Available online at www.sciencedirect.com
ScienceDirect
Lithos 102 (2008) viii – x
LITHOS
www.elsevier.com/locate/lithos

Editorial

Continental volcanism and chemistry of the Earth's interior

This Special Issue on "Continental volcanism and chemistry of the Earth's interior" arose from an international conference on Continental Volcanism, which was held at Guangzhou, China, May 14th to 18th, 2006. This conference, sponsored by the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI), brought together over 200 international scientists of different disciplines to discuss and share their views on the causes and consequences of continental volcanism and evolution of the continental lithosphere. A total of 132 oral presentations were given at the meeting, and 21 of these are selected for publication in Lithos with the focus on: (1) the age, composition and evolution of continental lithosphere with special attention to the north China Craton; (2) the formation and destruction of cratonic roots; (3) dynamic triggers and economic significance of large igneous provinces and (4) the source and origin of continental volcanism.

1. Formation and destruction of cratonic roots

Removal of deep continental lithosphere is increasingly cited as an important process that shapes the continental lithosphere. However, the conditions necessary both for the long term stabilization of continental lithosphere as cratons and for the ultimate destruction of the latter remain unclear. McKenzie and Priestley described the influence of lithospheric thickness variation on continental evolution. They provide some synthesis and thought-provoking ideas on the formation of cratons. O'Neill et al. present a series of sophisticated numerical models of the interaction between flow in the mantle and continental lithosphere, aiming at clarifying the conditions for long-term survival of the continental lithosphere. Their results yield implications for cratonic destruction.

2. Age, composition and evolution of continental lithosphere beneath eastern China

The lithospheric mantle under the North China Craton (NCC) has experienced thermal reactivation during the late Mesozoic. The age, petrology, mineralogy, chemistry, and physical character of the lithospheric mantle are therefore pivotal to understanding the destruction of a cratonic root. Y.-G. Xu et al. present new Sr–Nd–Os isotopic analyses on peridotite xenoliths from Tertiary alkali basalts in Yangyuan and Fansi, western NCC. They revealed an EM1-type mantle and obtained Os isotopic model ages of ~2.6 Ga, which overlap with the Nd model age of the overlying crust. The coupled crust–mantle system in the western NCC contrasts with the decoupled nature in the eastern NCC, suggesting the lithospheric removal was largely limited to the eastern NCC. X.S. Xu et al. provide new in-situ Os isotopic analyses from sulfides in ultramafic xenoliths from a wide variety of locations in eastern China. They demonstrate the very frequent existence of osmium isotopic heterogeneity between the sulfides of a single xenolith and argue for the existence of several generations of sulfides within a single rock. Dai et al. present new geochronological and geochemical data for a little-known occurrence of mafic lower crustal xenoliths from Hunan province in the Cathaysia Block of south China. They show that the mafic precursors of the xenoliths crystallized from basaltic magmas that intruded the deep crust during the Triassic (at 220 Ma), but all contain remnants of older crust, dating back to as old as 3.7 Ga. Yang and Li present new geochronological and geochemical data for several occurrences of Mesozoic lavas in the Liaoning area near the northern margin of the NCC. These lavas, which are compositionally diverse and erupted over a 70 Ma time span, reflect a diversity of origins. These include slab melts (with associated

0024-4937/$ - see front matter
doi:10.1016/j.lithos.2007.10.004

subducted sediment), melts of the Archean lower continental crust of the NCC, melts of lower crust that foundered from the base of the craton and, finally, intraplate basaltic magmas from a depleted mantle source. Chen et al. report U–Pb and in-situ Hf isotope analyses of zircons from 132 Ma old intrusions from the South Taihang magmatic complex, situated in the Central Block of the North China Craton. These intrusions, which range from syenite to monzonite, likely formed simultaneous by diverse processes, including melting of thinned, enriched lithospheric mantle and mixing between such lithospheric mantle-derived melts and melts from the ancient lower crust. Zhang et al. report a plethora of new SHRIMP U–Pb zircon and whole-rock ^{40}Ar–^{39}Ar ages for the voluminous volcanic rocks of the Great Xing'an Range in northern China. These lavas range in composition from basalt to rhyolite and most erupted over a very limited time span, peaking at 125 Ma and coinciding with lithospheric thinning in eastern China. These lavas thus record a large igneous event that may have been associated with subduction of the Paleo-Pacific plate during the Mesozoic. He et al. have brought together whole-rock geochemical and isotopic data for Proterozoic Xiyange assemblage and argued that these rocks originated in an arc environment rather than by rifting associated with a mantle plume. They suggest a Paleo-Meso-Proterozoic subduction zone along the southern margin of the NCC.

3. Dynamic triggers and economic effects of large igneous provinces

Five papers are devoted to field, geochemical, experimental, and petrologic studies of large igneous provinces and associated mineralization. Peate et al. provide a comprehensive review of crustal assimilation during the formation of the East Greenland Basalt Province and describe how the extent and locus of interaction between mantle-derived magma and crust varied as continental rifting proceeded and basalt magma supply rates waxed and waned. Wang et al. reports stratigraphic and textural relations and chemical compositions of the Fe–Ti–Cr oxide-hosted Xinjie intrusion in the Emeishan Large Igneous Province (ELIP) in SW China. To account for the unusual association of chromite, magnetite and ilmenite, they propose two parallel crystallization series: chromite to Fe–Ti solid solution accompanied by crystallization of olivine, clinopyroxene and plagioclase. Fan et al. deal with the extension of the ELIP. They suggest the late Permian flood basalts in the Guangxi region are the integral part of the ELIP, and thus the volume of material derived from this short-lived plume is much greater than that indicated by the present outcrops. Paul et al. describes the petrology, geochemistry and paleomagnetic features of the Mezozoic magmatic rocks of Kutch, and their relationship with the formation of the Kutch rift basin and the eruption of the Deccan Traps. The data bear important clues as to the onset of volcanism in the Deccan flood volcanism. Ukstins-Peate et al. have assembled a large and detailed geochemical and isotopic dataset on the silicic eruptive units in the Afro-Arabian LIP, and correlated deep-sea ashes. The paper makes some important advances in extending the known compositional variation for individual eruptions and yields insights into the evolution of the silicic volcanic components of the Afro-Arabian LIP.

4. Source and origin of continental volcanism

Farmer et al. investigates the mid-Tertiary ignimbrite flare-up of the western USA. They estimate the volume of the mantle needed to produce the basaltic magmatic trigger for these event(s) and conclude that conductive melting of the sub-continental lithospheric mantle is not viable unless the basal lithosphere under the entire region was melted. This is only plausible if the lithosphere was metasomatised by subduction-related fluids and would require focusing of mantle melt over distances of 300 km. Peters et al. revisit the origin of the late Neogene Zuni–Bandera volcanic field in New Mexico, southwest USA. These workers use new chemical and isotopic data, including U-series isotope analyses, to provide compelling evidence for basalt production via polybaric melting involving both lithospheric and sublithospheric mantle. Altunkaynak and Genc outline the regional and local significance of the post-collisional Cenozoic igneous suites of the Aegean–western Turkish region. They document four stages of evolution and the apparently systematic change in Sr and Nd isotopes through Stages 1 to 4. Li et al. present SHRIMP U–Pb zircon ages and isotopic data for Mid-Proterozoic igneous rocks from south China. These authors use these data to argue against the active continental margin model for the southern edge of the Yangtse Block. They propose that intra-plate magmatic events linked to a superplume and break-up of the Rodinia supercontinent better explains the dataset. Peng et al. describe some high quality chemical, isotopic and U–Pb zircon age determinations from Early Triassic intermediate composition volcanic rocks in the southern Lancangjiang zone, southwestern China, and interpret these rocks as having formed at a continental margin arc during the closure of the Paleo-Tethyan Ocean. Zhao et al. identify a suite of genetically distinct adakites in the Awulale and Sanchakou area of the Xinjiang Tianshan region, China. They proposed that the source of these adakites was basaltic rock underplated to the base of the lower crust, that partially melted at the rutile-bearing amphibole-eclogite facies (>650 C and 1.5 Gpa minimum pressure (≥50 km)). Negrete-Aranda and Canon-Tapia present the first attempt to compile published chemical and age information for Late Cenozoic volcanic rocks from the Baja California Peninsular in northwestern Mexico. Using space–time–composition maps for the compositionally diverse volcanic rocks found in this region, these authors suggest that the Baja California volcanic history may reflect changes in the availability of magmatic pathways through the continental lithosphere and not variations in the timing of magma generation.

We thank the Chinese Academy of Sciences, Guangzhou association of Science and Technology, IAVCEI, National Natural Science Foundation of China and Guanghou Institute of Geochemistry for financial support and sponsorship of the IAVCEI 2006. We are indebted to Mr. Ruud Koole, the Journal Manager, for his valuable help and support during review process, and Steve Foley, Editor in Chief, for approving publication of these selected papers in Lithos and his advice and support throughout the process. The guest editors like to thank the contributors for their enthusiastic involvement and co-operation to bring out the issue in time. Last but not the least, those colleagues who extended their valuable time and co-operation in providing thoughtful comments are gratefully acknowledged.

Yi-Gang Xu
Key Laboratory of Isotope Geochronology and Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, 510640 Guanghzou, China
Corresponding author. Tel.: +86 20 85290109; fax: +86 20 85290261.
E-mail address: yigangxu@gig.ac.cn.

Lang Farmer
Department of Geological Sciences and CIRES, University of Colorado, Boulder, 80309 USA

Martin Menzies
Department of Geology, Royal Holloway University of London, Egham, Surrey TW20 OEX, UK

Roberta Rudnick
Geochemistry Laboratory, Department of Geology, University of Maryland, College Park, MD 20782, USA

Mei-Fu Zhou
Department of Earth Sciences, University of Hong Kong, Hong Kong, China

11 October 2007