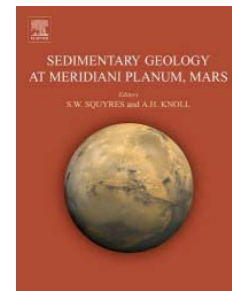


*Sedimentary Geology at Meridiani Planum, Mars*, edited by S.W. Squyres & A.H. Knoll, 2005. Elsevier, P.O. Box 211, 1000 AE Amsterdam, The Netherlands. Hardback, 189 pp. Price EUR 52.95; USD 57.95; GBP 36.99. ISBN 978-0-444-52250-4.



At the beginning of 2004, two twin spacecrafts landed on Mars. The two landers were by far the most advanced objects that have been placed on the surface of Mars. They unloaded two rovers (the Spirit and the Opportunity) capable of (relatively) long-distance travelling, and equipped with a set of instruments able to produce some kind of analogue of our laboratory on Earth. Thanks to these features, they represented a quantum leap in the investigation of Mars, providing more data over larger areas than the previous Vikings and the Mars Pathfinder. But the real significance for the study of Mars was that, for the first time, one of the landers (the Opportunity) allowed scientists on Earth to perform real and trustable sedimentological analyses of sedimentary rocks.

The rover Spirit landed in the Gusev impact crater, which can be considered as a real sedimentary basin, even though no subsidence was involved in the formation of this structure. A large valley is debouching into the crater, and there are still remnants of large deltaic sedimentary bodies. The rover Opportunity landed instead in the flat area of Meridiani Planum, with the objective to investigate the presence of hematite on the surface. Between the two rovers, the Spirit was the most promising in term of sedimentary geology because it was landing in a fluvio-lacustrine paleoenvironment. However, the real sedimentological data were provided by the Opportunity, because it was able to approach and observe outcrops of sedimentary rocks. The landing site of the Spirit was selected without considering that the long and still ongoing eolian history of Mars has totally reworked the aqueous sediments, forming a blanket of eolian deposits or deflation surfaces: a situation quite similar to that of the present Sahara where eolian deposits cover and hide river, delta and lake deposits formed during wetter climatic conditions.

The Opportunity landed incidentally near the Eagle and Endurance craters, where outcrops were present and accessible. The choice of the landing area was perfect because the target was a zone where erosion and impacts were capable of exposing ancient rocks. The Opportunity discovered sediments, sedimentary structures, strata, stratigraphic units and all the sequel of features and lithologies that we are used to find and study on Earth.

This book is a tribute to the ingenuity, to the spirit of exploration and discovery, and to the study of sedimentary environments and processes. With the development of the exploration of Mars up to the deployment at the surface of astronauts and geologists, this book will remain a milestone as the first real piece of work in sedimentary geology on Mars and beyond the Earth.

The book is a collection of papers that had been published earlier in a thematic issue of "Earth and Planetary Science Letters" in 2005. The book is certainly not an extensive work, but its 8 papers – which provide a comprehensive overview of the sedimentary deposits at Meridiani Planum – present a wealth of data. In addition, the book is lavishly illustrated with high-quality colour images.

The first paper is by Squyres and Knoll and gives an overview of the scientific outcomes of the mission. The second paper, by Grotzinger et al., is a thick report of the stratigraphy and sedimentology of the deposits of the Burns formation: the first recognisable sedimentary unit on Mars, although still informal for obvious reasons. This account is a detailed analysis of the sediments cropping out in the study area. Facies are described and interpreted and all the data are

well represented, even in an impressive foldout that gives a general view of the best outcrops. The third paper deals with the chemistry of the deposits. Clark et al. here extract also mineralogical data from the elemental analysis obtained by the APXS and Mossbauer spectrometers on board of the Opportunity. Unfortunately, no X-ray diffractometer was present in the payload to give a more direct analysis of the mineralogy of the rocks. However, both NASA and ESA will use these instruments on their future missions, respectively for the Mars Science Laboratory and ExoMars. The diagenesis is analysed in a paper by Mc Lennan et al.; this paper addresses the presence of hematite spherules that attracted the attention of the geologists on this site. The paper by Tosca et al. deals with the geochemistry of the evaporitic deposits found by the Opportunity; this paper provides a model for that formation and it is a fine account that may be useful also for sedimentologists interested in evaporitic deposits on Earth.

Two papers do not provide direct data from the Opportunity but deal with some possible terrestrial analogues. One paper, by Fernandez-Remolar et al., discusses the strong oxidation environments of the Rio Tinto in Spain. This river displays an amazing sequence of oxidised deposits ranging from the Pliocene to the present day, and is considered one of the best case histories on Earth for this kind of deposits. The other paper, by Morris et al., deals with hematite spherules from basaltic tephra on Mauna Kea (Hawaii). The final paper is by Knoll et al. and gives an astrobiological perspective on the basis of these deposits.

Because the book is a collection from a single set of papers published in a major journal, it is only justified to ask if there is a real need for this publication. My answer is “yes”. Not only professionals must read the book, but I think it must be included in sedimentary geology curricula to expose students to these new findings. The price is, unfortunately, probably a little too high considering that this is a reprint collection.

On the other hand, the set of data and the related interpretations and discussions are impressive. In several instances, terrestrial sedimentologists may find some of the analysis too simple or straightforward, but this is due to the evident constraints of working with data remotely collected. These minor pitfalls cannot diminish the great achievements reported in this book that represent not only a departure point for future geological investigations of Mars but also a point of arrival: we finally clearly see that water was present on Mars in a variety of processes and environments and that the geology of Mars is also a history of sediments and sedimentary rocks.

This a major achievement considering that, only less than ten years ago, it was not an easy task to get a paper published that proposed the existence of deltaic bodies on the surface of Mars. The idea that Mars is a complex planet is finally accepted, as it is accepted that most of this complexity is linked to sedimentary processes at its surface: processes that form and transport sedimentary particles, the deposit sedimentary units, and that fill basins with sedimentary successions.

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