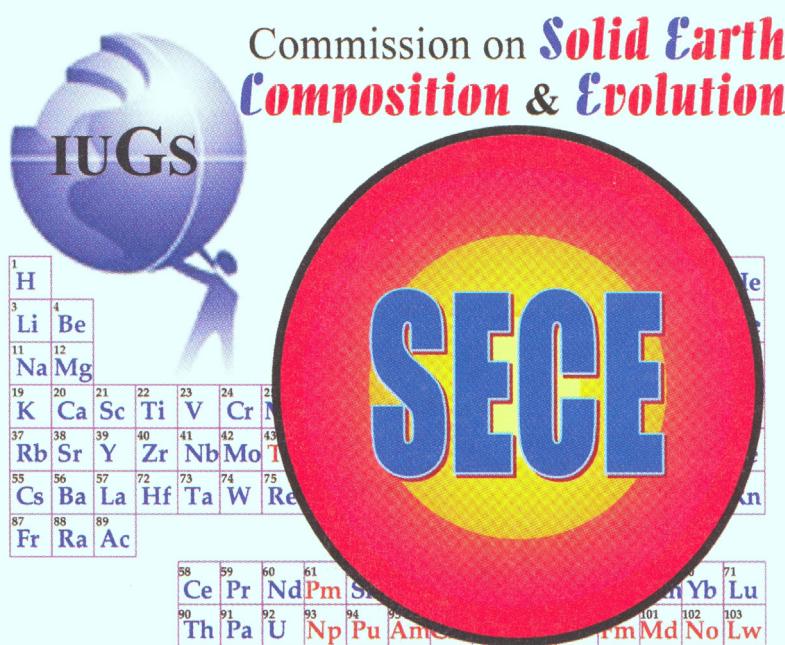


**Special Issue**

**The Origin, Evolution and Present State  
of Continental Lithosphere**

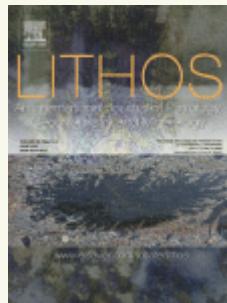
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## Lithos

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### The Origin, Evolution and Present State of Continental Lithosphere, The Origin, Evolution and Present State of Subcontinental Lithosphere

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#### 1. Editorial Board

Page IFC

#### 2. The origin, evolution and present state of continental lithosphere

Pages ix-x

Yaoling Niu and Shuguang Song

#### 3. Integration of geology, geophysics and geochemistry: A key to understanding the North China Craton

Pages 1-21

Martin Menzies, Yigang Xu, Hongfu Zhang and Weiming Fan

#### 4. A possible model for the lithospheric thinning of North China Craton: Evidence from the Yanshanian (Jura-Cretaceous) magmatism and tectonism

Pages 22-35

Jinfu Deng, Shangguo Su, Yaoling Niu, Cui Liu, Guochun Zhao, Xingguo Zhao, Su Zhou and Zongxu Wu

#### 5. Lower crustal processes leading to Mesozoic lithospheric thinning beneath eastern North China: Underplating, replacement and delamination

Pages 36-54

Mingguo Zhai, Qicheng Fan, Hongfu Zhang, Jianli Sui and Ji'an Shao

#### 6. Chemical and stable isotopic constraints on the nature and origin of volatiles in the sub-continental lithospheric mantle beneath eastern China

Pages 55-66

Mingjie Zhang, Peiqing Hu, Yaoling Niu and Shangguo Su

#### 7. Importance of melt circulation and crust-mantle interaction in the lithospheric evolution beneath the North China Craton: Evidence from Mesozoic basalt-borne clinopyroxene xenocrysts and pyroxenite xenoliths

Pages 67-89

Hong-Fu Zhang, Ji-Feng Ying, Gen Shimoda, Noriko T. Kita, Yuichi Morishita, Ji-An Shao and Yan-Jie Tang

#### 8. Petrology and geochronology of Xuejiashiliang igneous complex and their genetic link to the lithospheric thinning during the Yanshanian orogenesis in eastern China

Pages 90-107

Shangguo Su, Yaoling Niu, Jinfu Deng, Cui Liu, Guochun Zhao and Xingguo Zhao

#### 9. Geochemistry of Cenozoic basalts and mantle xenoliths in Northeast China

Pages 108-126

Yang Chen, Youxue Zhang, David Graham, Shangguo Su and Jinfu Deng

#### 10. Contrasting zircon Hf and O isotopes in the two episodes of Neoproterozoic granitoids in South China: Implications for growth and reworking of continental crust

11. **Recycling of deeply subducted continental crust in the Dabie Mountains, central China**

Pages 151-169

Fang Huang, Shuguang Li, Feng Dong, Qiuli Li, Fukun Chen, Ying Wang and Wei Yang

12. **Zircon SHRIMP U-Pb dating for gneisses in northern Dabie high T/P metamorphic zone, central China: Implications for decoupling within subducted continental crust**

Pages 170-185

Yi-Can Liu, Shu-Guang Li and Shu-Tong Xu

13. **U-Pb zircon, geochemical and Sr-Nd-Hf isotopic constraints on age and origin of Jurassic I- and A-type granites from central Guangdong, SE China: A major igneous event in response to foundering of a subducted flat-slab?**

Pages 186-204

Xian-Hua Li, Zheng-Xiang Li, Wu-Xian Li, Ying Liu, Chao Yuan, Gangjian Wei and Changshi Qi

14. **Post-collisional adakites in south Tibet: Products of partial melting of subduction-modified lower crust**

Pages 205-224

Zhengfu Guo, Marjorie Wilson and Jiaqi Liu

15. **Mantle contributions to crustal thickening during continental collision: Evidence from Cenozoic igneous rocks in southern Tibet**

Pages 225-242

Xuanxue Mo, Zengqian Hou, Yaoling Niu, Guochen Dong, Xiaoming Qu, Zhidan Zhao and Zhiming Yang

16. **Petrological and geochemical constraints on the origin of garnet peridotite in the North Qaidam ultrahigh-pressure metamorphic belt, northwestern China**

Pages 243-265

Shuguang Song, Li Su, Yaoling Niu, Lifei Zhang and Guibing Zhang

17. **Triassic collision of western Tianshan orogenic belt, China: Evidence from SHRIMP U-Pb dating of zircon from HP/UHP eclogitic rocks**

Pages 266-280

Lifei Zhang, Yongliang Ai, Xuping Li, Daniela Rubatto, Biao Song, Samantha Williams, Shuguang Song, David Ellis and J.G. Liou

18. **Diachronous lithospheric thinning of the North China Craton and formation of the Daxin'anling-Taihangshan gravity lineament**

Pages 281-298

Yi-Gang Xu

19. **Controls of stable continental lithospheric thickness: the role of basal drag**

Pages 299-314

Zvi Garfunkel

20. **Timescale and evolution of the intracontinental Tianchi volcanic shield and ignimbrite-forming eruption, Changbaishan, Northeast China**

Pages 315-324

Haiquan Wei, Yu Wang, Jinyu Jin, Ling Gao, Sung-Hyo Yun and Bolu Jin



## Preface

## The origin, evolution and present state of continental lithosphere

The continental crust comprises no more than ~0.5% of the Earth's mass, but it is an important geochemical reservoir because it is enriched in many incompatible elements, and contains probably >30% of Earth's Ba, Rb, Th, U, K, Pb budget. While continental crust is most accessible to us, a genuine understanding of its origin, accretion, bulk composition and evolution remains distant. The fact that the average continental crust is >2.5 Ga whereas the oceanic crust is <200 Ma tells us that the bulk continental crust is relatively permanent whereas the oceanic crust is not. The prevailing view is that the continental lithospheric mantle (CLM) represents partial melting residues of early Earth melt extraction events, and is thus compositionally depleted and physically buoyant (i.e., more refractory with high Mg/Fe and low Al<sub>2</sub>O<sub>3</sub>) with respect to the underlying asthenosphere. As a result, the buoyant CLM, ever since its inception, has been physically isolated from the convective mantle. It is the buoyant nature of the CLM that allows it to protect the overlying crust from being destroyed. The similar age of the CLM and the overlying crust in many cratonic regions not only points to their physical association, but probably the genetic link as well. Thus, the *origin, evolution and present state of continental lithosphere* is key to the understanding of many aspects of the continental crust. Is CLM forever? If so, the continental crust would be forever with the exception of terrigenous sediments transported to deep sea trenches and recycled into the deep mantle. If CLM is not forever, then the continental crust may not be well preserved. This has important consequences not only for the origin and evolution of continental crust over Earth's history, but also for the chemical geodynamics in the context of models of mantle circulation and crust–mantle recycling.

Recent studies have shown that not all the continental lithospheres are forever. Lithosphere thinning is well known at zones of continental rifts, and is inferred petrologically and seismically in tectonically active

regions (e.g., Sierra Nevada, Basin-and-Range provinces in the western US, the southern Andes, and the Tibetan plateau). Lithosphere thinning has also been recognized in tectonically relatively stable regions like eastern Australia, eastern China, and in particular beneath some ancient cratons, which, by definition, should be stable (e.g., the Wyoming craton, North China craton, portions of South America etc.). What may have caused CLM thinning? Oceanic lithosphere subduction may lead to CLM "delamination". Continental collision could cause CLM thickening and then thinning through basal "delamination" or convective removal. These processes could also cause density-induced foundering of deep continental crust. However, this crustal foundering model is in apparent discrepancy with continental collision associated magmatism and its net contribution to continental crust growth. The crust-CLM coupling would also require coeval or co-genetic lithospheric contribution to stabilize the crust. What may have caused CLM thinning beneath stable cratons is more enigmatic. Thermal erosion by mantle plumes, regional extension/stretching, hydration-weakening, and continental subduction are among the popular hypotheses.

Given the significance of the scientific problem, an international conference, *The origin, evolution and present state of subcontinental lithosphere*, was held in Beijing, China, June 25th to 30th, 2005 (*Episodes*, 28, 209, 2005). This conference, co-sponsored by the IUGS Commission on Solid Earth Composition and Evolution (SECE), National Natural Science Foundation of China, Elsevier B.V., Peking University and China University of Geosciences (Beijing), brought together scientists of different disciplines world wide to discuss and share their views on this important problem. This conference was held in Beijing, China because of the unique geology. Eastern China, especially the North China Craton (NCC), presents us with an excellent example of CLM thinning since the Mesozoic. The existence of

Paleozoic diamondiferous kimberlites in the NCC suggests a thick, ~200 km, lithosphere back in the Paleozoic, yet the lithosphere is <80 km thick at present as revealed through seismic studies and petrologic studies of mantle xenoliths associated with the widespread Mesozoic–Cenozoic “intra-plate” volcanism. The NCC is bounded to the south by the Triassic Qingling–Dabie–Sulu orogen, and to the north by the Permian–Triassic Central Asian orogen. In a broadest sense, the NCC is bounded to the east by the western Pacific subduction zones with subducted paleo-Pacific lithosphere still lying horizontally in the transition zone beneath eastern China as detected seismically. All these could have set a favorable boundary condition for the Mesozoic CLM thinning beneath the NCC. Ultrahigh pressure metamorphic rocks from orogenic belts in northwestern China offer different perspectives on the role of oceanic lithosphere subduction and continental collision in causing CLM thinning. The syncollisional and post-collisional magmatism in Tibet allows us to assess mantle contribution to continental crust accretion, and to infer whether continental subduction/collision can indeed result in significant CLM thinning.

The 18 articles of this Special Lithos volume result from this conference and deal with the origin and evolution of continental lithosphere with different emphases: (1) Concepts, observations, problems and hypotheses about CLM; (2) intraplate magmatism and petrogenesis of crustal rocks; (3) petrogenesis at active tectonic zones and orogenies; (4) ultrahigh pressure metamorphism and continental accretion; and (5) geophysical observations and quantitative interpretations. We highly value each of these contributions not much because they have solved some or any specific problems, but because they share new observations, offer new ways of thinking, and put forward new hypotheses

for future research into this fundamental Earth problem. We predict with enthusiasm that this special volume will become a necessary source of reference for many researchers in the broad field of Earth Science.

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