Availability of photosynthetically active radiation in Antarctica

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We report here the photosynthetically active radiation (PAR) variations at Antarctica (latitude 70° S) for the summer period. The variations in PAR are intense in Antarctica because of its unique polar position and weather conditions. We present here the data on clear day PAR variations at the ice shelf and inside the greenhouse at Maitri station collected during the 10th Indian Scientific Expedition to Antarctica. The highest PAR level at the ice surface attains 90,000 lux. The PAR level at Maitri station is somewhat low, the maximum value being 81,000 lux. The PAR level remains at minimum 20,000 lux between the hours 01 and 20. Peak levels occur between the hours 08 and 16. The PAR levels inside the greenhouse vary from 100 lux to 45,000 lux.

ANTARCTICA is an isolated glacial continent having an area of 14 million km^2, situated at the southern pole. Only 2% of this area is free from ice. The region experiences the most adverse environmental conditions, the average temperature ranges from 0.4° C in summer to −40° C in winter. The Antarctic climate is characterized by strong blizzards, high albedo and six months light and dark period with increased UV radiation. Because of its polar position Antarctica receives lesser amount of solar radiation, however the daily total solar radiative energy received during summer at the south pole is about the same as that received in equatorial regions[1].

Increased scientific activity in the continent and the prolonged stay of scientists initiated experiments on growing plants for fresh food[2,3]. The studies on Antarctic flora as well as those on polar horticulture stimulated the collection of data on photosynthetically active radiation. The information presented in this paper consists of the average data collected during the 10th Indian Scientific Expedition: 1990–91 for summer period.

The study was conducted at and around the Maitri station (latitude 70° 45′ 39.4″ S). Luxmeters (Yorko make) were employed for collecting data. The time was measured by electronic clocks. The data were recorded at the local mean time (GMT) and represent the same.

The PAR variations are presented in Figure 1. The outdoor PAR level of minimum 10,000 lux was available for 24 hours. The peak PAR levels occurred between hours 08 and 16. Twentyfour hour average PAR levels were 40,000, 39,000 and 11,000 lux respectively at the ice surface, Maitri station and inside the greenhouse. The maximum PAR level at the ice surface was 90,000 lux while the corresponding levels at Maitri station and inside the greenhouse were 80,000 lux and 45,000 lux respectively. The PAR level inside the greenhouse varied between 100 lux and 45,000 lux. Because of improper orientation of the greenhouse it did not receive direct sunlight for the whole day (Figure 1).

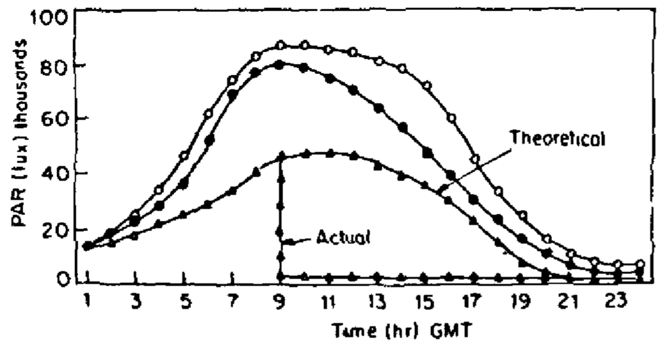

Figure 1. Availability of photosynthetically active radiation in Antarctica. (○, Series A ice sur; ●, Series B Maitree; △, Series C GH).

The study was conducted keeping photosynthesis in view. However the light or spectral quality (for morphogenesis in plants) will need further study, because the spectral composition of light changes with the ratio between direct and diffuse radiation. Diffuse radiation, percentually contains more short wavelength radiation (i.e. green and blue) than does direct radiation[4]. The extraterrestrial strength of illumination amounts to an average of 14,000 lux. Siedentopf and Reger[5] have measured global illumination at noon time in various northern latitudes under cloudless sky. These data show illumination of 36,000 lux for March to September and 84,000 lux for June at 70° latitude. While in Antarctica illumination in June is zero because it is the polar night period and during summer (November to February) it is 90,000 lux. The month of June is summer in the northern hemisphere but January is the summer in the southern hemisphere. The light intensities in the two summer months (June in the northern hemisphere and January in the southern hemisphere) show a closer value; 84,000 lux corresponding to 90,000 lux.

Clouding naturally influences both the strength of illumination as well as of global radiation very considerably. Under a cloud-covered sky the illumination averages only about 27% of that under a clear sky. However in the presence of scattered clouds it is possible that a reflection effect may produce an increase in the strength of illumination in comparison to that of a clear day.

The data presented here may find numerous *applications in plant science, oceanography and marine* biology in Antarctic region.

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K/Ar hornblende ages from the Higher Himalaya: implications for the India–Asia collision and Himalayan metamorphism

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Two amphibolite samples from the Higher Himalayan Crystalline (HHC) belt from the Suru Valley, Zanskar, have yielded Eocene K/Ar hornblende cooling ages between 40 and 45 Ma, thus indicating much older peak metamorphic conditions in northern parts of the Indian Plate. These ages are in conformity with almost identical ages from metamorphic complexes across the Nanga Parbat syntaxis in Pakistan and reveal a 65 to 70-Ma collision phase of the Indian indentor in the NW-Himalaya.

WITH the loftiest summits on Earth, the Himalaya is the epitome of mountains formed by continent-to-continent collision of the Indian and Eurasian plates during the Cenozoic[1–3]. Timing of the orogenic events of the Himalaya constitutes an important aspect of Himalayan geology. In this regard, isotopic ages provide a valuable tool. In this paper, firstly we report two hornblende K/Ar ages from the Higher Himalaya in the Zanskar region, N.W. India, and secondly, we synthesize the hornblende K/Ar and Ar40/Ar39 ages reported throughout the Higher Himalaya and analyse the data to put time constraints on the early stages of the thermotectonic evolution of the Himalaya.

The fundamental principle in applying radioactive clocks to thermotectonics is that while radioactivity itself is not affected by temperature, the stability of its record for various decay systems and mineral phases is mainly temperature-controlled[4]. The concept of closure temperature has been helpful in reconstructing the metamorphic and cooling history of orogenic belts, e.g. the Alps[5]. In high-grade metamorphic rocks where the thermal peak exceeds 550° C, K/Ar or Ar40/Ar39 ages on hornblende reveal the cooling history following the thermal peak of metamorphism[6]. This is due to the high closure temperature of hornblende, i.e. 525 ± 25 (ref. 7). This approach can be used to decipher the early history of the Himalayan orogeny.

The Higher Himalayan Crystalline (HHC) rocks (Figure 1) constitute the backbone of the Himalaya[8]. In the Himalayan orogeny and during the post-collisional period, the HHC has not only experienced the maximum uplift and crustal shortening but also forms the main metamorphic belt of the Himalaya[9], where deep-seated rocks now occupy high topography. These rocks have been well-exposed in the Zanskar region, Jammu and Kashmir State, where two amphibolites were collected among many samples during the field trip of summer 1987.

Hornblende separates from these rocks were dated by the K/Ar method at the Teledyne Isotope Laboratories. The analytical results are given in Table 1. The

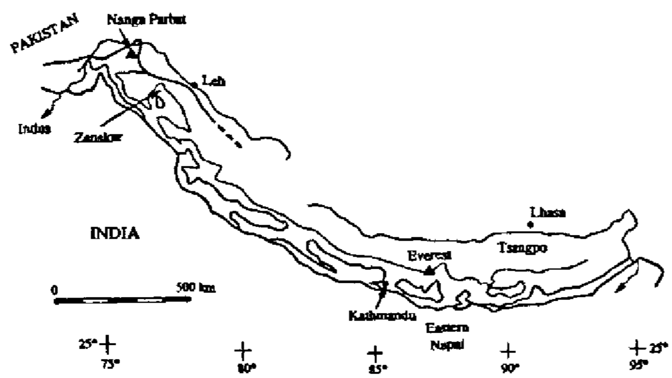

Figure 1. Sketch map of the Himalaya showing the Higher Himalayan Crystalline rocks.