Lithos xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Lithos

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

Paleogene post-collisional lamprophyres in western Yunnan, western Yangtze Craton: Mantle source and tectonic implications

Yong-Jun Lu [a,*], T. Campbell McCuaig [a], Zheng-Xiang Li [b], Fred Jourdan [c], Craig J.R. Hart [d], Zeng-Qian Hou [e], Suo-Han Tang [e]

[a] Centre for Exploration Targeting, Australian Research Council Centre of Excellence for Core to Crust Fluid Systems (CCFS), School of Earth and Environment, University of Western Australia, Crawley, WA 6009, Australia
[b] Australian Research Council Centre of Excellence for Core to Crust Fluid Systems, The Institute for Geoscience Research, Department of Applied Geology, Curtin University, GPO Box U1987, Perth, WA 6845, Australia
[c] Western Australian Argon Isotope Facility, Department of Applied Geology and JdL-CMS, Curtin University, Perth, Australia
[d] Mineral Deposit Research Unit, Department of Earth and Ocean Sciences, University of British Columbia, Vancouver V6T 1Z4, Canada
[e] Institute of Geology, Chinese Academy of Geological Sciences, Beijing 100037, PR China

ARTICLE INFO

Article history:
Received 30 August 2014
Accepted 4 February 2015
Available online xxxx

Keywords:
Lamprophyres
Western Yunnan
Himalayan orogen
Lithospheric mantle
Metasomatism
Delamination

ABSTRACT

A suite of lamprophyres, spatially associated with mafic lavas and potassic felsic intrusive rocks, was emplaced between 36.5 ± 0.2 and 33.7 ± 0.5 Ma (based on phlogopite $^{40}Ar/^{39}Ar$ dating) on the eastern side of the Ailao Shan-Red River shear zone in the western Yangtze Craton. These shoshonitic and ultrapotassic intrusive rocks post-date the ~60–55 Ma collisional event between the Indian and the Asian continents. They are characterized by: (1) enrichment in large-ion lithophile elements and light rare-earth elements with $(La/Sm)_n = 3.15–7.15$; (2) strong positive Pb spikes; (3) depletion in high-field-strength elements (e.g. Nb/La = 0.08–0.98); (4) high initial $^{87}Sr/^{86}Sr$ (0.706–0.709) with negative εNd(t) values of −10.5 to −0.9; (5) old Nd model ages of 1542–945 Ma; and (6) radiogenic $(^{207}Pb/^{204}Pb)_i$ of 15.57–15.70 and $(^{208}Pb/^{204}Pb)_i$ (38.70–39.06). These features suggest that the mantle source was metasomatized by Proterozoic subduction beneath the Yangtze Craton. The lamprophyres have similar trace element patterns, and Sr–Nd–Pb isotope compositions, as coeval mafic lava, indicating a common source of metasomatized veined continental lithospheric mantle (CLM). Lower degree partial melting of metasomatic veins likely generated the lamprophyres, whereas the coeval mafic lava was likely derived from melting of phlogopite harzburgite. The lamprophyres and mafic lava have similar Sr–Nd isotope systematics as CLM-derived Neoproterozoic mafic rocks and Late Permian Emeishan low-Ti basalt in the region, indicating that they share the same Proterozoic source. We envisage that mantle plumes thermally eroded the Proterozoic metasomatized CLM beneath the western part of the Yangtze Craton during 825–750 Ma and 260–250 Ma, although residual metasomatized domains remained before being tapped by delamination after the India–Asia continental collision during the Paleogene period.

1. Introduction

Potassic igneous rocks are generally characterized by high concentrations of incompatible elements and, in the case of lamprophyres, high volatile contents (Foley et al., 1987; Rock, 1987). It is widely accepted that continental potassic mafic magmas are produced by small degrees of melting of metasomatized continental lithospheric mantle (CLM; Conticelli et al., 2009; Ersoy et al., 2010; Farmer, 2003; Foley, 1992; Pilet et al., 2008; Turner et al., 1996). Such melts, therefore, provide an important window into the composition of the CLM and its metasomatic history.

Eocene–Oligocene igneous rocks in the western Yunnan Province, southwestern China, form part of a semi-continuous potassic magmatic province in the eastern Indo-Asian collisional zone (Fig. 1; Chung et al., 1998, 2005; Zhang et al., 1987). The nature and origin of the mantle source, and the tectonic trigger for the partial melting of CLM beneath the western Yangtze Craton, remain controversial (Chung et al., 1998; Guo et al., 2005; Huang et al., 2010; Li et al., 2002; Wang et al., 2001; Xu et al., 2001a). For example, an enriched lithospheric mantle source beneath western Yangtze Craton has been interpreted to be exotic Tibetan lithosphere that extruded eastward under the Yangtze Craton during the Indo-Asian collision at ca. 55 Ma (Xu et al., 2001a). It has also been suggested that the western Yangtze lithospheric mantle was metasomatized locally by migrating melts from the seismic low-velocity zone after 250 Ma (Huang et al., 2010), or metasomatized by Proterozoic and Paleo-Tethyan oceanic subduction (Guo et al., 2005).

* Corresponding author.
E-mail address: yongjun.lu@uwa.edu.au (Y.-J. Lu).

http://dx.doi.org/10.1016/j.lithos.2015.02.003
0024-4937/

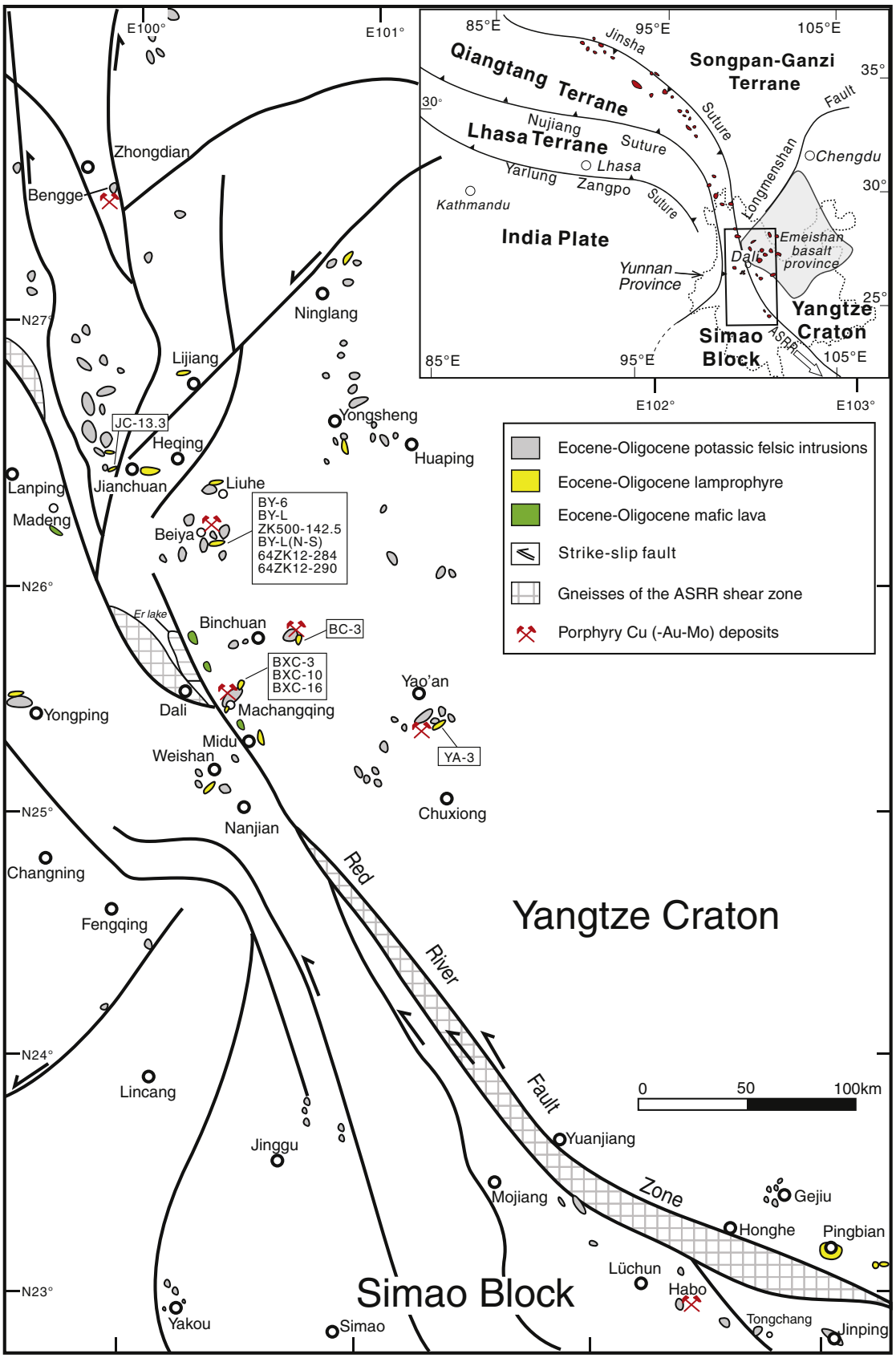

Fig. 1. Simplified geological map showing the distribution of Eocene–Oligocene potassic igneous rocks of western Yunnan (modified from Zeng et al., 2002; Huang et al., 2010). The inset shows the tectonic framework of the Tibetan Plateau and surrounding areas, the geographic boundary of Yunnan Province (dashed lines) and the red fields denote the Eocene–Oligocene potassic magmatic rocks along Jinsha Suture (modified from Yang, 1998; Xu et al., 2001a; Chung et al., 2005). Please note that there is no ophiolite outcrop of the Jinsha suture in the study area but the Ailao Shan-Red River shear zones are thought to mark the western boundary of the Yangtze Craton (e.g. Guo et al., 2005). Samples collected in this study are shown within rectangles. ASRR, Ailao Shan-Red River shear zone.

Please cite this article as: Lu, Y.-J., et al., Paleogene post-collisional lamprophyres in western Yunnan, western Yangtze Craton: Mantle source and tectonic implications, Lithos (2015), http://dx.doi.org/10.1016/j.lithos.2015.02.003