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LIFE, THE KEELING'S CURVE AND THE OCEANS

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Since the early stages of the Earth oceans played an important role in modulating its atmospheric composition and climate. At some stage the climate facilitated the formation of initial life forms. Most of the carbon dioxide in the ancient atmosphere was deposited in the ocean, through inorganic and biological precipitation, which is now locked in the massive rock deposits. The advent of photosynthetic life exerted strong influence on the primitive atmospheric (nitrogen-carbon dioxide) composition by changing it to the present nitrogen-oxygen combination.

While attempting to estimate carbonates in ground waters Charles D. Keeling's experiments led to the development of a device to estimate carbon dioxide in air with high precision. His initial experiments provided first evidences for differences in atmospheric carbon dioxide between habited and remote regions, and between seasons. The atmospheric carbon dioxide record from late fifties, generated at his Mauna Loa Laboratory in Hawaii, came to be known as 'Keeling Curve' and formed the basis to realizing the human interference with natural climate system.

By recognizing the rise in anthropogenic carbon dioxide in atmosphere is a cause of global warming the attribution of increases in greenhouse gases as the sole reason for climate change is debatable. Nevertheless, this awareness of interference forced us to look for the remedial measures primarily using oceans; an idea that would risk the future of ocean and global environment and climate. It will be prudent to curtail the human interference while paying more attention to understand dynamic ocean-ecosystem-climate linkages.

INDIAN OCEAN AND MONSOON COUPLED INTERACTIONS IN A WARMING ENVIRONMENT

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Several studies have drawn attention to the steady warming of the equatorial and tropical Indian Ocean (IO) sea surface temperature (SST) observed during recent decades. An intriguing aspect of the IO SST warming trend is that it has been accompanied by a pronounced weakening of the large-scale boreal summer monsoon circulation. Based on a detailed diagnostic analysis of observed datasets and reanalysis products, this study examines how the observed changes in the summer monsoon circulation could have contributed to this SST warming trend. The present results reveal that the weakening trend of the summer monsoon cross-equatorial flow has favored a reorientation of surface westerlies towards the equatorial IO during recent decades, relative to summer monsoons of earlier decades, which were dominated by stronger cross-equatorial flow. Our analysis suggests that the weakening of the summer monsoon cross-equatorial flow has in turn significantly accelerated the SST warming in the central equatorial IO. While the trend in the equatorial westerlies has promoted downwelling and thermocline deepening in the eastern equatorial IO, the central equatorial IO warming is attributed to reduced upwelling in response to a weakening trend of the wind-stress curl. The observed trends in Indian monsoon rainfall and the near-equatorial SST warming are shown to be closely related to variations in the meridional gradient of the monsoon zonal winds. An examination of the twentieth century simulations from IPCC CMIP3 models, suggests that some models capture the recent equatorial IO warming associated with the weakened summer monsoon circulation reasonably well. The individual member models, however, exhibit significant inter-model variations in representing the observed response of the IO and monsoon coupled system.

A SHELF, THE SHELF AND THE LAW OF THE SEA

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When is a continental shelf not a shelf? Where in the ocean does the shelf break not mark the outer limit of the shelf? When does the shelf plus slope plus rise become equal to an extended shelf? Where in the world is a submarine ridge not a submarine elevation? Intriguing and improbable as these questions may seem to any geoscientist, these are in fact the essence of the ten paragraphs that comprise the article 76 of the 1983 United Nations Convention on the Law of the Sea (UNCLOS) which seeks to define the continental shelf and prescribe the ways and means to define and delineate its outer limits. Touted (rightly so) as a regime for the Oceans, the Convention seeks to codify the ocean space into different maritime zones, with sovereign rights of Coastal States being phased down through successive zones. The continental shelf is but one of such maritime zones. The Convention also states that rights of a coastal Nation over its continental shelf do not depend on occupation or on any express proclamation. If it is so, why is it that as on date, 77 submissions have been received by the United Nations Commission on the Limits of the Shelf laying claims for continental shelves beyond 200 nautical miles? In this presentation I discuss some of the nuances of the article 76, if only to highlight the intricacies of the process of delineation, utilising examples from Summaries of the recommendations made by the Commission, and on a lighter note, what happens when legal eagles turn scientists and vice versa.

**PROGRESSIVE TRENDS IN THE NEW MILLENNIUM:
MINERAL RESOURCES BEYOND NATIONAL JURISDICTIONS**

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Three decades ago, the negotiated text of the Third United Nations Conference on the Law of the Sea, termed as “UNCLOS-III or the Convention” was opened for signature on December 10, 1982 at Montego Bay, Jamaica. Recently in Kingston, the Assembly of the International Seabed Authority (ISA) also called “the Authority” met in a special session (in 2012) to commemorate that milestone event, and pay tribute to those who worked for the successful adoption of UNCLOS. The background information with regard to the formation of International Law Commission, led to the United Nations and the three United Nations Conferences on the Law of the Sea (UNCLOS-I, II and III) and their genesis are discussed and presented.

On the opening session, the President of the Assembly of the Authority from Mauritius said that the landmark Convention allowed the world to celebrate a treaty addressing the concept of the common heritage of mankind, and the establishment of its appurtenant legal regime and implementing agency. He described Article 136 of the Convention as “one of the landmarks of legal drafting of international instruments by virtue of its simplicity, yet unambiguous affirmation of a commitment to international cooperation and equity”. The UNCLOS-III is one of its rare kind of texts and international understanding aimed to develop a regime to share the resources of the seabed beyond national jurisdiction as “Common Heritage of Mankind”. Though the UNCLOS faced a lot of opposition from the technologically advanced and developed nations towards the provisions of deep-sea mining and technology transfer, however, the years of negotiations and consistent approach resulted in establishing the ISA on 16th November, 1994 with its headquarters in Kingston, Jamaica upon the entry into force of the UNCLOS-III Convention.

During the last twenty annual conventions held in Kingston, ISA made a substantial progress as an autonomous organization of the United Nations, with 163 countries currently as the Parties to the Convention. The Authority adopted three sets of Regulations for the major deep-seabed mineral resources, viz., Polymetallic Nodules (in 2000), Polymetallic Sulphides (in 2010) and Cobalt-rich ferromanganese crusts (in 2012).

To elaborate on the various resources for which exploration contracts have been signed between the parties and the Authority are:

- (a) fourteen contracts for Polymetallic nodules;
- (b) four contracts for Polymetallic sulphides, and
- (c) two areas filed for Cobalt-rich ferromanganese crusts.

Of the fourteen contracts approved for nodules, one contract by India falls in the Central Indian Basin of the Indian Ocean and the rest thirteen contracts are confined to the Clarion-Clipperton Zone (CCZ) of the Pacific Ocean by China, Japan, Germany, Russian Federation, France, Nauru, Tonga, Republic of Korea, Belgium, UK, Kiribati, UK (second area in CCZ) and Singapore are in Pacific Ocean.

Six hydrothermal sulphide areas claimed under the joint venture with the Authority so far. Of these, four have signed contracts including China, Republic of Korea, France and Russian Federation, of which two former claims fall in SW Indian and Mid-Indian Ridges (Indian Ocean) and the later two in Mid-Atlantic ridge (Atlantic Ocean), respectively. The other two claims are India and Germany across Mid-Indian, SE and SW-Indian ridges have been approved during 2014 and the contracts yet to be signed.

After the adoption of Regulations for Cobalt-rich crusts in 2012 during the 18th session of the Authority, China and Japan filed applications under the joint venture with the ISA for Cobalt-rich crusts exploration areas in Western Pacific and Russia in Magellan Mountains, Pacific Ocean. All the three countries signed their contracts with ISA.

A substantial progress made by the Authority since its establishment two decades ago, paved a way for the States/Countries that are capable of investing into the deep-sea mineral resource exploration and parties to the Convention to claim for areas under various mineral regime Regulations in vogue. Interest during the last six years by small island nations backed by private partners (with developed countries nationalities) lead to allocation of reserved areas in CCZ and progressively the countries like UK, Belgium and Singapore (Reserved Area) to enter into contracts with ISA for nodules. Many countries including those which in early 1980s went against to recognize a UN system that was then being established under the Preparatory Commission (PrepCom). The United States of America went on to recognize (1981) certain claims made for polymetallic nodules in CCZ by the four Consortia which are now formed a part of the claims made to the ISA as contract areas of some European and other countries. Thus, we are getting into progressively the era of colonization of "the Area" (seabed beyond national jurisdiction). Further, how this renewed interest to enter into contracts for exploration with the ISA can lead to the mining of the seabed in future. This presentation also discusses the expiry of majority of nodule contracts in near future and the position of the Authority.