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NEWS

CSIR (EMR) support to research in earth sciences – A report

The EMR (Extra-Mural Research) Division of the Human Resource Development Group (HRDG) of CSIR has now earmarked funds for allocation to research projects of direct relevance to the programmes being undertaken in the Council of Scientific and Industrial Research (CSIR) Laboratories.

The research committees of CSIR, consisting of experts drawn from universities, CSIR laboratories and industries, examine the proposals, select the promising schemes and recommend appropriate allocations, based on peer evaluation and their own perception. The Research Committee on Earth, Atmospheric and Ocean Sciences felt that the quality of research proposals submitted to CSIR for support under the EMR scheme was not up to the mark. It was, therefore, decided that a brainstorming session of experts across the country be organized to discuss, debate and decide on the desired nature of research proposals, preferably in the 'bilateral' mode.

A study of the Earth System, because of its complex nature involving many fields, has to be based on a holistic approach to comprehend current trends and foresee what is required to be done in the future. In a way, the International Geosphere Biosphere Programme (IGBP), initiated by the international community of scientists paved the way for such an approach. Modelling at different levels like the micro to continental scale and then on to global scale, is required not only to carry out coherent investigations but also keep the overall objective in mind.

The brainstorming session in Earth Sciences held on 17–18 August 1995 at JNU, New Delhi, was aimed at bringing together creative and working scientists with proven capabilities to deliberate and come up with a report which could serve as a guideline for the coming five years. Over fifty scientists from all over the country gathered for the two-day session.

Our immediate attention within geology should be focused on those processes that link the solid earth, fluid envelope and the biosphere for the past 60 my. These studies are essential to evaluate how the different components of the earth system evolved, how they function now and how they can be expected to function and evolve at a time scale significant to people. Formation and evolution of igneous and metamorphic terrains that go to make up the Indian continent and the sedimentary basins included in it, require a reinvestigation using modern geochemical and geophysical tools. This, together with the studies of rock–water interactions, will help in evaluating the resource potential of our continent. Sedimentary systems and processes, especially those of weathering and soil formation, sediment transport and deposition that cause extensive geochemical differentiation warrant studies with modern geochemical and isotopic methods. This research will provide basic data to understand and maintain inherent soil fertility to ensure sustainable agriculture as well as arrest environmental degradation arising out of local, regional and global changes. The following thrust areas of geological research have been recommended: **Global Paleoenvironmental and Biological Evolution** (comprising Cenozoic geology, paleoenvironment and paleontology, problems of stratigraphic boundaries and interaction between man-made environment and geology); **Geochemistry and Biogeochemical Cycling** (comprising exogenic geochemical processes and weathering and climate); **Fluids in/on Earth** (comprising magma generation and emplacement and fluid–rock interaction (High T & Low T); **Crustal Dynamics (Continental and Oceanic)** (comprising evolution of sedimentary basins, Thermotectonic evolution of metamorphic terrains, and the process modelling of rock deformation); **Experimental ore petrology** (comprising sulphide phase equilibria, physical chemistry of fluid inclusions in ore deposits and genetic modelling of potential ore formations in some of the well-known terrains).

For geophysical investigations, the spatial distribution of physical properties with the help of experimentally-determined properties of known rock and synthetic samples and observed surface structure help in understanding the distribution of chemical compositions and structural configurations within the earth. A comprehensive understanding of the Indian lithosphere with regard to its structure, composition and evolution will require incisive data acquisition by careful experiment design, laboratory measurements of physical properties and mathematical modelling of the physico-chemical processes occurring within the earth.

Some of the key areas are Geophysical imaging at fine scales, Elastic wave propagation and electromagnetic field diffusion in real earth like media, Molecular modelling of rock-forming minerals and rheological modelling of

rocks. Fluid processes in the crust, Earthquake-generation processes and lithospheric stress, Quantitative hazards mapping, Sedimentary basin evolution *vis-à-vis* hydrocarbon generation and ore genesis, Mineral discrimination through artificial electrical excitation, Heat/moisture transport at the near earth's surface, and Mantle convection and geochemical dynamics.

Studies in oceanography in India have so far been more qualitative and were directed more to specificities than looking at the ocean as a whole. With the advent of IGBP and the strides mathematical modelling is making in the realms of oceanography, a stage is reached when a more complete understanding of the oceanic processes (both contemporary and paleo) in terms of their nature and rates can be envisaged.

The following areas have been identified for future research taking into account the special features of the northern Indian Ocean. These include the unique circulation arising from the unusual geographical setting and climate; extensive suboxi zone resulting in globally-significant biogeochemical cycling; importance of the land–sea and cross-shelf exchange of materials; and preservation of a variety of monsoon proxies in sedimentary records to provide insight into the functioning of global climate and perhaps its evolution through time.

The study of **Physical processes** includes Bay of Bengal circulation, Kelvin, Rossby and gravity waves in the northern Indian Ocean, Satellite oceanography, Deep sea circulation using tracers (C-14, Ra-226, CFC's), Air–sea interaction including gas exchange, and Modelling. The study on the **Chemical and Geological processes** deals with the riverine inputs of organics and trace elements including pollutants, Composition and flux of aeolian material, Particle–water interactions, Material exchange across the boundaries: sediment–water interface, coastal–deep sea, ocean–atmosphere and carbon cycling through the entire ocean. The area of **Paleoceanography – Paleoclimates** includes Contemporary sedimentary processes, and evolution of past circulation pattern, climate, sea level changes etc. using as many proxies as possible on the records preserved in the marine environment. The study of **Mineral Resources** includes Survey, evaluation of economic potential and development of mining strategies for (a) authegenic, (b) diagenetic, and (c) hydrothermal deposits.

A realistic approach for medium as well as extended range simulation/prediction of monsoon over India needs a comprehensive coupled land–atmosphere–ocean systems modelling. It is well-recognized that the physical forcings are dominant over dynamical forcings in the determination of tropical circulation – weather and climate. Therefore, models have to incorporate many sub-grid scale physical processes such as convection, cloud, radiation, boundary layer, etc. in parameterization form. Thus, the research and development work in this area warrants a multidisciplinary approach by a number of groups. Considering the complexities and multicomponent nature of this modelling effort and the limitation of resources and specialized manpower, it is felt that a well-planned and coordinated research effort in this key area is likely to be more productive than work on unconnected problems. The different components of such a research plan are: **Study of air–sea** (including interaction in relation to weather systems in India; interaction in the genesis, intensification and movement of tropical cyclones, and structure of coupled variabilities and diagnostic studies); Development of nested grid regional ocean–land–atmosphere coupled model for the maritime and coastal region; Development of parameterization scheme of atmosphere interaction for inclusion in large scale models; Retrieval of basic meteorological/oceanic data over the data sparse regions using remote sensing platforms; Monsoon variability; Development of component (ocean, atmospheric and land surface processes) models to simulate low level (or surface) flows; Simulation/analysis of oceanic variabilities and their relation to the Indian summer monsoon variabilities, like for example ENSO-monsoon connection; Sensitivity of monsoon simulation to land surface processes; Climate change and coupled dynamics (including ionospheric irregularities in space and time; ozone depletion and global warming; monitoring greenhouse gases emission and climate modelling); Atmospheric effects on radio propagation (including HF communications and trans-ionospheric propagation).

The above areas are brought to the knowledge of all scientists in the hope that proposals on these topics will be forthcoming and can be considered for CSIR funding throughout the country.

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