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Evaluation of methods to estimate foliage density

Over the past few decades, a number of indirect methods have been developed to estimate total leaf surface area in forests, woodlands or plantations. Reliable estimates of leaf surface area (foliage density and leaf area index) are crucial in studies relating to ecosystem productivity and photosynthetic processes. This assumes even greater significance in the face of climate change and the issue of carbon sequestration. Few of these methods have however been applied or even validated in tropical forests. In this article (**page 508**), the estimates provided by two classical indirect estimation methods, the sampling pin or point quadrat method and the photographic checkered-board method, have been compared with direct estimates from leaf counts. The study also provides detailed information on the relation between species dominance in terms of individuals versus leaf area dominance and distribution at small spatial scales in a tropical evergreen forest. The study suggests an overestimation of foliage density by about 20% by the point quadrat method and an underestimation of between 20% and 40% by the photographic method. This is consistent with the results of other studies using instruments based on the same theoretical principles as these two methods. One caveat of the present study is that the 'direct' method also used an estimate: ideally, one should harvest and measure the surface area of every leaf and use the total as the reference value, but this was not possible because the study was carried out in a National Park. Although the authors measured the margin of error, they failed to develop a theoretical model for effective error correction. The underestimation by the photographic method is likely due to

the clumped distribution of foliage, which violates the assumption of a Poisson distribution, on which the estimates are based. It is hoped that the article will inspire further research into developing theoretical treatments for appropriate error correction, given non-random foliage distribution, a problem that has not been resolved so far for any indirect estimation method.

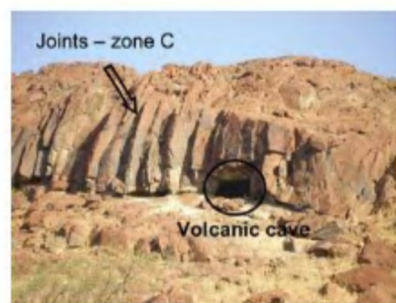
Hydrogen gas from water

Photosynthesis has been the energy source for life in the biosphere during most of earth's history. In our present society, it provides us with all our food and fuel for our vehicles, and much of our building materials and other commodities. Now, when our society faces the Big Energy Crisis, this ancient biological property may come to our rescue, in the form of bioenergy, for the production of biofuel by plants and algae, and in the form of optimized biomass and crop production by means of novel, technologically modified versions. Maria Ghirardi and Prasanna Mohanty (**page 499**) discuss the technology, and the theory behind using green algae and cyanobacteria to generate hydrogen gas from water.

Primary volcanic structures from Nakora area of Malani Igneous Suite

Naresh Kumar and Vallinayagam (**page 550**) report studies of primary volcanic structures and their implications for cooling and emplacement of volcanic flows in the Nakora Ring Complex (NRC). NRC is a part of Neoproterozoic Malani Igneous Suite (MIS) in the Trans-Aravalli Block (TAB) which is unique in the geological evolution of Indian Shield. MIS is the largest (55,000 km², 732 Ma) A-type, anorogenic, high

heat producing acid magmatism in the Peninsular India and owes its origin to hotspot tectonics. Volcanic vent, lava channels (tunnels), volcanic caves, flows, perlite, breccia, agglomerates, geode, veins, vugs, vesicles and acid/basic dykes are the characteristic features of Nakora area. NRC comprises 44 volcanic flows and they are characterized into three different zones, viz. A, B and C, on the basis of patterns of lava



flows, cooling joints, vesicular nature and relative stratigraphic position observable in the field. Flows in zone A in Nakora are more perfect, suggesting slow cooling and farther location from the volcanic vent, as compared to zone C, where flows are thicker as observed at locations closer to the vent. Detailed geological field work, measurement of thickness and attitude of individual flows, vesicles and joints and petrography suggest that Nakora volcanic episodes were initiated with minor basic flows, developed later as voluminous rhyolite comprising all 44 flows. Differences in the thicknesses of the flows have been related to total cooling time of the lava flows. Using the temperature–depth/thickness–time diagram, the total cooling time of these volcanic flows (40 flows are acidic and 4 flows are basic) with total thickness of 1776 m has been calculated and found to be 534.108–610.661 years.