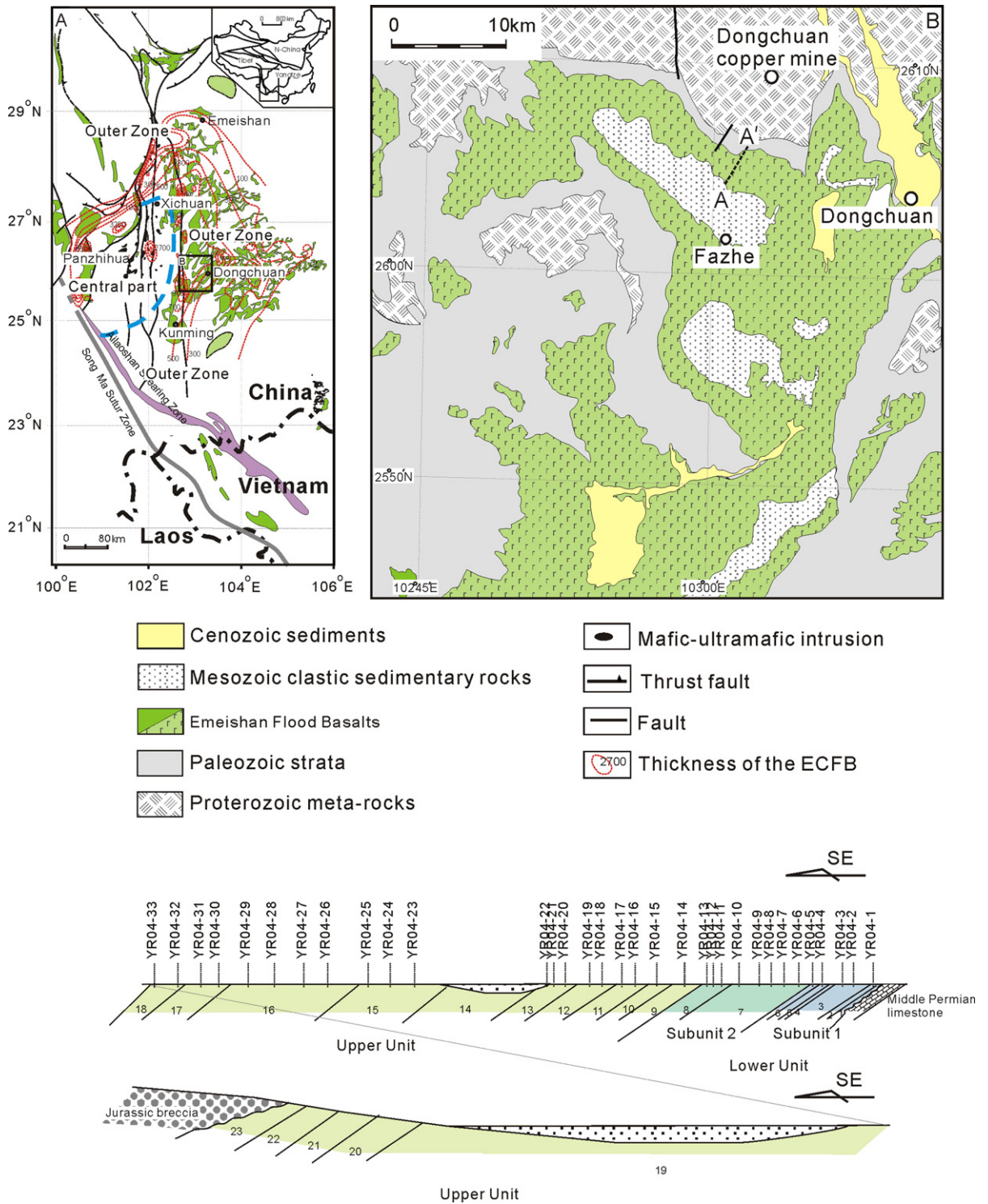


Fig. 1. Distribution of the Emeishan continental flood basalts and related intrusions in the Emeishan large igneous province (A), in the Dongchuan area (B), and (C) cross-section of the ECFB in Dongchuan.

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