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REVIEWS

MAGNETOSPHERIC PLASMA PHYSICS Atsuhiro Nishida, (Ed.) Center for Academic Publication Japan/Tokyo. D. Reidel Publishing Company/Dordrecht-Boston, London 1982.

This book contains review articles drawn from five lecture series comprising the space plasma physics course given at the Autumn College of Plasma Physics, International Centre for Theoretical Physics, Trieste, Italy, October 16-November 23, 1979. It is mostly devoted to the Earth's magnetosphere and deals with some of the central issues of magnetospheric physics, like the origin of magnetospheric plasma, waves and radiation in the magnetosphere and the interaction of the solar wind plasma with magnetosphere, including new concepts and ideas emanating from recent observations.

The authors are well-known specialists and it is thus no surprise that the Chapters are so well organised and clearly presented. The book begins with a Chapter on the origin of magnetospheric plasma that essentially deals with sources of plasma which fills planetary magnetosphere. There has been continuous controversy for the past one decade or more about the processes by which the solar wind plasma interacts with the magnetosphere and produces convection or large scale plasma motion by transporting plasma and flux tubes from dayside to nightside. This topic has been dealt with in second and third Chapters by considering both the solar wind interaction with the dayside magnetosphere and the tail dynamics. The major strength of these Chapters is the attempt to discuss the quantitative success of some of the theoretical concepts with the help of recent high resolution plasma and field data of ISEE 1, 2 and 3 satellites.

Aurora is an ancient discovery and yet it is not well understood. One Chapter is fully devoted to this particular problem. The author has presented the results of numerical simulation of auroral acceleration process. Electrostatic waves and strong diffusion of the magnetosphere electrons are reviewed in the last Chapter. Several new suggestions concerning quasi-linear diffusion and saturation of electrostatic waves are included. There are also discussions on observations and theory of double layers and electromagnetic radiation, but the book's coverage of these is much less complete than one would wish. Coupling of magnetospheric field or plasma with low latitude ionosphere has not been considered. It is, of course, obvious that complete coverage of all relevant topics is clearly outside the scope of a single volume.

The book contains recent results and is certainly highly valuable for magnetospheric plasma physicists. It can also be recommended to all physicists and to graduate students who wish to understand some important aspects of current magnetospheric physics.

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METALS FROM THE SEABED – PROSPECTS FOR MINING POLYMETALLIC NODULES BY INDIA. Edited by Manjula R. Shyam, Monograph No. 103. The Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad. Oxford and IBH Publishing Co., New Delhi, Bombay, Calcutta, 1982, pp. xvi+165, Price Rs. 72.

Minerals on land, which are wasting assets of a country, are not likely to last long in view of the gargantuan appetite of expanding modern industrial civilization. This naturally raises the question of alternate sources and all eyes have turned towards the sea as the future source of minerals. In this context, the book by Manjula R. Shyam is well timed as it focusses attention on various aspects of metal resources of the seabed and their relevance to India.

The book is organised into seven Chapters with a post-script added. In Chapter I the author introduces the readers to the relevance of the subject of mineral resources of the seabed. It was on 18th February 1873, the H M. S. Challenger recovered the first ferromanganese nodules 160 miles southwest of the island of Ferro in the Canary Island Group. Since then, these metallic resources of the seabed have been the subject of much speculation. The geochemical interest in these nodules started only after the second world war and since 1950 the economic potential of polymetallic nodules has attracted the attention of scientists, entrepreneurs and governments. Chapter 2 discusses the characteristics of the nodules and of a viable mine site. It is the nickel and copper in the nodules which will form the mainstay of the seabed mining industry. The author has made a pragmatic approach to the problem of nodule resources from the point of view of economic exploitation from viable mine sites. Although the Indian ocean area has not received as much attention as the North Pacific from the resource point of view, the central part of the Central Indian Ocean basin is the most promising area for the first generation mining site that India can hope to develop. The book includes useful data relative to this region.

Chapter 3 summarises the technological parametres of seabed mining with a brief discussion on various aspects of exploration and processing of these nodules. It provides an insight into various problems connected with the exploitation, technical risks not excluded.

Chapter 4, deals with the cost aspect based on the Massachusetts Institute of Technology base model adopted by the law of the sea conference from 1978 onwards. The need for a more systematic study of the cost estimate is emphasised. Any Indian programme should make its own cost estimate before venturing on a mining project in the Indian ocean as this deals with a frontier technology in which India presently lacks the knowhow.

Chapter 5 reviews the extent of India's current dependence on outside sources for strategic minerals and the extent to which growing needs could be met from resources within the country. The author dilates on the mineral economics involved in the exploitation of nodules. Nickel, copper and to some extent cobalt provide the most important economic incentive for seabed mining. The author has shown that nickel and copper content of the nodules have greater resource potential than their land-based counterparts in India. Even the manganese content of the nodules would prove an important resource potential, once the land-based manganese is exhausted by about 2011. Thus, the projections of future demand and available reserves make the exploitation of nodules an attractive proposition. However, the author has not taken into consideration the employment potential in the exploitation of land-based minerals in comparision with seabed mining in

the Indian context. Some thoughts on infrastructural facilities, manpower requirement, environmental control, power requirement and ocean transport available in India and a comparative analysis of the economics of land-based mining and sea-bed mining would have enhanced the utility of the book.

Seabed mining will be different from land-based mining as it has to be undertaken beyond the limits of Exclusive Economic Zone, where it cannot be governed by national laws. This aspect brought into picture the need for an International Authority proposed after intensive negotiations since 1967 under the auspices of the United Nations. In 1973 the Third United Nations Conference on the Law of the Sea was convened which brought into focus the divergence of interests between the developed and the developing countries. The Draft Treaty proposes that all mining will be carried out or controlled by the International Seabed Authority. Chapter 6 discusses these aspects and attempts a detailed analysis of the main features of the Draft Treaty relating to seabed mining by first summarising the relevent provisions and then discussing their implications for Indian policy. It also evaluates the implications of these provisions from the standpoint of Indian interests, both as a consumer of metals and as a potential seabed miner. The author also discusses the alternative scenarios in case an effective International Seabed Authority fails to materialise.

In the final chapter, the author analyses the various policy choices for India, if the treaty is ratified and the International Seabed Authority becomes operational. She also discusses the different sets of choices if efforts to establish a controlling and effective international mechanism fails. She points out the sectors in which India could falter. However, considering the technological potentiality of India, she is confident that the problems can be overcome and we cannot but agree with her about the need for self-reliance in this realm of new technology.

The author has thoughtfully added a postscript which includes important developments at the eleventh session of the Third U. N. Conference on the Law of the Sea and adopted a wide-ranging treaty to govern the use and exploitation of the seas with the main focus on the provisions relating to the mining of the metallic nodules on the ocean floor. The convention on the Law of the Sea is a major achievement for the international community as a whole. From the Indian point of view it is gratifying that it has been accorded the status of pioneer investor. This is a major triumph for its diplomacy and a recognition of its technological capability.

The book although small provides a range of information from nodule occurrence to laws governing its mining. All those interested in seabed mining and the International Law of the Sea should read this compendium.

The book lacks an index which is so very essential in modern reading. The glossary is useful for non-technical readers.

S. V. SRIKANTIA

GEOPHYSICAL RESEARCH BULLETIN (dedicated to Dr. Hari Narain) Special Issue. Editors: K. L. Kaila and P. R. Reddy, National Geophysical Research Institute, Hyderabad, 1982, pp. 412.

This volume is a compilation of twenty-six papers on various geophysical subjects covering the results of investigations carried out by NGRI scientists during the past two decades since the Institution was founded. As it is not feasible to review all the 26 papers individually, a selection has been made for the purposes of this review.

Kaila and Reddy in their study of crustal and upper mantle structure point out that there are both lateral and vertical inhomogeneities in the mantle in various parts of the Earth including the Indian subcontinent. Maps on seismic zoning in the Himalayan Alpine belt have been presented by Kaila and Rao. The maps reveal that there are two high seismicity zones in Nepal and Tibet regions which run transversely to the great Himalayan trend. The eight maps presented, have been prepared with considerable thought and scanning a large volume of seismic data and are sure to prove useful for reference and study by research workers in seismic tectonics. The authors have come forward with a new Indian Plate boundary based on seismicity maps and deep seismic soundings.

In their seismological investigations in Himalaya and nearby regions, Gupta and others put forward some interesting results: (1) the crustal thickness in the Himalayan and Tibetan region is 60-70 km, (2) fossil seismicity is noticed in the Chidrang river area in the Bramhaputra valley. When we keep in mind that the Chidrang fault trace was described by Oldham in his account of the great Assam Earthquake of 1897, the information on the recurrence of earthquakes here would be very useful.

'Deep seismic sounding studies in India' by Kaila presents a comprehensive review of the DSS investigations carried out along a total of 10 profiles over various geological settings in the Peninsular shield and the Himalayas. Reference may be made here to three areas where DSS studies have thrown light on important subsurface geologic features: (1) in the Cambay Basin, not only the top and the bottom of the Deccan Traps beneath the thick cover of Tertiary sediments, but also the existence of Mesozoic sediments below the traps and eventual granitic basement have been indicated. The Mesozoic sediments have potential hydrocarbon accumulations. (2) In the Koyna area, one depression of 200 m amplitude has been indicated. This flexure coincides with the deep fault in this region and may have significance in relation to the seismicity of the reservoir area. (3) The Nangaparbat-Sopur profile investigated across the syntaxis in the Kashmir Himalayan range has indicated a very deep fault at Sopur, north of Srinagar. If NGRI could investigate several more DSS profiles across the Himalayan range we may obtain a great deal more information regarding the structure of the crust and upper mantle in this region.

H. K. Gupta and others in their study of Reservoir Induced Seismicity of earthquakes point out that after impounding water in Koyna reservoir, seismicity in the area started and that both in number and magnitude the seismicity increased culminating in the earthquake of December 16, 1967. It is said that infiltration of water into pre-existing faults generally trigger the earthquakes, while the tremors are caused by the stresses induced by the impounded water in the reservoir. However, there are other reservoirs where seismicity has not been reported and areas where seismicity has been observed in the Deccan Plateau where there are no reservoirs. It has been reported that between 1967 and 1977 there have been at

least six earthquakes with intensity greater than 5 felt in the Shield area. These have been studied in some detail but we are not clear as yet regarding the specific causes that triggered the earthquakes.

'Geomagnetic Phenomena in India' by B. J. Srivastava and S. N. Prasad discusses some of the outstanding aspects of geomagnetic data with reference to geology. To mention three of the findings: (1) an indication of a very large subsurface conductor has been found beneath the Aravallis which extends and cuts across the Himalayan foot hills; (2) a graben structure between Palk strait and Sri Lanka has been indicated and (3) geomagnetic anomaly noted during total solar eclipse. As regards (1) the authors have tried to give three alternative interpretations, but none of them are convincing. It would be better if further investigations employing geoelectrical methods are carried out to confirm the extent and outline of the supposed conductor. Regarding (2), it would be interesting to ascertain the results of marine seismic surveys carried out by ONGC in this area. If the graben structure is confirmed, the potentiality for hydrocarbon accumulations would be well worth further exploration. Regarding (3) geomagnetic observation recorded during the total solar eclipse, February 16, 1980, it is said that there is a decrease in intensity of the horizontal magnetic component of the earth's field corresponding with the maximum phase of the eclipse at Etiyapur in Andhra Pradesh. Palaeomagnetic studies through 1981 on Indian rocks by M. S. Bhalla furnishes a compilation of a large number of determinations of paleomagnetism of Indian rocks. So far as interpretation of the data is concerned, little has been said. The author's investigation of the Deccan trap rocks at Mahabaleshwar with a vertical section of 300 m has indicated reversals of the geomagnetic field at least 5-7 times in the duration. It will be interesting to know the magnitude of the time involved in that duration.

The role of modified pseudo depth sections in interpretation of Resistivity and Induced Polarisation data by Appa Rao proposes a modification of a method of interpretation which has been in vogue during the past decade or so. The author claims, on the basis of model studies and field investigation, that what he has proposed is a better one, and that it may be used as a direct tool which is simple, elegant and less costly. But only one case history has been cited in support of this claim. It is desirable that his method is tried at least in a few more areas with varied geological settings to establish its merit.

Analog models of Geoelectromagnetics by J. G. Negi and others, furnishes the results of model investigations relating to indications in conductive overburden concealing conductive target. In the experiments carried out at NGRI several years back, it was found that in such cases the signal response was enhanced by the conductive overburden in inductive prospecting. This effect, was contrary to general expectations. Hence the effect has been termed 'negative screening'. The present paper furnishes more extensive model investigations which have confirmed the negative screening effect. However, no actual field results to establish the use of this effect in inductive prospecting have been put forward so far. 'Environmental Radioactive studies in Groundwater Hydrology' by B. S. Sukhija deals with the sophisticated methods using tritium and radio carbon in investigations of groundwater hydrology problems. Results of such investigations in Mehsana, Gujarat, Vedavati Basin in Karnataka and Andhra Pradesh and Ramanathapuram in Tamil Nadu, have been presented. Such investigations may be profitably employed in several other areas in India.

Geothermal studies in India by M. L. Gupta have highlighted certain interesting observations. Heat flow in the Archaean terrain is said to be significantly

lower than in areas covered by Proterozoic rocks. In parts of the Cambay Basin, heat flow is quite high. The authors have explained this greater heat flow as due to transient thermal perturbations introduced by basic magmatic intrusives at a depth of 10 km. A more proximate cause, however, is to be found in the Deccan Traps underlying the Tertiary sediments in this basin. Actually a deep well was drilled near Cambay by ONGC about 20 years ago. This well encountered very high temperatures of over 100° C after penetrating hardly 100 m of Trap, so much so that further drilling had to be given up.

This volume, including several other papers not specifically mentioned above, constitutes an important addition to literature not only on geophysics but also on geosciences in general. The record of varied investigations carried out has brought to the Institute international recognition. The addition of a geochronological laboratory would add to its usefulness.

M. B. RAMACHANDRA RAO

ANNOUNCEMENTS

The Indian Geologists' Association is organizing a DST and CAS sponsored Symposium on Carbonate Rocks of Himalaya on October 24 and 25, 1983 at the Department of Geology, Panjab University, Chandigarh.

Manuscript(s) complete in all respects should reach the Editor, Professor V. J. Gupta by September 15, 1983.

For further information please write to Dr. Naresh Kochhar, Secretary, Indian Geologists' Association, Department of Geology, Panjab University, Chandigarh 160 014.

NARESH KOCHHAR

ALL INDIA SEMINAR ON 'AMPHIBOLITES: THEIR MINERALOGY, PETROLOGY, GENESIS AND GEODYNAMIC SIGNIFICANCE'

(SAMPEGGS)

28th November to 1st December 1983

The Department of Geology, M. S. University of Baroda jointly with the Mineralogical Society of India is organising an All India Seminar on 'Amphibolites: Their mineralogy, petrology, genesis and geodynamic significance' from 28th November to 1st December 1983. The seminar aims at bringing together the various active workers of the country, who are working or have worked, on any aspect of amphibolites and provide them an opportunity to present their papers and exchange views.

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