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Book review: *From Crust to Core – A Chronicle of Deep Carbon Science* by Simon Mitton

Mohamed Ali Bouhifd

Laboratoire Magmas et Volcans, CNRS & Université Clermont Auvergne Campus universitaire des Cézeaux, 6 Avenue Blaise Pascal, 63170 Aubière, France

Correspondence: Mohamed Ali Bouhifd (ali.bouhifd@uca.fr)

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Mitton, S.: From Crust to Core – A Chronicle of Deep Carbon Science, Cambridge University Press, University Printing House, Cambridge CB2 8BS, UK, 382 pp., ISBN: 9781316997475, EUR 44.99, 2020.

Carbon is the fourth most abundant element in the solar system. Its presence significantly affects chemical and physical processes in the Earth's atmosphere, mantle and core. The importance of carbon also lies in the fact that it has been essential for the origin and evolution of life, that it is involved in an important fraction of the energy we use, and that it is assumed to play a fundamental role in the Earth's climate system. In *From Crust to Core – A Chronicle of Deep Carbon Science*, Simon Mitton explores several centuries of philosophical and scientific inquiry on the nature of the Earth's interior, as based on the stories of over 100 scientists, and sheds light on the particular roles of deep carbon. The author is a life fellow at St Edmund's College at University of Cambridge. His current research discipline is history of science, and his field of expertise is the history of astronomy and planetary science in the nineteenth and twentieth centuries. He is a member of the Deep Carbon Observatory (Carnegie Institution for Science, Washington, DC) network of scientists whose mission is to understand better the element carbon in Earth.

Composed of 15 chapters, the book starts with why carbon in Earth matters and follows with the origin of carbon and its delivery to Earth. In chapters 4–7, the author presents scientific adventures behind the determination of the age and of the physical and chemical interior of the Earth. In chapters 8–10, the reader will meet a number of remarkable scientists whose discoveries were to have major implications for understanding not only the dynamics of the Earth's interiors, but also the genesis of a new interdisciplinary field: oceanography. In chapters 12–14 the focus is on the cycles, reservoirs and the fluxes of carbon between the main Earth reservoirs and also on the history of high-pressure physics and chemistry of carbon-bearing minerals under the Earth's mantle conditions. In the final chapter, research on deep life is told from the studies by the pioneer Alexander von Humboldt to our days. For every chapter, the author provides a very interesting list of references reporting some remarkable discoveries that changed our understanding of Earth-system science as a whole.

In summary, the book introduces the history of Earth's carbon all the way from its synthesis in the first generation of stars in our universe, to its incorporation in the solar nebula, where the Sun and planets formed nearly 4.5 billion years ago, to its final delivery to Earth with chondrites. The book takes the reader on a captivating trip with an excellent narrative style. Many discoveries, which led to enormous advances in broadening our understanding of the history of science in general, are told, for example, the discovery by Hans Bethe (Nobel Prize in Physics in 1967), who made a breakthrough regarding the synthesis of elements in stars, by showing the carbon role in the astrophysical conversion of mass into energy, validating Einstein's theory, $E = mc^2$. The book also includes the history of the discovery of radioactivity, a process for which Becquerel, Pierre and Marie Curie were awarded the Noble Prize in Physics in 1903. This discovery would have a huge impact on the Earth's internal dynamics over its 4.5 billion years of history owing to the important amount of thermal energy produced by radioactive elements present within the Earth. The discovery of radioactivity provided a novel and robust way to measure the age of rock samples that made most other geological dating methods obsolete. The book includes the fascinating history of the

theory of plate tectonics and a history of research on deep diamonds, which can keep the chemical message of their formation billions or millions of years ago. It also includes the history of the pioneering research on deep life during the last half a century of extraordinary progress on questions about the limits of life on Earth and the nature of deep life. In a final note, the author reaches the philosophical conclusion that there is a great deal still to be discovered about the microbial environment of Earth's interiors that is highly relevant to the search for life elsewhere. Therefore, it seems entirely plausible that, right beneath our feet, deep carbon science could yet uncover important clues on the origin of life in the universe.

This is an excellent book for everyone interested in knowing the stories behind the key discoveries in deep carbon science that includes (but not restricted to) the Big Bang, origin of carbon in the universe, formation of rocky planets, diamonds in the Earth's mantle and the signs of deep life. Additionally, *From Crust to Core – A Chronicle of Deep Carbon Science* is well affordable for all "amateurs" and also professionals who are looking for the fascinating story of the evolution of Earth system science in general and deep carbon science in particular.