Constraints on Composition, Structure and Evolution of the Lithosphere: Preface

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The idea for this special issue was triggered at the Goldschmidt Conference held in Florence (August 25-30, 2013), where we convened a session titled "Integrated Geophysical-Geochemical Constraints on Composition and Structure of the Lithosphere". The invitation to contribute was extended not only to the session participants but also to a wider spectrum of colleagues working on related topics. Consequently, a diverse group of Earth scientists encompassing geophysicists, geodynamicists, geochemists and petrologists contributed to this Volume, providing a comprehensive overview on the nature and evolution of lithospheric mantle by combining studies that exploit different types of data and interpretative approaches. The integration of geochemical and geodynamic datasets and their interpretation represents the state of the art in our knowledge of the lithosphere and beyond, and could serve as a blueprint for future strategies in concept and methodology to advance our knowledge of this and other terrestrial reservoirs.

Noteworthy, although all the papers of this Volume are based on geochemical data, the Authors invariably considered first-order geological and geophysical data in their interpretations. This holistic approach fulfilled the spirit envisioned by the Guest Editors, providing a Special Issue that should be valuable for the wide range of readers of Tectonophysics.

A heartfelt thank-you from the guest editors to the Elsevier editorial assistants Surya Nedunchezhiyan and Samikannu, Iswarya, who have shown great efficiency, dedication, diplomacy and patience during the long process of getting this volume together. Without their enormous help this would have been a much more arduous task.

We open this special issue with the contribution of **Sgualdo et al. (2015)** which consists of a petrological and geochemical investigation of mantle xenoliths from a Neogene-Quaternary volcanic region located in Southern Yemen. The authors suggest that the lithospheric mantle beneath the Arabian margin was affected by continuous chemical, modal and mineralogical modification, developed during large extractions of basic melts since the late Proterozoic (~ 2 Ga, according to Lu–Hf model ages). The presented isotope systematics of Nd-Hf-Pb-He also indicate subsequent episodes of widespread metasomatism, possibly during the Cenozoic in connection with the general extensional and rifting regime affecting the whole East Africa-Arabian region.

Kourim et al. (2015) combine petro-physical and geochemical investigations of mantle xenoliths sampled in Cenozoic volcanics from southwestern Hoggar, Algeria. The geochemistry of the peridotites reveals different thermal regimes (ranging from Low-LT, to High-HT temperatures) that strongly relates to the microstructures and crystallographic textures. The authors demonstrate that the microstructural and chemical characteristics of the LT xenolith group were established in the Neoproterozoic as inherited from the Pan-African orogeny, whereas the grain-growth of the HT xenoliths suggest deformation associated with melt channeling that culminated in the formation of high-permeability porous-flow conduits.

El Messbahi et al. (2015) investigate the mechanism of lithospheric thinning and the component of mantle buoyancy which account for the Moroccan topography. Two distinct suites of mantle xenoliths from the Middle Atlas region have been analyzed for this purpose. The authors interpret the mineralogy, microstructure and crystallographic orientation of the xenoliths as the result of two distinct mechanisms of lithospheric thinning (decompression vs thermal erosion), which occurred at a short wavelength scale.

Yoshikawa et al. (2015) present a new study focused on one of the best-preserved ophiolite complexes worldwide, the Oman ophiolite. In particular the authors examine the mantle segment of the Fizh block, representing the northernmost section of the Oman massifs. The major and trace elements and Sr-Nd isotopic features of the main peridotite phases (mainly clinopyroxene), are explained as products of a polygenetic evolution of melt extraction of a variously depleted mantle source and a subsequent interaction with fluids derived from dehydration of the metamorphic sole, during incipient subduction and obduction.

Hidas et al. (2015) constrain the geochemical characteristics of gabbroic dykes and their geometrical relationships within two sections of the Betic peridotite complex: the Ojén and Ronda massifs. The authors analyzed in detail the major and trace element composition of the gabbro paragenesis (plagioclase and clinopyroxene), and conclude that parental melts share a common source with an island arc tholeiitic affinity. The authors ascribe the emplacement of the gabbros to a hyperextension regime of the continental lithosphere, with extreme backarc basin extension induced by the slab rollback of the Cenozoic subduction system in the westernmost Mediterranean.

Liang et al. (2015) present new U–Pb zircon dating of lithologies outcropping along the Mesozoic tectonic lineament of the Xingcheng-Taili ductile strike-slip shear zone, formed during the Mesozoic reactivation of North China Craton (NCC). Some granites and gneisses record Neoarchean protolith ages (~ 2500 Ma), whereas other granites yield Upper Triassic ages (210-220 Ma) plausibly related to the collision of the NCC with the Yangtze craton in early Mesozoic time. Furthermore, adamellite bodies record ages of 150-160 Ma related to the thinning of the NCC's continental crust and the strongly deformation event that occurred in the Early Cretaceous as a result of ongoing roll-back of the Pacific Plate beneath the eastern NCC.

The temporal sequence, spatial extent, and cause of the lithospheric thinning of the North China Craton are also investigated by **Liu et al. (2015)** on the basis of olivine composition, whole rock Re-Os isotope systematics and platinum-group element abundances of mantle peridotite xenoliths. The samples are from two basalt localities of Cenozoic and Cretaceous age in the eastern NCC that are located far from the main tectonic element in the region, the Tan-Lu fault system. Peridotites in both localities represent fertile lithospheric mantle. The xenoliths entrained in Cenozoic basalts record a main melting event during the Early Paleoproterozoic (~ 1.8 Ga), with only sporadic preservation of minor Archean lithospheric components detected by Os model ages. In contrast, peridotites in Cretaceous basalts record the coexistence of both Archean and modern lithospheric components. The authors propose that the removal of the original Archean lithosphere occurred first within Proterozoic collisional orogens, followed by replacement of Precambrian lithosphere during the Mesozoic in the course of general onset of Paleo-Pacific plate subduction.

Chen et al. (2015) explore another important volcanic region in northeastern China: the Cenozoic intraplate magmatism of Shuangliao, in the Songliao Basin. In order to better characterize the mantle source of the Shuangliao basalts, the authors analyze the H_2O contents in clinopyroxene phenocrysts by Fourier transform infrared spectrometry (FTIR) and calculate, the H_2O contents of the coexisting melts. On the basis of previous geochemical and isotopic studies, this basaltic suite records HIMU metasomatic in the related mantle sources. The clinopyroxene water contents and their relationships with other geochemical indicators, also suggest the influence of recycled oceanic crust, recycled marine sediments and a depleted mantle component should be involved in the related magma source. The authors also suggest a progressive increasing of marine sediments in the mantle source for the youngest basalts.

Melchiorre et al., (2015) present a geochemical study of mantle xenoliths entrained in post-plateau alkaline lavas belonging to Meseta Lago Buenos Aires (Central Patagonia) with the aim of constraining the processes that affected this portion of the Patagonia lithospheric mantle. The xenoliths are devoid of modal metasomatism, but on the basis of textural and geochemical evidence, they record an unusual coexistence of three generations of orthopyroxene. The authors suggest that a refertilization event induced by transitional alkaline/subalkaline melts has largely modified this lithospheric domain.

We conclude this issue with the contribution of **Gentili et al. (2015)** that presents a methodological study to quantitatively determine the mineralogical assemblages of ultramafic rocks. They compare the results obtained with Rietveld refinement method to X-ray powder diffraction (XRPD) to that obtained by mass balance (MB) calculations. The authors demonstrate that the Rietveld method is applicable even when limited amount of material (< 1 g) is available, and the "classical" chemical approaches (MB: bulk rock and mineral chemistry) cannot be applied. Moreover the Rietveld method provides supplementary information on crystallographic data (i.e., mineral crystallite size, mineral lattice parameters, density, site occupancies), which are valuable input parameters for the interpretation of large-scale geophysical characteristics of the upper mantle.

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