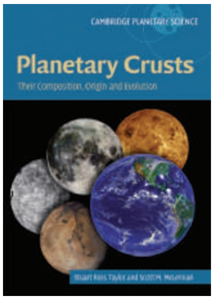
The book is organized into chapters by planet. The Moon and Mars, which share the advantage of having undergone detailed geological and geochemical investigations despite their extreme distance from terrestrial laboratories, are allocated two chapters each; the Earth, with several hundred years of intensive scientific scrutiny, warrants four chapters.

The authors bring to bear their considerable expertise in crustal research, particularly for the Earth, Moon and Mars. Lunar rocks have changed very little over the past 3,000 million years, and their geochemical analysis formed the foundations for much of our current understanding of early crustal formation. We know the composition and structure of the martian crust primarily from the analysis of a handful of rocks that were ejected from its surface and made their way improbably to Earth. The composition and history of the crusts of Mercury and Venus are more conjectural, with our understanding being based largely on analogy and inference. But none of these examples of crustal generation prepare us for the enormous complexity of the Earth, which hosts the only known example of a highly differentiated crust that has undergone multiple cycles of generation.

The book is written from a decidedly geochemical viewpoint, which is understandable given that the bulk of our knowledge comes from the chemical analysis of rocks — the building blocks of planets. However, this can make for a difficult slog for non-specialists unused, for example, to the subtle implications of Rb/Sr ratios or



Planetary Crusts: Their Composition, Origin and Evolution

By S. Ross Taylor and Scott McLennan

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departures from CI chondrite elemental abundances. Although the authors deride the proliferation of jargon in their preface, it is not long before such beasts as siderophile/lithophile/chalcophile, ε_{Nd} and $\delta^{18}O$ rear their ugly, undefined heads to send novices scrambling to their geological dictionaries. But persistence on the part of readers will be rewarded with a comprehensive description and insightful discussion of virtually all salient aspects of the formation and the evolution of planets and their interiors.

My only substantial disappointment is with the superficial treatment of the icy satellites of Jupiter and Saturn, with their silicate interiors and water-dominated crusts. They commit a common error in referring to an "icy crust overlying a liquid ocean": a more accurate description would include a predominantly water crust comprising a solid upper layer and molten lower layer. Further, they give no consideration at all to whether the outer layers of the silicate interior of a body such as Europa might form a crust in themselves.

Their ultimate conclusion is a cautionary tale for advocates of comparative planetology. In fact, one encounters at least a half-dozen explicit 'cautionary tales' in the course of the book. They argue that planetary formation and evolution is governed by essentially random processes, relying on the fortune (or misfortune) of collisions between Moon-to-Mars-sized incipient planets of various compositions. For example, the Earth and Venus are near-twins in size and composition, but a glancing collision with a Mars-sized body produced the Moon, and the late addition of a relatively small amount of water may have made plate tectonics on the Earth possible. Taken together, these processes made the difference between the world we live on and the hellish surface of Venus.

The implications of the book's conclusions for the search for 'Earth-like' planets are profound. It is not enough for a planet to be of the correct size and to orbit a star at the right distance. Even a composition similar to Earth's will not guarantee an Earth-like environment. We now know that the details of crustal formation are a key to many of the attributes of our planet that make it so agreeable, and if Taylor and McLennan are correct, the evolutionary preconditions for the environment that exists on the Earth's surface appear to be absurdly improbable. When it comes to forming planets and their crusts, it seems that God does indeed play dice. ❐

REVIEWED BY W. BRUCE BANERDT
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For the love of fossils

LECTURE

The trilobite — an extinct marine creature with numerous legs and a uniquely shaped exoskeleton — occupied almost every ecological niche available to its phylum throughout the Palaeozoic era. In a talk in the 'Café Scientifique' series at London's Dana Centre, the creatures were introduced as "eyewitnesses of evolution" by Richard Fortey, a Merit Researcher at the London Natural History Museum (http://www.danacentre.org.uk/events/2009/02/18/488).

Fortey's affection for the organisms that have been the focus of his scientific career was apparent throughout the highly engaging talk. A highlight focused on the development of the trilobite eye — one of the most complex ever captured in the fossil record. Trilobite eyes were made of a staggering number of tiny calcite lenses, ranging from the hundreds to thousands, some of which Fortey himself counted in his days as a post-graduate student.

Some of the uniquely adapted eyes could see 360°, and one of Fortey's favourite eyes had a special 'shade' that served as a sun visor, allowing the creature to see prey at distance across the sea floor. Other trilobites had variable amounts of magnesium within the crystal structure of the lens, apparently for the purpose of focusing the lens.

Images from the expansive trilobite fossil record captured the audience's imagination, from smooth little burrowers occasionally found in North American backyards to elaborately spiked, spined and even trident-bearing versions unearthed from the sands of North Africa. The creatures described ranged from humble pillbug-like creatures burrowing across the sea floor to metre-long, armoured predators that terrorized the water column.

Both the lecture and the subsequent discussion ended on the trilobite fossil trade. Like dinosaur fossils in China, trilobites from North Africa have become a commodity — several specimens on sale at London's luxury department store Harrods turned out to be unknown species. However, Fortey pointed out a potential upside: he and his colleagues were not able to find representatives of all these new species on subsequent field trips; without a market for the fossils, these species may never have been found. ❐

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