Editor's note

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Norman (Norm) H. Sleep is Professor of Geophysics in the School of Earth Sciences at Stanford University. He received a BSc (1967) in Mathematics from Michigan State University and both an MS (1969) and a PhD (1973) in Geophysics at Massachusetts Institute of Technology (MIT). With a brief postdoctoral fellowship at MIT, Norm joined Northwestern University as an Assistant Professor in 1973 before he moved to Stanford University in 1979 as an Associate Professor. Since 1984, he has been Professor of Geophysics and Geology and Professor of Geophysics at Stanford. His important scientific contributions are manifested by numerous honors and awards. He was elected Fellow of the American Geophysical Union (AGU, 1980), Fellow of the Geological Society of America (GSA, 1984), and Fellow of American Association for the Advancement of Science (1993). In 1999, he was elected to the US National Academy of Sciences. Norm has also received *James B. Macelwane Award* (1980) and *Walter H. Bucher Medal* (1998) from the AGU, *George P. Woollard Award* (1991) from the GSA, *Wegener Medal* (1997) from the European Union of Geosciences, and *Wollaston Medal* (2008) from the Geological Society of London.

Majoring in mathematics while taking several geology and geophysics classes in his undergraduate years (1963–1967) at Michigan State University, Norm developed skills and interests in quantifying geological processes. His curiosity on what may have caused the subsidence of the Michigan Basin (and “geosynclinals” basins in general) tweaked his interest in geodynamics. He arrived at MIT in the summer of 1967 and attended a small conference at Wood Hole Oceanographic Institution where marine scientists presented new results confirming the reality of seafloor spreading. But why the seafloor becomes deeper with age was poorly understood. Norm’s experience with the Michigan Basin led, by analogy with oceanic lithosphere, to the concept of thermal basin subsidence (thermal contraction), which is a founding concept in Plate Tectonics. In fact, Norm has made many seminal contributions to most of the advances in our present-day understanding of geodynamics that cover a wide range of topics, including physical processes of mantle melting and melt segregation, petrological and physical consequences of melting a compositionally heterogeneous mantle, ocean ridge magma chamber processes and ocean crust

formation, hotspots and mantle plume dynamics, continental margin processes, subduction zones, island arcs, mantle convection, fault mechanics and earthquake mechanisms, Archean tectonics, Earth’s thermal evolution as well as the origin, evolution and present-state of oceanic and continental crust and mantle lithosphere. He has also made original contributions to planetary geology such as thermal state of Mars, Martian tectonics, astrobiology, etc. His more recent research into ocean-ridge hydrothermal circulation and its effects on ocean chemistry, ecosystems at present-day ocean ridge enrichments and in the early Earth are particularly exciting and important towards the revelation of the origin and evolution of life.

I am delighted that Norm Sleep accepted the invitation to contribute an article to *Chinese Science Bulletin* on *Small-scale convection beneath oceans and continents*. This is an important contribution that endeavors to resolve one of the fundamental geodynamic problems that remains puzzling despite the efficacy of the Plate tectonics in explaining many phenomena since its advent some 40 years ago. If the thickness of the lithosphere increases with its age because of heat loss, then it would be well over 400 km thick beneath old cratons, yet the observation that it is ~ 200 km thick requires heat supply to prevent from thickening. Sleep quantifies that small scale convection at the lithosphere-asthenosphere boundary (LAB) supplies adequate heat. The oceanic lithosphere begins to form at ocean ridges, thickens with age, reaches its full thickness of ~ 90 km at the age of ~ 70 Ma, and maintains the same thickness independent of its further aging beneath much of the world ocean floor (with few exceptions). Sleep shows that small scale convection at the LAB beneath the mature (> 70 Ma) ocean floor is also a viable mechanism to supply heat and to prevent oceanic lithosphere from further thickening. On the other hand, the petrology suggests that the stability of the hydrous amphibole under conditions of < ~ 1100°C and < ~ 90 km defines the depth of the LAB. Obviously, to understand the nature of the LAB holds the promise towards a full understanding of the workings of plate tectonics. The elegant models by Sleep offer new insights into this fundamental problem, which, together with his thorough reviews in the context of mantle geodynamics, provide an impetus that encourages enthusiastic young scientists to investigate this and many other geodynamic problems of global significance.

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