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Earth: The First 4.5 Billion Years, from Stardust to Living Planet is a new account by geologist Robert Hazen that brings the outline up to date with the latest research and links the story in a unique and compelling way to the formation of minerals at different stages in Earth's history.

Hazen is a good writer; reading the book is a pleasure, but the content is dense. *The Story of Earth* is neither a casual read nor a scientific text. There are no references and no equations, and in places, I would have welcomed a figure or two. But the descriptions are complete. I would recommend this book to anyone committed to understanding Earth and its history. As an added bonus, the reader will see that history through diverse minerals and gems.

The book begins with the Big Bang and moves quickly to the formation of Earth in the rotating disk of material surrounding the young Sun. The focus then turns to the large impact thought to have ejected from Earth the material that became the Moon. In that chapter, and throughout the book, Hazen describes not just what we think we know but how and why we came to believe it was so. For example, he describes the three competing theories for the Moon's origin that were most popular before the Apollo missions: fission from Earth, capture, and coformation. The compositional and isotope data from the Apollo samples showed that the Moon was essentially material similar to Earth's crust but depleted in volatiles. Consideration of the Apollo results spurred the new idea of impact formation.

An internationally known researcher with a broad interest in Earth sciences and astrobiology, Hazen knows what is happening in those fields and what leads are under investigation. A good example is his discussion of the possible role of methane in breaking Earth out of global, glacial "Snowball Earth" events. Methane is a more potent greenhouse gas than carbon dioxide. But its sources and their variation over Earth's timeline remain an area of research.

Hazen recounts a teacher telling him that if confronted with any mystery rock, he would be right 90% of the time by guessing it to be composed of plagioclase, a component of basalt—good to know if you travel to the Moon or Mars. Basalt, the rock that rules the worlds, was our planet's first covering and is still the most abundant rock on Earth's sea floor and on Mercury, Venus, Mars, and the Moon. But as Hazen explains, it is granite that makes the land as we

know it. Granite forms when basalt is slowly melted in the presence of water and the lighter, silicon-rich materials come to the top. The results are of fundamental importance for Earth. The granite collects and floats on the basalt, forming the continents. If not for granite, Earth would be a water world with only small basalt islands like the Hawaiian chain.

Although the mineralogy of early Earth is interesting, the diversity of minerals soared after complex life began to produce oxygen. Hazen and his colleagues were the first to point out that two-thirds of the 4500 known minerals (including my favorite, turquoise) could not have formed without free oxygen. Indirectly, those gems are biomarkers.

In his final chapter, Hazen looks to Earth's future. All good things must end someday, and so it will be with Earth. As the Sun gets brighter, eventually becoming a red giant, Earth will no longer be in the habitable zone and will be turned to a cinder or outright vaporized. Hazen shows us that final picture and then puts it in context with the near-term effects of human activities. We humans are not destroying Earth; we are only making it uncomfortable for ourselves. In time, the many species we drive to extinction will be replaced by others, and the sea-level rise that will destroy our coastal cities will be a blur in the history of geological change.

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new books

materials science

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miscellaneous

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nuclear physics

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IX Latin American Symposium on Nuclear Physics and Applications. R. Alarcon, E. Ayala, C. Granja, N. Medina, eds. *AIP Conference Proceedings 1423*. Proc. symp., Quito, Ecuador, July 2011. AIP, Melville, NY, 2012. \$179.00 (495 pp.). ISBN 978-0-7354-1003-9

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optics and photonics

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particle physics

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The National Institute of Standards and Technology (NIST) expects to make two new Precision Measurement Grants that start on 1 October 2013, contingent on the availability of funding. Further guidance will be provided on the Web when the funding level is resolved. The grants would be in the amount of \$50,000 each per year and may be renewed for two additional years for a total of \$150,000. They are awarded primarily to faculty members at U.S. universities or colleges for research in the field of fundamental measurement or the determination of fundamental physical constants.

Applications must reach NIST by **5 February 2013**. Details are on the Web at: physics.nist.gov/pmg.

For further information contact:

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quantum physics

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