(a) Identify components of biological diversity important for its conservation and sustainable use having regard to the indicative list of categories set down in Annex I,

(b) Monitor, through sampling and other techniques, the components of biological diversity identified pursuant to subparagraph (a) above, paying particular attention to those requiring urgent conservation measures and those which offer the greatest potential for sustainable use,

(c) Identify processes and categories of activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, and monitor their effects through sampling and other techniques; and

(d) Maintain and organize, by any mechanism data, derived from identification and monitoring activities pursuant to subparagraphs (a), (b) and (c) above

Article 8. In-situ conservation

Each Contracting Party shall, as far as possible and as appropriate.

(c) Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use,

(d) Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings;

(j) Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices

Annex I. Identification and monitoring

1. Ecosystems and habitats: containing high diversity, large numbers of endemic or threatened species, or wilderness, required by migratory species, of social, economic, cultural or scientific importance, or, which are representative, unique or associated with key evolutionary or other biological processes,

2 Species and communities which are threatened, wild relatives of domesticated or cultivated species, or medicinal, agricultural or other economic value, or social, scientific or cultural importance, or importance for research into the conservation and sustainable use of biological diversity, such as indicator species; and

3. Described genomes and genes of social, scientific or economic importance

The author is in the Centre for Ecological Sciences and Biodiversity Unit, Jawaharlal Nehru Centre for Advanced Scientific Research, Indian Institute of Science, Bangalore 560 012, India

OPINION

Earthquakes of peninsular India and plate tectonics

Parashu R. Uniyal and Janardan G. Negi

The Maharashtra earthquake of 30 September 1993 in peninsular India (magnitude ~ 6.4; focal depth ~ 10 km; origin time ~ 0356 hrs local time; area of devastation confined to a circle of radius ~ 20 km around epicentre) claimed >11,000 human lives. It was perhaps the deadliest of all historical intraplate (taking place away from plate boundaries) earthquakes. Such an earthquake raises serious issues concerning seismic hazard mitigation in the area, and has important implications for validity of plate tectonics for the continental Indian lithosphere.

According to a recent census report, the provinces of peninsular India have average population density varying between 150 and 750 km^{-2}. Given that ~ 80% of the population lives in rural areas, of which ~ 50% live below poverty line, there are serious implications for 75,000–375,000 human lives. Furthermore, seven cities in the peninsula have population of 1.7 million or more (including Bombay, which has a population of ~ 12.5 million) – a fact that makes prospects even worse.

Very few historical intraplate earthquakes worldwide have caused surface ruptures of the Earth – a fact that lends support to the hypothesis of such earthquakes taking place in hidden fault zones in the Earth's crust. A large area (~ 600,000 km^2) of the Indian peninsula is covered by basaltic lava flows, making the delineation of hidden fault zones a daunting task.

The Indo-Australian plate is a well-known example of violation of axioms of the theory of plate tectonics. A wide zone (5°N–10°S; 78°–90°E) of intense intraplate deformation exists in the northern Indian Ocean basin in a lithosphere of age 60–90 Myr^{1-3}. The various models to explain this oceanic intraplate deformation include: buckling of oceanic lithosphere in response to large (~ 600 Mpa) N–S compressive stresses resulting from Himalayan orogeny[1]; brittle failure of the oceanic lithosphere and the reactivation of pre-existing spreading centre-formed faults[2]; and a diffuse plate boundary separating assumed rigid Indian and Australian plates[3].

A wide area (8°–24°N; 68°–90°E) of the continental Indian plate has experienced nine earthquakes of magnitude 6–6.5 since 1900 AD, with hypocentral depths ranging from ~ 10–33 km, and focal mechanisms consistent with the predominantly N–S compressional stress regime[4]. The surface heat flow across the area varies[5] from 27–110 mW m^{-2}, with an average of 59 mW m^{-2}.

Simple plate tectonic models of the strength and deformation of intraplate

continental lithosphere under compression require either unrealistically large initial applied stresses or very high heat flow to result in *whole lithosphere failure* causing geológically significant strains[6]. While the large initial stresses during the breakup of Pangaea may be difficult to explain, a hotter Indian lithosphere during late Cretaceous and early Tertiary[7] may have met the necessary conditions required to cause whole lithosphere failure. We lack independent estimates of strain in the continental Indian plate to test this hypothesis. The deep seismic sounding profiles that can constrain the rheological state of lithosphere in this area are very few and far between.

Future experiments to estimate the rates of deformation using arrays of global positioning system (GPS) receivers, and to constrain the rheological state of the Indian continental lithosphere using state-of-the-art controlled source seismology will lead to a better understanding of the intraplate earthquakes of the Indian shield *vis-à-vis* theory of plate tectonics. Furthermore, such experiments have a great potential for characterizing the hidden fault zones.

1. Mc Adoo, D. C. and Sandwell, D. T , *J. Geophys Res* , 1985, 90, 8563–8569.
2 Bull, J M and Scrutton, R. A., *Nature*, 1990, 344, 855–858
3 Gordon, R. G. *et al* , *Tectonics*, 1990, 9, 409–422
4. Chandra, U , *Bull. Seismol Soc. Am* , 1977, 67, 1387–1413
5. Pollack, H. N., *et al* , The New Global Heat Flow Compilation (unpublished), University of Michigan, Ann Arbor, 1991.
6. Kusznir, N J. and Park, R. G , *Geophys J. R. astr Soc.*, 1984, 79, 513–538
7. Negi, J. G. *et al* , *Tectonophysics*, 1986, 131, 147–156

The authors are in the MP Council of Science and Technology, Science Block, Kisan Bhavan, 26 Arera Hills, Bhopal 462 011, India.

What should India be doing in the human genome?

S. S. Agarwal

If there can be genuine differences of opinion on the subject of human genome research between elite scientists the world over, how can India be an exception? And if there is a difference of opinion and it is not expressed, how can one expect a mature decision? This is what has motivated me to pen down my thoughts as a rejoinder to the views expressed by J. Gowrishankar in his erudite article on the subject which appeared in *Current Science*, 1993, 64, 705. I do not think there can be any difference of opinion on the need and utility of research on human genome as conceded by Gowrishankar himself. The real difference is in the approach. One school of thought would like it to be pursued in mission mode while the other would like it to be supported through standard individually initiated peer reviewed mechanisms as has been suggested by Gowrishankar. This debate is the same, whether it is India or United States. The interested reader is referred to a series of articles that appeared in the January 1991 issue of the journal FASEB. But what may be applicable to US may not be applicable to India and so the question still remains what should India be doing? We have to admit that there is severe resource constraint in India. More important than financial crunch is the human resource crunch. There is very little critical mass in most fields. Another limiting factor in front-line research is dependence on imported equipment and chemicals. Under these circumstances we have to heavily weigh the chances of success even if we start in mission mode. However, there are several positive indicators as well. One is that our scientists have the advantage of English as a medium of education They are well informed about the developments in the field. The second is that the nation has recognized long ago that biotechnology is the need of the hour and considerable infrastructure has been built in this direction in the country over the last 10–15 years. What is missing is the participation of medical men and women and a mission and zeal that is required to accomplish a task. It is both because of lack of appreciation and commitment as well as lack of inputs. What is more important to be decided is the cost-effectiveness of the approach rather than the fear of funding poor quality research under mission mode.

It does not require any clairvoyance to visualize the importance of possessing the knowledge of the human genome. The talk of patenting the human genome and TRIPS is not trivial. In this context the words of the President of ASSOCHAM are worth reminding. He has very succintly said that if we keep on importing technology a day may come when we may not have it even if we have the money to pay for it. The recent episode of cryogenic rockets is a good pointer in this direction. One laudable step of the GOI has been to be watchful of the future interests of the country in its Antarctica mission. Likewise, the investment in human genome is for the 21st century. A decision to remain out of the pursuit of human genome must be carefully debated.

Now coming to the question of cost effectiveness. To my mind there is nothing more frustrating than a half-hearted approach. It is a peculiar syndrome of a developing country like India that we would like to do it but cannot muster sufficient courage and will to do it. It is true that this may be related to our financial difficulties. But even the more affluent countries have their financial constraints. We have to decide about our investment which can pay in future. The direction of research takes a long time to develop and is determined by funds. Support for research on cancer and AIDS in US are prime examples. It is only when sustained funding is assured that researchers take that direction. The mission mode cannot bring overnight accomplishments Mission mode is not to waste funds or to make miracles It is