Chapter 17
Morphometrics and Cosmology: Short Note and Future Hope

Ashraf M.T. Elewa

"By using a D'Arcy machine to begin a study of microbial life on Earth, someday remote and automated instruments may be able to identify life elsewhere in the universe – whatever form that life may take". This paragraph is mentioned in an interesting article titled "Who Wrote the Book of Life?" written by Leslie Mullen (6 Jan 2001) on the firstscience.com website. It is also mentioned in MARSBUGS, The Electronic Astrobiology Newsletter, before that date (28 May 1999).

Is this true? Is there life outside Earth? Were there creatures elsewhere in the universe? Are there creatures living, for example, on Mars? These questions and more arise to mind when you think of this mystery. Several scientists devoted their research to search for life outside Earth (e.g. Goldsmith and Owen 1992; Davies 1995; Sagan 1995; Angel and Woolf 1996; Goldsmith 1997; Walter 1999; Scott 2008).

Firstly, to clarify this topic it is important to introduce the David Harland's thought in his book titled "Water and the Search for Life on Mars", which is published in the year 2005. He believes that searching for life on Mars should be associated with studying the origin of life on Earth. This means that if we could discover, from the rocks of Mars, what is believed to be the earliest form of life (cyanobacteria with chlorophyll for photosynthesis), then we can provide evidence that the same could be the case on Mars.

Consequently, we should think of three possibilities (hypotheses) to answer the above mentioned questions:

1. There are no and there were no life and creatures on Mars; or
2. There were life and creatures on Mars; or
3. There are life and creatures on Mars.

The oldest and most famous evidence of life possibility on Mars is the meteorite ALH84001, which was discovered in Allan Hills of Antarctica in the year 1984.

A.M.T. Elewa (✉)
Geology Department, Faculty of Science, Minia University, Box 61519, Minia, Egypt
e-mail: aelewa@link.net; ashrafelewa@ymail.com

A.M.T. Elewa (ed.), *Morphometrics for Nonmorphometricians*, Lecture Notes in Earth Sciences 124, DOI 10.1007/978-3-540-95853-6_17,

The idea could be proved if we can establish somesort of paleoenvironmental similarity between Earth and Mars. The ideal example is represented by the thermal springs that were associated with extreme environments. Astrobiologists believe in the likelihood of abundant thermal spring environments on early Earth and Mars.

Tang and Roopnarine (2003) stated that thermal springs in evaporitic environments provide a unique biological laboratory in which to study natural selection and evolutionary diversification. These isolated systems may be an analogue for conditions in early Earth or Mars history.

Usually, cosmologists speak about and describe how meteorites strike Earth, and explain the results of the collision between these meteorites and the Earth. One of these possible severe results is the extinction of dinosaurs since about 65 million year. Many authors assigned this extinction to the extraterrestrial impact. Conversely, recent studies, including my own research, indicate multiple causes for this extinction. The most important part, however, is the age dating using radioactive elements. Some authors believe that $\Delta^{14}C$ has a half-life of 5750 years. Here I would note that some other scientists found it inaccurate to apply this technique for organic matters of more than 3,000 years old. I would also add that there should be definite cautions when applying this technique because any disturbance of the optimum conditions will normally lead to inaccurate results.

Dealing with our focus on the material suitable for morphometric analyses (carbonate globules), authors mentioned two significantly controversial ages to the carbonate globules present in the meteorite ALH84001. These conflicting results ensure my previously mentioned note on how the change in the surrounding conditions and the chemical composition affects the results of age dating.

I should note that all experiments (e.g. labeled-release, gas-exchange, and pyrolitic-release) made to verify life on Mars have promptly failed. Therefore, there should be another solution to solve the problem of discovering the origin of these carbonate globules.

Anyway, these globules contain aromatic hydrocarbons, magnetic minerals (iron oxides and sulphides), and bacteria-like forms but with significant smaller size than any bacteria discovered on Earth (for details see Goldsmith 1997).

Again, we should think of two hypotheses:

1. These carbonate globules that were formed within the fractures of the meteorite are from Mars; or
2. These globules were formed in the fractures of the meteorite after its collapse and collision with Earth.

It is possible that severe environmental conditions may lead to assemble these globules with their organic constituents in the meteorites after their falling down to Earth!! Solving this problem may help discovering the truth.

It seems that this solution could be found through studying shapes (morphometrics) of these bacteria-like forms in the carbonate globules. Though, how can we use morphometrics to do that?

I suggest the following scenario for that solution:

1. At first, we try to prove the hypothesis of significant variation between shapes of these bacteria-like forms and their resemblances of Earth origin that live under extreme conditions;
2. If this variation is significant, then these bacteria-like forms could be another type of bacteria characteristic to Mars or they were not living organisms at all;
3. To establish that these forms were organisms it is important to search for characteristics of living forms in the carbonate globules (e.g. evidences of cell division, the walls of these cells were made of organic matter . . . etc.). However, it is not easy to do that with such very old rock. If we substantiated that these forms were organisms, then we should try to discover their origin (Earth or Mars) in the next step:
4. If the variation of shapes is insignificant, we may conclude probable affinity connecting these two groups; consequently
5. We study the environmental conditions under which the bacteria from Earth could live. At this point, the close similarity between the environmental conditions of the two studied groups supports the second hypothesis that is mentioned above. In contrast, dissimilarity confirms the first hypothesis.

Even though, one may ask how can we study the environmental conditions of the bacteria-like forms. The answer is very simple; you can analyze the carbonate globules using isotope analyses to define elements leading to environmental significances.

As a final point, I did not discuss the morphometric tools and techniques that are relevant to analyze such data, it is not my mission here to review them; instead, I gave notice to one of several scientific branches that could be developed using morphometrics as a stride towards better future.

References

Angel R, Woolf N (1996) Searching for life on other planets. Scientific American 274 : 60–66

Davies P (1995) Are we alone? New York, Basic Books

Goldsmith D (1997) The hunt for life on Mars. Penguin, USA

Goldsmith D, Owen T (1992) The search for life in the universe (2nd ed).Addison-Wesley, Reading

Harland DM (2005) Water and the search for life on Mars. Springer Praxis Books / Space Exploration, Berlin

MARSBUGS (1999) The Electronic Astrobiology Newsletter 6 (14)

Sagan C (1995) Pale blue dot: A vision of the human future in space. Headline Book Publishing, London

Scott E (2008) Mars and the search for life. Clarion Books, New York

Tang CM and Roopnarine PD (2003) Evaporites, water, and life, Part I: Complex morphological variability in complex evaporitic systems – Thermal spring snails from the Chihuahuan Desert, Mexico. Astrobiology 3 (3): 597–607

Walter M (1999) Search for life on Mars. New York, Basic Books