

TreesBEEs - Trees as biogeomorphic ecosystem engineers - biological weathering, initial soil production and hillslope relief formation caused by tree roots, rhizospheric bacteria, and mycorrhizal fungi

The very beginning of life on the planet Earth is hidden behind the aura of mystery. A similar situation with little solid evidence revolves around the expansion of plants on land in the Devonian and the role soil microorganisms could have played in this rapid spread of early vascular plants. In this research project we endeavor to explain issues supporting the rapid development of forest ecosystems. The successful colonization of lands by forests, as suggested by some studies, might be linked to a positive feedback loop in which the ability of tree root systems to biologically weather bedrock leads to the formation of an appropriate substrate for soil development. As a consequence, scientists assume gradual expansion of trees in the terrestrial environment. This mechanism can be associated with the ability of tree roots to biomechanically and biochemically weather bedrock (fractured bedrock). It is assumed that these mechanisms can be strengthened by the presence of soil bacteria (rhizospheric bacteria) and mycorrhizal fungi in the root zone of trees, resulting in mineral weathering.

Due to the complexity of such a research problem, the analyses which are proposed for this project will be interdisciplinary. We plan geochemical, pedological, microbiological, geophysical, and dendrogeomorphological analyses. Among many chemical and physical indicators of biological weathering, we are looking for direct and indirect evidence of biomechanical weathering in the anatomical features of tree root wood (in cells and tree rings).

One of the fundamental questions which we are attempting to answer is whether tree roots in cooperation with soil bacteria and mycorrhizal fungi are active participants in biological weathering, initial soil formation, and hillslope relief development. The second question is to determine what anatomical features of tree roots can provide evidence of biomechanical weathering of bedrock.

These questions have significant meaning in the context of contemporaneous soil and hillslope development but are also very important in paleoenvironmental analyses because the mechanism that promoted the expansion of trees on land in the Devonian still awaits a definitive explanation. We intend to acknowledge additional arguments in the discussion of this problem and considerably widen our knowledge in the range of basic research, mainly in the disciplines of biogeomorphology, dendrogeomorphology, microbiology and geochemistry.