



The Red Soil on Mars as a proof for water and vegetation!

R.Paepe

GEOBOUND International, BV MUHS, The Hague, The Netherlands

(geobound.roland.paepe@wanadoo.nl / Phone: +31-703-520510)

Red Soils on Earth are common features. Actually, what does the label “soil” stands for? It is used by so many people most of them with no training in soil science or in the related field of geology. And yet, everybody uses “Soil” as a simple connotation to indicate the surface, floor, territory, base/bottom, ground; or any kind of loose earth. And when it is red, it is called Red Soil. However, as a concept in soil science a Red Soil means something quite different: it then relates to a thorough soil/pedological weathering most often originating under tropical climatic conditions. The latter is characterised by specific sediment differentiation in the uppermost geological layers as to structure, texture and development of successive soil horizons. The latter biochemical process is a result of the clay/humic/Fe-sesquioxides vertical transport in the surface layers under the aegis of leaching respectively enrichment enhanced along the roots of any kind of vegetation cover. This process is called “pedogenesis” or soil development resulting in the development of a series of specific “soil” horizons in the strict pedological sense. Depending on the nature of the parent material (hard or loose) and of the prevailing climatic conditions, different soil types may be generated which are compiled in the international soil classification system. In reverse, from the soil type former conditions of climate and vegetation cover may eventually be disentangled. Despite the fact that pedology has the state of a well developed science in earth sciences the term “soil” as stated above has still different meanings and connotations depending on the professional field in which it is being considered and not at least on the skilfulness of the scientist involved. In fact numerous geo-scientists misuse the name too. And what about the scientists not acquainted with earth science at all? This is absolutely true in the field of astrobiology. What is then the meaning of the label “Red Soil” on Mars, Venus and other planets? In fact are they really “Soils” as defined

above or just simply red coloured (pediment) surfaces as the ones covering broad extensions in the tropical regions of Brazil and Congo? In fact, soil weathering should be clearly dissociated from all other types of rock alteration processes. Moreover soil composition, especially clay – phyllosilicates, display characteristic features enabling detection of real pedogenetic processes. Close observation of the impact traces at the Mars module site as well as the recent detection of phyllosilicates clays on Mars, may lead to firm indicators about pedogenesis processes on Mars. This opens new possibilities for the study of soil development similar to earthly soil processes on Mars and perhaps on other planets of the Solar system as well.

Bacteria occur in great amounts in soils on Earth. Both aerobic and anaerobic bacteria occur so that a great variety of species is shown. Most unexpectedly their number is higher in desert environments rather than in moist places like the Amazon. Hence, soil cyanobacteria play an important role in the building of microbiotic crusts in extreme environments of drought and cold like Antarctica. Cyanobacteria also induce important biochemical cycles such as the nitrogen-fixation in soils. Geologically their origin may be far remote in time so that it may be assumed that they are time-resistant as well. Therefore soils of extreme desert conditions, cold and warm, on both Earth and Mars may contain great amounts of such resistant bacteria. Soils in the pedological sense if present on Mars and other Planets may then likely open new broad fields of investigation which research has hitherto been somewhat neglected.

As a consequence, now that phyllosilicates have been detected on Mars the role of water in the soil-weathering process of clays has undoubtedly been proved. This could furthermore imply that not only water and soil weathering / pedogenesis extended over the entire surface of Mars, but a vegetation cover as well. The far too general connotation of 'soil' should then be reconsidered as a true soil concept inferring both water and vegetation in its development.

Hence, the relationship between soil development and vegetation/bacterial life on the surface of Mars opens up new broad possibilities for studies in astrobiology. Soils in Space and their related cyanobacterial content should become the genuine research for all evidences of real soil development outside planet Earth in our Solar System.