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INDIAN SOCIETY OF ENGINEERING GEOLOGY

(IAEG India National Group)

A Biannual Newsletter

ISEG NEWS

Bridging Communication Gap.....Dissipating Information

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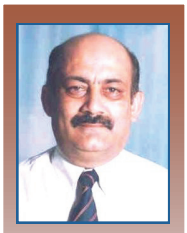

EDITORIAL

Dear Colleagues,

In my first newsletter of April 2013 after taking over as Editor, the importance of communication was emphasized. It was also stated that it should never be assumed that we are over communicating. However, another aspect that I would like to add in my last editorial before signing of the end of 2015 is the significance of correct communication. It is amazing how miscommunication or mis-guidance can conceal the facts and prove false to be true and vice-versa. Therefore not only communication but proper communication is an essential ingredient of a successful organization.

This newsletter is to be released during the International Conference "Engineering Geology in New Millennium" and therefore will be one of documents getting wider publicity than usual. The Organizing Committee led by the Chairman Dr Gopal Dhawan has left no stone unturned to make this conference a success. By the time this periodical is released we shall come to know about the outcome of the conference after intense deliberations. The title of the conference was chosen to depict modern engineering geology, recent advances in the subject and the way

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MESSAGE FROM SECRETARY

Dear Members,

Indian Society of Engineering Geology, founded on 15 October 1965 at Kolkata, under the able guidance of Dr. D.N. Wadia, the Founder President of the Society and doyen of Indian Geology, has just completed fifty years of its existence. As the Society completes its 50 years of its existence, we, the members, lovers and well-wishers of the Society celebrate its Golden Jubilee in a befitting manner. And in order to commemorate the event, the Society is also organizing an International Conference on Engineering Geology in New Millennium on 27-29 October, 2015 at IIT, Delhi. Accordingly, the Society started a website www.egnmindia2015.org which keeps up to date information of the event and maintains transparency.

Ever since the present Executive Council took over charge on 1st January, 2013, it organized a number of Seminars, Workshops and ultimately geared up to celebrate its Golden Jubilee. The Society has a Mission to promote the study of Engineering Geology and allied sciences, effectively served as a formidable bridge between the geologists and engineers; provided a vibrant platform for discussing and debating a host of geotechnical problems and state-of-the-art technologies; and projected the Nation's achievements in the field of Geotechniques before the world.

Knowing well that we cannot bask in past glory forever and survive on sermons of achievements of our ancestors, Dr. Gopal Dhawan, President, ISEG is enthusiastic and encourages anything which glorifies ISEG. Shri Yogendra Deva, past

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1965– 2015

INDIAN SOCIETY OF ENGINEERING GEOLOGY

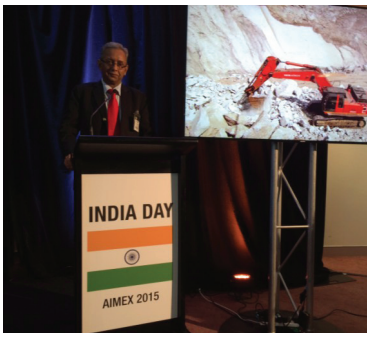
BIANNUAL HIGHLIGHTS

May 2014 to October 2015

The last six months witnessed very hectic preparation for International Conference "Engineering Geology in New Millennium" EGNM-2015 which is being organized to commemorate Golden Jubilee Year of ISEG. Dr Gopal Dhawan, President ISEG and Chairman, OC, Shri Y. Deva, Co-Chairman, OC, Shri M. Raju, Convener, OC and Shri R.N. Mishra Convener, Exe Committee for EGNM have organised numerous meetings of OC to take stock of the progress made and inspired all the teams to put in their best efforts to make this conference a huge success.

The conference has received a very enthusiastic response from the geoscientist and engineering community from world over. Beginning on 27th October 2015 it has received more 137 full papers to be presented in three parallel sessions beside two poster sessions. More than 300 National and International delegates have already been registered.

PRESIDENT ISEG VISITS AUSTRALIA



Dr. Gopal Dhawan, President ISEG addresses at AIMEX at Sydney, Australia.

Dr. Gopal Dhawan, Chairman-cum-Managing Director, Mineral Exploration Corporation Ltd. & President, ISEG participated in Asia-Pacific International Mining Exhibition (AIMEX) from 1- 4 September 2015 at the Sydney, Australia as delegate member of Govt. of India. The delegation was led by Hon'ble Minister of Steel and mines, Shri Narendra Singh Tomar. AIMEX is the world's largest mining exhibitions in Asia Pacific region.

India day was also organised during this event where presentation on mineral sector in India were made by Indian organisation. Delegation also visited Alcoa Bauxite mines in Western Australia.

Signing of MoU between Geoscience Australia and Geological Survey of India

EDITORIAL

(Continued From Page 1)

forward to serve nations and societies. In the new millennium there is no doubt that engineering has undergone radical change.

The basic purpose of choosing a title such as "Engineering Geology in New Millennium" was to depict the importance of modern engineering geology. With the onset of new millennium since 2001 the advancement of IT has greatly influenced all science and engineering. As several programs are now available for soil and rock mass analysis their behavior and response in surface or underground excavations can be predicted or simulated with more accuracy. This also means an added responsibility on engineering geologists for characterization of rock mass. Alternatively, detailed characterization means more laboratory as well as insitu testing especially for large civil engineering structures. We sincerely hope that this conference changes attitude towards engineering geology and geotechnical engineering in particular. We have to now talk about 10-20 tests or samples instead of 1-2. Innovative design & team work are also need of the hour. Use of modern technology right from concept to commissioning is the actual follow up of engineering geology in new millennium. This conference has attracted 226 abstracts in different themes and 137 full papers. While we were expecting good response in conventional engineering geology, landslides and hazards, what has come as a pleasant surprise is the response and quality of papers in rock mechanics, soil mechanics, hydrology and environmental geology. Truly we have come a long way and this is actual celebration of 50 years of hard work.

As we go to the press with October issue of ISEG News the Executive Committee meeting of IAEG has already taken place on October 25th 2015. Informal meeting has also taken place between President IAEG and President ISEG on cooperation in the field of engineering geology. Let us pray for the success of the conference.

This issue has two articles by academicians on quite diverse topics such as Seismic Harzard Analysis for gigantic Chenab bridge and another one on environmental aspects related to soils. We also have an abstract case study from a large hydropower project. Together with regular items such as biography of any famous engineering geologist or civil engineer/ geotechnical engineer this issue would also be quite useful.

As this is my last editorial I want to state that I have striven hard not only to maintain high standard & quality of all publications of the society but also incorporated changes whenever required. It has to be appreciated that this is a continuous activity and it is hoped in future more progress is made. I want to assure that my services will always be available for the work of the society. In end I want to thank my Joint Editor for the unstinted support and all the members of editorial board for their cooperation and hard work in evaluating the papers.

With sincere regards

Imran Sayeed
Editor

GLIMPSE FROM IAEG EXECUTIVE COMMITTEE MEETING 25 OCTOBER 2015 AT IIT DELHI INDIA

IAEG Executive Committee Group Photograph

Dinner Meeting of President IAEG and President ISEG 25 October 2015, New Delhi, India

MESSAGE FROM SECRETARY

(Continued From Page 1)

Secretary, ISEG and Vice President, IAEG (Asia) has become source of energy and innumerable ideas. The Society brings out its bi-annual Journal of Engineering Geology and the bi-annual ISEG News perseveringly. Keeping pace with the trends of the times, ISEG launched its website *www.isegindia.org.* All activities of the ISEG are transparent and it can be seen through its website and correspond through its email id *india.seg@gmail.com*. Further, the ISEG has a facility of exclusive website *www.joegindia.com* for its Journal and authors can directly submit their technical papers to this website.

Shri Imran Sayeed, Editor has brought out a few changes in Society's publications, got ISSN Number and thereby to get status of peer reviewed journal. As you all agree with me that the content of ISEG News has also grossly improved. It is said that if anyone wishes that he would not be forgotten as soon as he is out of the scene, he should either write things worth reading or do things worth writing.

Now, time has come for the present Executive Council of ISEG to bid farewell and to welcome the newly elected and more vibrant Executive Council, from 1st January, 2016.

Yours sincerely,

(M. RAJU)
Secretary, ISEG.
geolraju@gmail.com

ISEG BEST PAPERS AWARDS

ISEG BEST PAPERS AWARDS have been revived during 2015, the Golden Jubilee Year by Indian Society of Engineering Geology to reward the authors of full papers published in Journal of Engineering Geology, Conference Proceedings and Special Publication of the Society. The authors of the best article/paper published in ISEG NEWS, the biannual newsletter of the society are to be given BEST TECHNICAL CONTRIBUTION AWARD. For the year 2013 and 2014 following papers have been selected for the awards.

BEST PAPERS 2013		
First Prize	Design of Remedial Measures at Lukhbir Slide on NH 31 A	***P.S. Prasad, Kishore Kumar, Indervir S. Negi, & Anil Kathail.***
Second Prize	*Treatment of Geological Hotspots in Large Under-ground Storage Caverns*	***Saikat Pal, Ranjit Rath, Vijay Shahri & Atul Nanda***
BEST PAPERS 2014		
First Prize	*Strength and Deformability Characteristics of Pyroclastic Rock mass*	***Hari Dev, Rajbal Singh & J.K.Yachu***
Second Prize	*Prediction of Shear Strength Parameter for Prototype Rock-fill Material Using Index Properties*	***N.P. Hoknadavar, N. Kumar & M. Ratnam***
Third Prize	*Combating Rockburts in Underground Excavations*	***C. Srinivasan & Y. A. Willy***
BEST TECHNICAL CONTRIBUTION AWARD for articles/ papers published in ISEG NEWS for the years 2013 & 2014 (Combined)		
Glacial Lake Outburst Flood (GLOF) Study for Tawang Basin Projects, Arunachal Pradesh		***Balraj Joshi, Rajeev Baboota & Bharti Gupta***

Beneath all the wealth of detail in a geological map lies an elegant, orderly simplicity.

John Tuzo Wilson

SEISMIC HAZARD ANALYSES FOR CHENAB BRIDGE LOCATION, KATRA-DHARAM SECTION OF USBRL PROJECT, J&K

Prof. K. S. Rao
Department of Civil Engineering,
Indian Institute of Technology (IIT) - Delhi.
E-mail: raoks@civil.iitd.ac.in

INTRODUCTION

Indian Railways envisaged an ambitious project connecting Jammu to Baramulla through a railway link in the tectonically active and geologically complex Himalayan Mountains. The word's highest 359 meters railway arch bridge is under construction in Reasi district of Jammu and Kashmir as a part of this mega project. This region being in zone IV/V (IS 1893-2002) has experienced many earthquakes in the past and recent times. And also faces the danger of seismic threats from the central Himalayan seismic gap. The Konkan Railway Corporation Limited (KRCL) has requested Indian Institute of Technology Delhi to carry out a comprehensive study on Site Specific Seismic Hazard Analysis of Chenab bridge location. A detailed study using Deterministic and Probabilistic seismic hazard analyses by considering site specific geological, seismotectonic and recorded earthquake events in and around the site were carried out. The goal of earthquake-resistant design is to produce a structure or facility that can withstand a certain level of shaking without excessive damage. That level of shaking is described by a design ground motion, which can be characterized by design ground motion parameters (PGA). Seismic hazard analysis involves the quantitative estimation of ground-shaking hazards at the site.

SCOPE OF THE STUDY

The scope of the study is to conduct seismic hazard analyses both by deterministic and probabilistic approaches in order to arrive at suitable dynamic parameters to be adopted in the design of structures in the locality. More specifically the scope includes:

i) Collection and preparation of a catalogue of seismic events in the region
ii) Checking for its completeness and suitable recurrence parameters
iii) Preparation of a Seismotectonic map considering geological and tectonic features for the region
v) Conducting Seismic Hazard analyses both by Deterministic and Probabilistic approaches.
vi) Recommendation of dynamic parameters for the design of structures in the region.

STUDY REGION

Seismic data have been collected using databases of Indian Meteorological Department, International Seismological Center, United States Geological Survey, PESMOS, Harvard CCMT and COSMOS. The area bounded within 350km radius of the study was selected, i.e. between 30.0-36.0° N and 72.0-78.0° E. This area was selected so that all the seismogenic sources are identified. In the study region, data of 15,946 earthquakes having magnitude range of 1.4-8.2 from 1903-2014 were collected. The earthquake data was further declustered for removing aftershock/foreshock and duplicate using Gardner and Knopoff (1974), Urhammer (1986) and Grunthalet al. (2004) de-clustering algorithms. This results to 5,547 earthquake events for consideration.

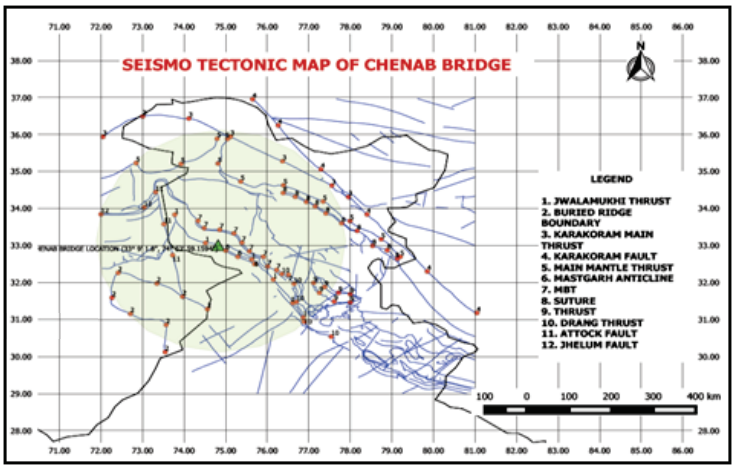


Figure 1 Major Faults/Thrusts within 350 Km Radius of Chenab Bridge

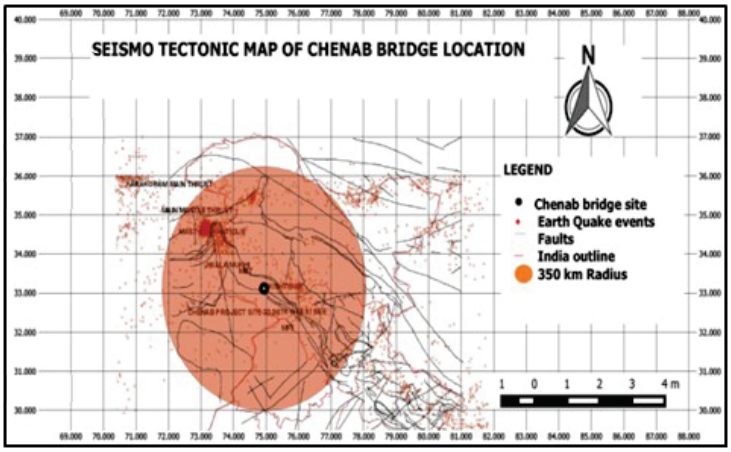


Figure 2 Seismo tectonic Map of Chenab Region

MAGNITUDE CONVERSION

Instrumental earthquake data reported contain body wave magnitude, surface wave magnitude, moment magnitude and local wave magnitude. In order to homogenize the different types of magnitudes, the data are converted to moment magnitude using the relation defined by Scordilis (2006).

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DETERMINISTIC SEISMIC HAZARD ANALYSIS

This is done when a particular earthquake scenario is assumed. DSHA is carried out for a particular earthquake, either assumed or realistic. The tectonic features are reasonably active and well defined. The focus is on determining Maximum Credible Earthquake (MCE) motion at the site. The MCE is the largest possible earthquake along a recognized fault.

Within the 350km radius, 82 seismic sources were identified. Wells and Coppersmith (1994) regression relations are used for determining the potential magnitude for the source. Most influential sources in the study region are shown in Fig. 1. Figure 2 shows the seismogenic activities within the 350km radius.

Deterministic analysis requires definition of seismic sources and their distance from the site. Each fault is treated as a separate source and is analyzed to assign a maximum magnitude. Maximum considered earthquake is found to be 0.33g for the study. Different attenuation equations are available for estimation of PGA due to maximum earthquake. Each method has merits and demerits. Care should be taken while selecting the attenuation relation. The relations used in this study are those of Jain et al. (2000), Sharma et al.(2009), NDMA(2012), NGA(2012), Rao and Rathod (2013) and Raghukanth and Kavitha (2014).

PROBABILISTIC SEISMIC HAZARD ANALYSIS

Probabilistic analysis provides a framework in which uncertainties in the size, location and rate of recurrence of earthquakes and in the variation of ground motion can be identified, quantified and combined in a rational manner. Segregation of the potential sources is done by selecting all the sources producing ground motion of at least 0.30g. The selected sources are shown in Fig. 1.

COMPLETENESS AND RECURRENCE RELATIONSHIPS

Earthquakes in the ancient times have not been recorded unless they were large and destructive. It illustrates the incompleteness of a catalogue and that an appropriate process must account for incompleteness in the statistical procedure of seismic hazard analysis. Catalogue incompleteness can be defined as recorded seismicity that differs from the real seismicity (Mulargia et al. 1985). There are different techniques used to account for catalogue incompleteness. To determine the completeness periods for different magnitude classes, two different methods namely Visual Cumulative (CUVI) method (Tinti and Mulargia, 1985) and the method by Stepp (1973) were used (also known as yearly based and decade based methods respectively).

GUTENBERG -RICHTER RECURRENCE LAW

Gutenberg and Richter (1944) showed that the magnitude-recurrence relationship may be represented by a linear relationship when the log of annual rate of exceedance was plotted against magnitude. This type of recurrence model has been use because of its simplicity and also it fits the data reasonably well over a useful range of magnitude of engineering interest. The Gutenberg-Richter law for earthquake recurrence was expressed as:

$$\log\lambda_m = a - bm \qquad (1)$$

Where,

λ_m = mean annual rate of exceedance,
m = magnitude of event,
A = mean yearly number of earthquakes of magnitude ≥ 0,and
b =relative likelihood of large and small earthquakes

The recurrence parameters determined using STEPP and CUVI methods for Chenab area are:

a=6.626

b=1.204

i.e. $\log\lambda_m = 6.626 - 1.204m$ (2)

PROBABLE MEAN RATE OF EXCEEDANCE (λ_Y)

Probable mean rate of exceedance is calculated for each individual source using a computer code program developed in PYTHON. Using this, mean rate of exceedance is calculated by finding the total number of earthquake exceeding the threshold magnitude, its annual frequency for each source, its magnitude uncertainty and distance uncertainty, Probability of PGA exceeding a particular PGA*, Mean rate of exceedance, and finally an equation to find probability of PGA or return period with remaining known two parameters

$$P = 1 - exp^{-\lambda_y T} \qquad (3)$$

Where, P is the probability; T is the return period; $\boldsymbol{\lambda_Y}$ the mean rate of exceedance (PGA can be calculated from the aggregate hazard generated). From the mean rate of exceedance value the aggregate hazard is drawn out from the individual hazard values of respective faults for a range of PGA values.

These curves are first obtained individually for all the 20 thrusts/ faults/lineaments and then summed up to estimate the aggregate hazard at the site. Typical seismic hazard curves at Chenab bridge location for PGA at bed rock level obtained by the above method (Fig. 3). The peak ground acceleration at bed rock level for 10%, 5%and 2% probability of exceedance in 50 and 100 years has been estimated for the study area and presented in Table 1.

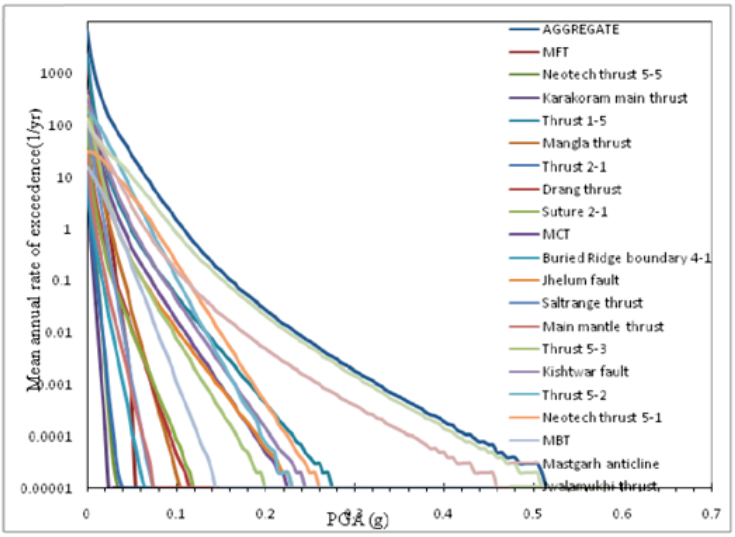

Figure 3 Aggregate Hazard Curve

Table 1 PGA Corresponding to Probability and Return Period

PGA Corresponding to	Return Period	PGA , g
2% in 50 years	2500	0.37
2% in 100 years	5000	0.40
5% in 50 years	1000	0.32
5% in 100 years	2000	0.36
10% in 50 years	500	0.30
10% in 100 years	1000	0.32

As indicated in the above table there is a 2% probability of getting PGA of 0.40g in 100 years, i.e. return period of 5000 years. 5% probability PGA of 0.36g in 100 years, i.e. return period of 2000 years, 10% probability of PGA of 0.32g in 100 years, i.e. return period of 1000 years.

RESPONSE SPECTRUM ANALYSIS (RSA)

For design, we usually need only the maximum response. Hence, a plot of maximum response versus natural period (for a given value of damping) is constructed. Horizontal acceleration time histories for five earthquakes which fall under the 350 km radius of Chenab bridge location have been considered for the study. They are Dharmasala, Mandi, Chamba, Himachal-Punjab boarder, Jammu and Kashmir-Himachal boarder earthquakes respectively. Figure 4 shows the response spectra for the rock sites for 5% damping. The figures include also the spectra obtained from the IS1893 (Part-I) 2002 and IITR (2004) procedures respectively for comparison.

The design spectra are obtained using appropriate reduction factors from the spectra and time histories of ground motion for maximum credible earthquake (MCE) motions. Spectral values of Design Basis Earthquake (DBE) can be obtained from MCE by multiplying with a factor of 0.5.DBE will be further reduced by a factor for structures which have in built ductility, arising from inelastic material behavior, detailing and over strength.

CONCLUSIONS

A comprehensive study on both deterministic (DSHA) and probabilistic hazard analyses (PSHA) was carried for the Chenab bridge location. The main conclusions are summarized below:

i) The Chenab bridge location is situated in the tectonically active Himalayan zone falling under zone IV of IS1893 (2002). Eighty two Seismotectonic features such as faults/ thrusts were identified which may generate considerable future earthquakes within 350 km radius of the Chenab bridge site.

ii) Out of these tectonic features, 20 of them were considered as major and their source lengths varying from 4.82 to 947.97 km. The Jwalamukhi fault which is very close to the site is significant.

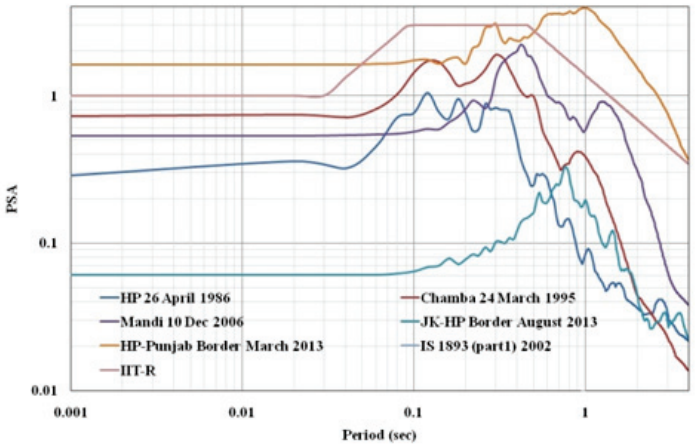

Figure 4 Response Spectra for 5% Damping

iii) Wells and Coppersmith's (1994) model was used to predict magnitudes (M_w) from the fracture lengths for all faults.

iv) PGA values were estimated for all faults using attenuation relations proposed by Jain et al.(2000),Sharma et al.(2009), NDMA(2012), NGA(2012), Rao and Rathod (2013)and Raghukanth and Kavitha(2014) models. Jwalamukhi fault is critical source, able to produce the Maximum Credible Earthquake (MCE) of $8M_w$ and PGA of 0.33g in the area. The DBE would be 0.165g.

v) For PSHA, the faults which are able to generate PGA values of 0.3g and above are considered. Extensive seismic data was collected from IMD,USGS, ISC, Harvard CCMT, PESMOS and COSMOS sources in the study area and the data was filtered. Total events were 15,946 and uniform magnitude, M_w conversion was done using Scordilis (2006).Windowing and removal of fore and aftershocks was carried out using Gardner and Knopoff(1974), Uhrhammer(1986) and Grunthal et al. (2004)models. The final catalogue consists of 5,547 events. Completeness was carried out by CUVI and Stepp methods and Gutenberg-Richter recurrence laws were applied. Probable mean rate of exceedance is calculated for each individual source using the Python code. Finally the aggregate hazard curve for the study area was proposed (Fig.4).

vi) In the present study, Sharma (2009) has been used for Probabilistic study since the equation gives a better result as compared to the other relationships. The peak ground acceleration at bed rock level for 10%, 5%and 2% probability of exceedance in50 and 100 years has been estimated for the study area (Table.1). Using this, there is a 2% probability of getting PGA of 0.40g in 100 years, i.e. return period of 5000 years, 5% probability

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ELECTION RESULTS TO THE ISEG COUNCIL FOR THE TERM 2016-2017

S. No.	Post	Vacancy	Name of Nominee	Membership Number	Result	Address	Proposed By	Nomination seconded by
1	**President**	1	**Mr. Ramesh Narain Misra**	LM 1349	Elected	SJVNL, Himfed Building, New Shimla, Shimla-171009	Mr. Ashok Kumar Chadha LM 816	Dr. Ranjit Rath LM 1361
2	**Vice President**	3	**Mr. Ashok Kumar**	LM 831	Elected	Dy. D.G., GSI TI, Hyderabad-500 067	Dr. D.D. Joshi LM 1217	Mridual Srivastava LM 1277
			Mr. K.C. Joshi	LM 1117	Elected	Director, EQG Division, GSI, Sector-E, Aliganj, Lucknow	Dr. D.D. Joshi LM 1217	Mridual Srivastava LM 1277
			Dr. V.K. Sharma	LM 758	Elected	DDG, GSI, Dehradun	Shri Bhupender Singh, LM 1393	Shri PVS Rawat, LM 1089
3	**Secretary**	1	**Mr. Imran Sayeed**	LM 1115	Elected	NHPC Limited, Sector-33, Faridabad- 121003, Haryana India	Mr. B. Prabhakaran LM 1267	Mr. R.G. Virmani LM 1114
4	**Jt. Secretary**	2	**Mr. Arindom Chakraborty**	LM 1269	Elected	Engineering Geology Division, NHPC Limited, Sector-33, Faridabad-121003, Haryana India	Dr. Gopal Dhawan LM 340	Mr. Pranay V. Singh LM 1391
			Mr. Akhouri Biswapriya	LM 1279	Elected	Superintending Geologist GSI, SU: Bihar, Patna.	Mr. M. Raju LM 664	-
5	**Treasurer**	1	**Mr. Alok Kumar**	LM 1174	Elected	GSI, Sector-E, Aliganj, Lucknow.	Dr. D.D. Joshi LM 1217	Mridual Srivastava LM 1277
6	**Editor**	1	**Mr. Rahul Khanna**	LM 1296	Elected	NHPC Limited, Sector-33, Faridabad- 121003, Haryana India	Mr. Imran Sayeed LM 1115	Mr. B. Prabhakaran LM 1267
7	**Council Members**	10	**1. Dr. Saibal Ghosh**	LM 1341	Elected	Superintending Geologist, GHRM Cell, GSI, CHQ, 15 A&B Kyd Street, Kolkata-700016	Dr. Pankaj Jaiswal LM 1216	Mr. Chinmoy Paul LM 1175
			2. Mr. G.C. Kandpal	LM 1014	Elected	Director, RTI, NR, GSI, Sector E, Aliganj, Lucknow.	Dr. D.D. Joshi LM 1217	Mr. Mridual Srivastava LM 1277
			3. Dr. Sanjay Kumar Narayan Patil	LM 1122	Elected	School of Environmental & Earth Sciences, North Maharashtra University, Post Box No.80, Jalgaon- 425 001	Dr. P.D. Nemade LM 1123	Mr. Atul Gote LM 1121
			4. Dr Pranay V. Singh	LM 1391	Elected	Asst. Manager (Geology) NHPC Ltd., Sector-33, Faridabad, Haryana- 121003.	Mr. Arindam Chakraborty LM 1269	Mr. Vachaspati Pandey LM 1226
			5. Dr Mridul Srivastava	LM 1277	Elected	GSI, Sector-E, Aliganj, Lucknow	Mr. Ashok Kumar LM 831	Dr. D.D. Joshi LM 1217
			6. Dr. P.D. Nemade	LM 1123	Elected	Principal & Professor, Department of Civil Engg., S. B. Patil College of Engineering, Vangali, Indapur, Dist: Pune-413106	Dr. S.N. Patil LM 1122	Mr. Atul Gote LM 1121
			7. Mr. P. Narasimhan	LM 1403	Elected	Asst. Engineer, Highways Department, Govt. of Tamil Nadu, No. 75, Salai Vinayagar Salai, Dharmapuri- 636701.	Mr. M. Raju LM 664	—
			8. Mr. Mahesh Chandra Upadhyay	LM 1088	Elected	Mobile no. 09630094788 mcupadhyay27@yahoo.com	Mr. Ramesh Chandra Shukla LM 1257	Mr. M. Raju LM 664
			9. Dr. Pankaj Jaiswal	LM 1216	Elected	Superintending Geologist, GHRM Cell, GSI, CHQ, 15 A&B Kyd Street, Kolkata-700016	Dr. Saibal Ghosh LM 1341	Mr. M. Raju LM 664
			10.Dr. Niroj K. Sarkar	LM 1387	Elected	GSI, Mon.V, CHQ, 27, JN Rd, Kolkata-16.	Dr. Saibal Ghosh LM 1341	Mr. M. Raju LM 664

M. Raju
Election Officer, Membership No. LM 664

SOIL HEALTH: AN APPROACH FOR SUSTAINABLE MICRO BIOTA FOR SOIL ENVIRONMENT

Dr. Sabiha Imran
Associate Professor (Biotechnology)
Faculty of Engineering & Technology
Manav Rachna International University
Faridabad, Haryana, India

Soil health refers to the biological, chemical, and physical features of soil that are essential for long-term, sustainable agricultural productivity with minimal environmental impact. Thus, soil health provides an overall picture of soil functionality. Although it cannot be measured directly, soil health can be inferred by measuring specific soil properties (e.g. organic matter content) and by observing soil status (e.g. fertility). There is also increased interest in studying soil microorganisms in their particular environment, as microbial diversity is intimately related to soil structure and function. One of the key objectives in determining soil health is to acquire indicators that can be used to evaluate the soil's current status and hence to develop sustainable agricultural systems. In this regard, significant progress has been made over the last few years in the development of specific biomarkers and macromolecular probes, enabling rapid and reliable measurements of soil microbial communities. In addition, modern molecular biological techniques, such as fluorescence in situ hybridization (FISH), reverse transcriptase polymerase chain reaction (RT-PCR), denaturing gradient gel electrophoresis (DGGE), and terminal restriction fragment length polymorphism (T-RFLP), have facilitated the analysis of microbial biodiversity and activity, whereas the application of modern analytical techniques, such as nuclear magnetic resonance (NMR) and pyrolysis gas chromatography-mass spectrometry (Py-GC-MS), have provided data on soil chemistry. The combination of these two approaches offers promise in determining soil health status.

There is a need for a holistic consideration of soil health as well as trans-disciplinary soil management approaches that integrate biological, chemical, and physical strategies to achieve soils supporting a sustainable agriculture. The environmental and economic benefits of sustainable soils are enormous: increased resource efficiency, decomposition and nutrient cycling, nitrogen fixation, and water-holding capacity, as well as prevention of pollution and land degradation. Current agricultural practices reduce soil biodiversity, mainly as a result of the overuse of chemicals, leading to compaction or other disturbances and hence irreversible adverse ecological alterations, resulting in loss of agricultural productivity. A series of long-term comparative studies have shown that organic/sustainable systems can increase both SOM accumulation and microbial activity. Moreover, the organic C lost during intensive agriculture could be regained through sustainable management practices, thereby contributing to mitigating climate change. The development of approaches that do not require the establishment of microbial cultures will undoubtedly enhance our knowledge of biodiversity and promote the discovery of new microorganisms with unique capacities for bioremediation, soil restoration, and therapeutic applications.

Studies of micro-organisms in the soil environment are complicated because microbial cells are commonly attached to surfaces where they live side –by –side with other populations in consortia usually containing different morphological and physiological types. Such assemblages of organisms cannot be described quantitatively using cultural techniques, such as plate counts, which underestimate both cell numbers and viable biomass. The development of more powerful observational and training techniques has improved our knowledge of the diverse morphological and biochemical composition of soil micro-communities. Such findings have been amplified at a grosser level by laboratory studies with multi-component systems (microcosm) to mimic field situations and to assess the range of biochemical potentials of microbial consortia. Some work has been done to define the fundamental ecological attributes of microbial assemblages in soil productive work on the metabolic activities of the soil micro biota, especially geochemical transformation of C,N, S, and P, has been under way for more than a century. But only in more recent years have been under way for more than a century. But only in more recent years have more sensitive and reproducible analytical methods become available to measure viable biomass in soil.

Global warming and Soil Health

Along with changes in temperature, climate change will bring changes in global rainfall amounts and distribution patterns. And since temperature and water are two factors that have a large influence on the processes that take place in soils, climate change will therefore cause changes in the world's soils. In fact, there are several ways that climate change will affect soil. Soils are also part of the global carbon and nitrogen cycles. The carbon-based gases carbon dioxide (CO_2) and methane (CH_4), and the nitrogen-based gas nitrous oxide (N_2O), are important greenhouse gases. So, as carbon dioxide, methane, and nitrous oxide levels change in the atmosphere, there will be corresponding changes in the soil. The higher temperatures also mean increased rates of organic matter decomposition by soil microorganisms. If the microorganisms decompose organic matter more rapidly than it's replaced, then soil organic matter levels will decline. Working out relationships like this are key to our understanding of the exact effects of climate change on soil and the ramifications for those effects on resources we rely on, like food crops and timber, that depend on soil.

The main potential changes in soil-forming factors (forcing variables) directly resulting from global change would be in organic matter supply from biomass, soil temperature regime and soil hydrology, the latter because of shifts in rainfall zones as well as changes in potential evapotranspiration. Soil changes because of a potential rise in sea level resulting from a net reduction in Antarctic ice cap volume . The biggest single change in soils expected as a result of these postulated forcing changes would be a gradual improvement in fertility and physical conditions of soils in humid and sub humid climates. Another major change would be the pole ward retreat of the permafrost boundary, discussed by Goryachkin and Targulian (1990). Other widespread changes would be in degree rather than in kind.

The changes in temperature but particularly in rainfall to be expected as a result of global warming are subject to major uncertainties for several reasons. Different global circulation models do not lead to mutually consistent results (an example for Europe is given by Santer, 1985), and they are not yet adequately verified. Also, the interaction with changes in location and intensity

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M.S. KRISHNAN

GEOLOGIST PAR EXCELLENCE

BIOGRAPHY

Maharajapuram Seetaraman Krishnan, was born on 24th August 1898 in a humble family, brilliant academically both at school and college, recipient of associateship to pursue post-graduate studies in England (rarely given to Indians in the 1920s under the British rule), Doctorate in Geology by the age of 26, got appointed to a senior post (Geologist) directly, unthinkable in the then British dominated period and subsequently he became the first Indian to head the Geological Survey of India.

Krishnan's early years in GSI were in the company of well-known giants of Indian geology like Lewis Fermor, C. S. Fox, J. A. Dunn, A. M. Heron, H. C. Jones and J. B. Auden, who were known for their painstaking fieldwork and observations. He had carried out extensive mapping, spanning the years 1925–33 and 1937–38, in Gangpur, Bonai, Bamra and Keonjar (parts of present Orissa State) and made some pioneering observations on the stratigraphic succession here by identifying a separate stage in the geological sequence which he named 'Gangpur Series'. This work formed the well-known *GSI Memoir 71* (1937). This was followed, between 1943 and 1947, by the investigations of iron ores, manganese ores, gypsum, mica, limestone and a host of other mineral resources of the erstwhile Madras Province (parts of present day Orissa, Andhra Pradesh, Tamil Nadu, and Karnataka) which formed the exhaustive *GSI Memoir 80* (1952). His tenure heading the Southern Regional office of the GSI in Madras also saw the birth and growth of huge lignite deposit (estimated to be over 3000 million tons) in southern India at Neyveli.

In fact, the name 'Krishnan' became synonymous for *Geology of India and Burma*, the classic textbook and a 'bible' for every Geology student in India. This important contribution could be due to his intermittent teaching stints, early in his professional life at various institutions like Presidency College, Madras (1920–21), Forest College, Dehra Dun (1928–30), Presidency College, Calcutta (1933–35), besides his vast exposure to field areas of the sub-continent, during which he realized the need of a comprehensive textbook for the students to teach Indian Geology. Subsequently, when Cyril S. Fox, one of the great Geologists of GSI of his times, suggested that he write a book on Indian stratigraphy, it spurred his latent longing for the same and the result was the publication of *Geology of India and Burma* in 1943. As the Director of GSI, his two other notable contributions to exploit economic mineral potential of the country were the mining of the lignite deposits at Neyveli overcoming problems of huge aquifer and clay cover, and the resurrection of gold mining in Karnataka, particularly the boosting of the mining operations in Hutti.

Krishnan served as a member of Coal Mining Committee (1936–37), Member of Indian Delegation to Empire Scientific Conference in England (1946) and United Nations Conference on Conservation and Utilization of Resources, New York (1949), Chairman of Committee on Conservation of Metallurgical Coal (1949–50) (when he suggested nationalization of coal mining), and member of several research committees, Fellow or Member of many learned societies and scientific associations in India and abroad, and before he retired, served as Government of India's Mineral Adviser and Joint

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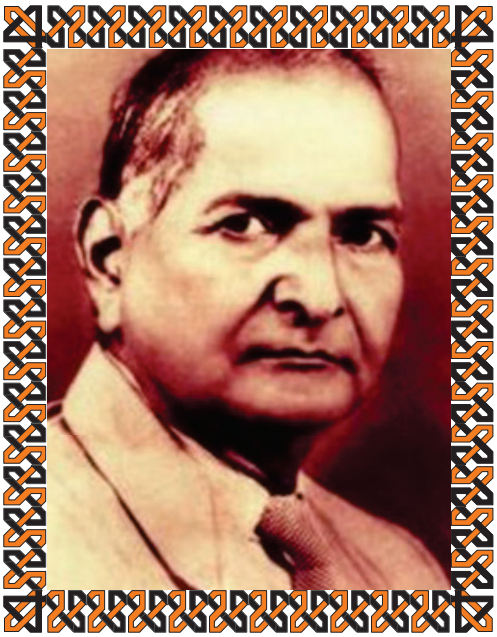


Dr. M.S. Krishnan
(24 August 1898 – 24 April 1970)

To all geologists, loving and gentle,
Whose clothes are baggy and who dressed very neatly.
To all very young ones and very mature,
Who are hiking peninsulas, mountains, and islands,
Avoiding tsunami and looking for landslides.
Geologists very romantic (there are no others).

(Translation from the Russian poem)

A personal toast from Dr. Geophysics

Dear friends, let us drink a few drops.
May the geologists, working far from home, in the wildernesses and the most remote regions of our restless planet,
soaked by rain, frozen by snow, yet warmed with friendship,
safely return home to their loved ones...

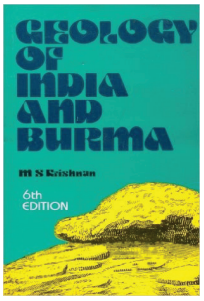
M. S. KRISHNAN

Continued from page 9

Secretary in the Ministry of Natural Resources and Scientific Research (1955–57).

Soon after India's independence in 1947, Krishnan was deputed to United States to study methods in radioactive mineralogy and rare earth geology and this enabled him to initiate reconnaissance of promising tracts with a small team, which later separated to form the Atomic Minerals Division, of the Department of Atomic Energy. He was the Director of Indian Bureau of Mines (New Delhi) from 1948 to 1951, Director of Indian School of Mines, Dhanbad, during 1957–58, Head of the Geology and Geophysics Department, Andhra University, Waltair from 1958 to 1960, and was a moving force behind the beginning of National Geophysical Research Institute, Hyderabad, of which he was also the first Director between 1961 and 63. President of Geology Section of the then prestigious Indian Science Congress by 37 years of age, later became President of its General Session in 1956.

Krishnan never rested on his laurels and had always explored avenues to keep Indian geology abreast with advances the subject had made over the years in the fields of mapping, exploration and basic studies and added new sections in the GSI to cover them. His contemporaries and juniors at the GSI recall that he was modest, easily approachable and ever willing to recognize new thinking or ideas even when it came from the juniors. He was open-minded, unlike many persons of his age, position or brilliance. This attitude of his enabled him to spot talent and bring it up. For instance, early in his stewardship of the GSI, he realized the importance of geophysics in exploration geology, and lost no time to introduce it by tapping the expertise of noted contemporary geophysicists in the country to organize geophysical investigations. These moves resulted in proper evaluation of many of the promising mineral deposits of the period.



The name 'Krishnan' became synonymous for *Geology of India and Burma*, the classic textbook and a 'bible' for every Geology student in India

India has been fortunate to have a person of the calibre of Krishnan at a time when the country, on the threshold of industrialization soon after independence, badly needed one who could organize and plan suitable surveys for some of the economic minerals and ores, and help to build proper infrastructure for their recovery. It is but fitting that Krishnan's lifelong dedication to Indian geology was recognized and he was honoured with the *Padma Bhushan* by the Shri S. Radhakrishnan, Hon'ble President of India, in January 1970. Eight months later, during a visit to his native village near Tanjore, he underwent an abdominal operation, but did not survive the surgery and breathed his last on 24 August 1970, on his 72nd birthday.

While recognising his yeomen service to the nation and particularly to the subject of Geology, the Geologists of GSI proposed to organise his birth day 24 August as Geologists' Day of the country. Accordingly, Scientific Officers Association of Geological Survey of India organised a function in August, 2015 and celebrated his birth anniversary at GSI, Eastern Region, Kolkata, in the presence of Shri Harbans Singh, Director General, GSI.

Free style compilation by:

M. Raju
Addl. Director General & HOD
Geological Survey of India,
Eastern Region, Kolkata

SEISMIC HAZARD ANALYSES FOR CHENAB BRIDGE LOCATION, KATRA-DHARAM SECTION OF USBRL PROJECT, J&K

Prof. K.S. Rao

Continued from page 6

PGA of 0.36g in 100 years, i.e. return period of 2000 years, 10% probability of PGA of 0.32g in 100 years, i.e. return period of 1000 years. Earthquake sources of near and far field are also studied. Jwalamukhi thrust is the most prominent source for near field and for far field MBT and MCT can give a PGA of approximately 0.1g in the site of interest. Besides this maximum PGA for 20 seismic sources of far and near field have been determined.

vi) Horizontal acceleration time histories for five earthquakes e.g. Dharmasala, Chamoli, Chamba, Himachal Punjab boarder and J&K Himachal Punjab border earthquakes have been used to generate response spectra for1%,2%,5%,7% and 10% damping ratios for the study. These will be useful in assessing the dynamic forces for structural design.

My message, especially to young people is to have courage to think differently, courage to invent, to travel the unexplored path, courage to discover the impossible and to conquer the problems and succeed. These are great qualities that they must work towards. This is my message to the young people.

-A. P. J. Abdul Kalam , Former President of India

REHABILITATION OF SURGE SHAFT: CASE STUDY OF TEESTA V HYDROELECTRIC PROJECT, SIKKIM, INDIA

N.K Mathur
Ex- General Manager, NHPC Ltd

An innovative approach in evolving engineering solution to rehabilitate the damaged civil structure is most sought after practice being adopted now a days by professionals. Failure of a large structure raises number of questions on one hand but accomplished geotechnical engineers take it as a challenge to rebuild the same by applying professional skill. In Teesta V hydroelectric project, Sikkim, (540MW) the layout of project has been framed in a sequential arrangement on left bank of river Teesta. Close to the dam structure three power intakes lead the water to three desilting chambers & further to 17 km long Head Race Tunnel. This tunnel is joining at bottom of 30m dia. 95 m Surge Shaft, and trifurcating in three vertical shafts before reaching to an underground power house. The tail race is 500m long to lead water back to the river.

The Surge Shaft has been constructed by conventional drilling and blasting & surface sinking method. Prior to taking up of active excavation work surface & subsurface geological conditions were ascertained by conducting surface mapping, geophysical explorations & core drilling. Interpretation from the geological exploration data indicated that the area comprised of a thick pile of clay underlain by a deeply weathered rock mass. It was inferred that the proposed surge shaft was likely to be housed in foliated to jointed quartzite, phyllitic quartzite and quartzitic phyllite rock mass. Presence of inter-folial shears of varying thickness with pockets of poor rock zones was also interpreted. Reduction in engineering quality of rock mass at few locations due to weathering was accentuated in the vicinities of thick shears and litho-types like phyllite and quartzitic phyllite.

Initially a pilot hole of 3 m diameter was excavated in the centre of shaft by raise borer to facilitate effective construction of main structure. Assessing the geotechnical conditions of the rock mass to be negotiated, entire shaft was supported by steel ribs backfilled by concrete and rock anchors to ensure long term stability of structure. At a few reaches, spacing of ribs varied from 1.5 to 3m.

In October 2003, when the excavation was at critical stage & shaft was at near completion, a huge collapse associated with slop failure from adjoining overlooking slope occurred around the surge shaft, which badly damaged almost 2/3 of the shafts' perimeter. Due to heavy rains, area around shaft became profusely saturated which increased pore pressure and caused distress in structure leading to collapse.

The overlooking slope around the surge shaft was excavated in 1:1 configuration with intermediate berms. However after the collapse the slope became haphazard completely exposing weathered rock mass in uneven geometry & a cap of residual soil rich in clay. Damage of shaft & associated slope failure had posed serious challenge to rebuild the structure and to achieve complete stabilization in the immediate vicinity of structure. Subsequent to the collapse, the activities to reclaim the surge shaft were taken up, starting with the stabilization of remains of

Photographs 1 & 2 : Surge Shaft before Collapse

Photographs 3 & 4 : Damaged Periphery of Surge Shaft

Photographs 5 & 6 : Rehabilitation of Surge Shaft

the slope overlooking the shaft. Systematic benches were developed with elaborate drainage system. Extensive consolidation grouting, shotcrete, wire mesh and reinforcement by 6m, 9m, 12m long rock bolt/rock anchors were carried out to stabilize the slope. In view of the strength of rock mass, advancement was done by using an excavator alone for development of benches in damaged slope with little or no use of blasting. Entire slope was monitored by instrumentation such as multipoint borehole extensometers, load cells and survey targets.

After installing required support elements and achieving stability in the damaged slopes, hollow cylindrical reinforced concrete structure was erected from bottom of damaged shaft up to the desired design level to rehabilitate surge shaft. Slope overlooking the shaft was kept away from rehabilitated structure. The restored structure is performing satisfactorily as integral part of project since its commissioning in year 2008. The careful handling of the events at the time of collapse, repair and rehabilitation work subsequently in a professional manner led to completion of project by NHPC Limited without additional delays.

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Imran Sayeed, Editor, ISEG
C/o Chief (Geology),
Project Investigation Division, NHPC Ltd,
Sector-33, Faridabad, Haryana-121003
E-mail: iseg2015@gmail.com

M. Raju, Secretary,
Indian Society of Engineering Geology
C/o Add. Director General & HoD,
Geological Survey of India, E. R.,
Bhu Bijnan Bhawan, Block DK-6, Sector-II,
Karunamoyee, Salt Lake, Kolkata-700091.
West Bengal, India.
Mobile: +91-9432672087
E-mail: geolraju@gmail.com

Further information on ISEG website: **isegindia.org**
For Journal of Engineering Geology: **joegindia.com**

Newsletter designed & formatted by :
Editorial team, ISEG
(Imran Sayeed & Rahul Khanna)

A view of soil profile with gravel below

SOIL HEALTH: AN APPROACH FOR SUSTAINABLE MICRO BIOTA FOR SOIL ENVIRONMENT

Continued From Pg 8

of major ocean currents and resultant possible modifications in sea surface temperatures is still most uncertain, as well as the interaction with possible major changes in cloudiness and land cover and the resulting changes in albedo and actual evapotranspiration.

Indirect effects of climate change on soils through CO_2-induced increases in growth rates or water-use efficiencies, through sea-level rise, through climate-induced decrease or increase in vegetative cover, or a change in human influence on soils because of the changes in options for the farmer, for example, may well each be greater than direct effects on soils of higher temperatures or greater rainfall variability and larger or smaller rainfall totals.

POSSIBLE CHANGES IN FORCING VARIABLES

With these caveats, one could stipulate the following changes in forcing variables as likely to materialize sometime during the next century:

- A gradual, continuing rise in atmospheric CO_2 concentration entailing increased photosynthetic rates and water-use efficiencies of vegetation and crops, hence increases in organic matter supplies to soils.
- Minor increases in soil temperatures in the tropics and subtropics; moderate increases and extended periods in which soils are warm enough for microbial activity (warmer than about 5°C) in temperate and cold climates, parallel to the changes in air temperatures and vegetation zones as summarized by Emanuel et al. (1985).
- Minor increases in evapo-transpiration in the tropics to major increases in high latitudes caused both by temperature increase and by extension of the growing period.
- Increases in amount and in variability of rainfall in the tropics; possible decrease in rainfall in a band in the subtropics pole ward of the present deserts; minor increases in amount and variability in temperate and cold regions. Peak rainfall intensities could increase in several regions.

A gradual sea-level rise causing deeper and longer inundation in river and estuary basins and on levee back slopes, and brackish-water inundation leading to encroachment of vegetation that accumulates pyrite in soils near the coast.

EFFECT OF HIGHER CO_2 ON SOIL FERTILITY, PHYSICAL CONDITIONS AND PRODUCTIVITY

Higher atmospheric CO_2 concentration, increases growth rates and water-use efficiency of crops and natural vegetation in so far as other factors do not become limiting. The higher temperature optima of some plants under increased CO_2 would tend to counteract adverse effects of temperature rise, such as increased night-time respiration. The shortened growth cycle of a given species because of higher CO_2 and temperature would be compensated for in natural vegetation by adjustments in species composition or dominance. In agro-ecosystems the choice of longer-duration cultivars or changes in cropping pattern could eliminate unproductive periods that might arise because of the shorter growth cycle of the main crop. There will be adequate time to adjust to the changes since these are expected to occur over decades, rather than years or days as in all present experimental situations. This chapter deals with the effects of gradually rising CO_2 concentrations as observed in the recent past and stipulated in simulation models that apply transient scenarios.

The increased productivity is generally accompanied by more litter or crop residues, a greater total root mass and root exudation, increased mycorrhizal colonization and activity of other rhizosphere or soil micro-organisms, including symbiotic and root-zone N, fixers. The latter would have a positive effect on N supply to crops or vegetation. The increased microbial and root activity in the soil would entail higher CO_2 partial pressure in soil air and CO_2 activity in soil water, hence increased rates of plant nutrient release (e.g., K, Mg, micronutrients) from weathering of soil minerals. Similarly, the mycorrhizal activity would lead to better phosphate uptake. These effects would be in synergy with better nutrient uptake by the more intensive root system due to higher atmospheric CO_2 concentration. There is no a priori reason why the degree of synchrony between nutrient release and demand by crops or natural vegetation would be subject to major changes under high CO_2 conditions.

The greater microbial activity tends to increase the quantity of plant nutrients cycling through soil organisms. The increased production of root material (at similar temperatures) tends to raise soil organic matter content, which also entails the temporary immobilization and cycling of greater quantities of plant nutrients in the soil. Higher C/N ratios in litter, reported by some workers under high CO_2 conditions, would entail slower decomposition and slower remobilization of the plant nutrients from the litter and uptake by the root mat, and would provide more time for incorporation into the soil by earthworms, termites, etc. Higher soil temperatures would counteract increases in 'stable' soil organic matter content but would further stimulate microbial activity.

Increased microbial activity due to higher CO_2 concentration and temperature produces greater amounts of polysaccharides and other soil stabilizers. Increases in litter or crop residues, root mass and organic matter content tend to stimulate the activity of soil macro-fauna, including earthworms, with consequently improved infiltration rate and bypass flow by the greater number of stable bio-pores. The greater stability and the faster infiltration increase the resilience of the soil against water erosion and consequent loss of soil fertility. The increased proportion of bypass flow also decreases the nutrient loss by leaching during periods with excess rainfall. This refers to the available nutrients in the soil, including well-incorporated fertilizers or manure, but not to fertilizers broadcast on the soil surface.

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