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INDIAN GEOLOGICAL INFORMATION SYSTEM

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Abstract

Instant access to the surface geology is of great use to an earth scientist such that the information can be viewed or printed through a computer. A software package for "Indian Geological Information System" has been developed at National Geophysical Research Institute (NGRI) on CYBER 180/850-A main frame computer. It can be used in an user friendly interactive session, to get the information on regional Indian geology directly on the workstation screen. Several options are provided to meet the requirements of an earth scientist. With these options one can a) view the geological map of India as a whole, b) view different rock types by choosing a particular geological system, c) select a part of an area by choosing latitude and longitude or a toposheet number etc., In addition to these options, the surface geology can also be viewed along a selected profile. The information on the screen can be printed using a colour copier.

Introduction

Quick access to the geological information of an area is very useful to an earth scientist, more so, in the form of a graph or a figure. This has become an essential prerequisite to a geologist or a geophysicist before acquiring new information of an area or initiating new research.

At present the geological information is available in the form of maps on different scales. However, if one requires information of a small area or to know the occurrence of a particular rock type or the surface geology along a particular profile, he needs to spend some time to get the information using maps. Quick access to such type of information of Indian Geology is a long standing requirement of an earth scientist.

Indian geology is quite complex and consists of various rock formations originated at different geological time periods (Krishnan 1982). These rock types have been arranged and classified broadly based on their age (million year scale) in a chronological order. They have been divided into several groups in the order of their increasing antiquity, right from

RECENT (0 million years) to ARCHEAN (greater than 2500 million years) system. The geological systems and their ages (GSI map, 1964) are tabulated in Table-1.

An attempt has been made in the present study to develop a software package on mainframe Computer at NGRI, Hyderabad. The general objective of the software package "Indian Geological Information System" (IGIS) is to provide information interactively with menu driven options to display the geology as per the user's desired need. Although several commercial graphic packages are available (Radhika, 1993) on mini's and micro computers (eg: Arc/Info, PAMAP, Intergraph GIS, ISRO GIS etc.), this is the first time such a package has been developed on a mainframe computer considering the regional Geology for the whole country.

Geological Data Base and Software

The geological information has been acquired from the Regional maps published by the Geological Survey of India (G.S.I). These maps (1 : 2,000,000 scale) have been digitized and a data base has been prepared based on the dominant rock formation. in that

Table-I

The table shows the names of various geological system and their ages in million years. (modified from GSI map 1964)

Code	System	Age
CENOZOIC ERA		
1.	Recent	0
2.	Pleistocene	2
3.	Plio-Pleistocene	7
4.	Mio-Pliocene (Neogene)	7
5.	Miocene	26
6,7	Oligo-Miocene, Oligocene	38
8.	Eocene	54
9.	Tertiary	65
MESOZOIC ERA		
10-12	Upper Cretaceous, Lower Cretaceous and Cretaceous	135
13,14	Jurassic-Cretaceous, Jurassic	195
15-18	Mid-Triassic-Lower Cretaceous, Triassic, Mesozoic, Upper Carboniferous -Lower Triassic	225
PALEOZOIC ERA		
19.	Carboniferous-Permian	345
20.	Silurian-Devonian	435
21.	Ordovician-Silurian	500
PRECAMBRIAN ERA		
22-26	Cambrian, Palaeozoic, Upper Precambrian-Lower Palaeozoic, Upper Precambrian, Lower Precambrian	600
27,28	Archean (Granites & Gneisses, Unclassified Granites & Gneisses)	2500
INTRUSIVE ROCKS		
29,31	Tertiary (acidic, basic)	65
30,33	Precambrian-Lower Palaeozoic (acidic, basic)	600
32	Mesozoic (basic)	225
EFFUSIVE ROCKS		
34,35	Upper Precambrian - Lower Palaeozoic, Upper Precambrian (acidic)	600
36.	Upper Pre Tertiary-Recent (basic)	65
37.	Mesozoic-Lower Tertiary (basic)	225
38,39	Palaeozoic, Precambrian (basic)	600

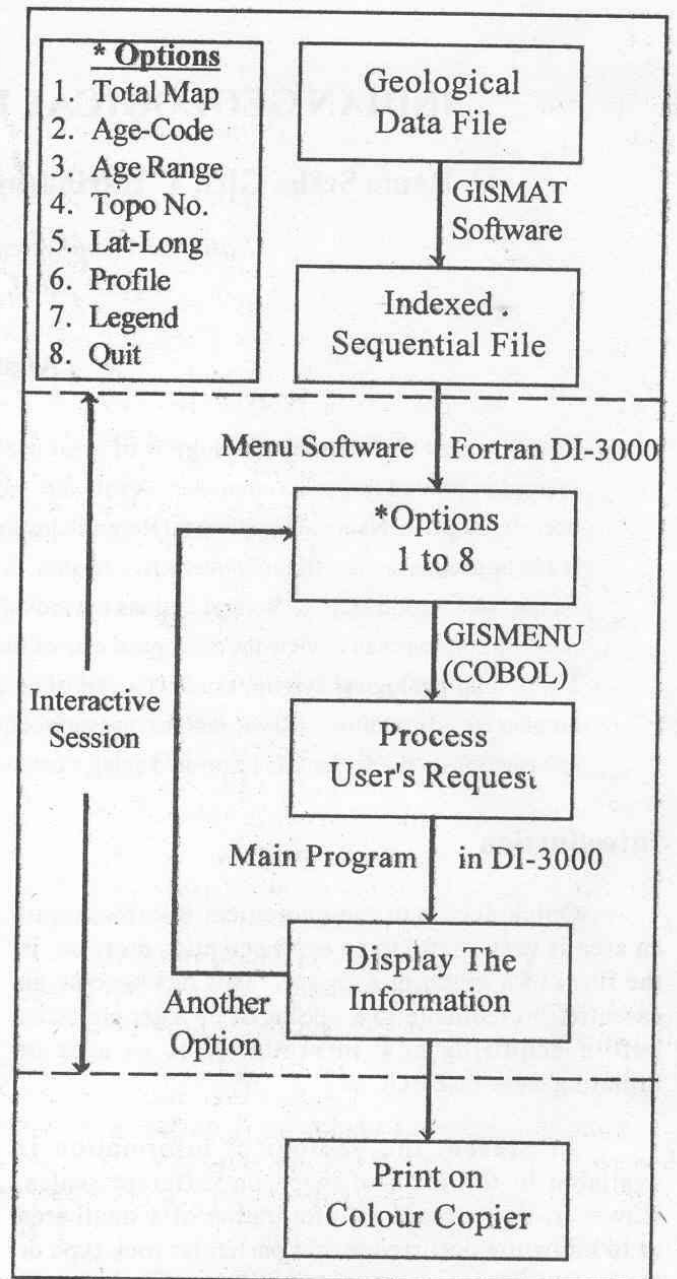


Fig 1: The major steps involved in the software package and the geological data.

unit area. An area of about 750 sq. Km. (1" = 4 miles scale map) has been considered as one unit in the present study for the whole of India. For the purpose of digitisation and presentation, toposheet index system - which is in conformity with the geographic latitude and longitude system - has been considered. The data thus acquired has been fed to the computer and a data file has been created.

The development of the software package IGIS

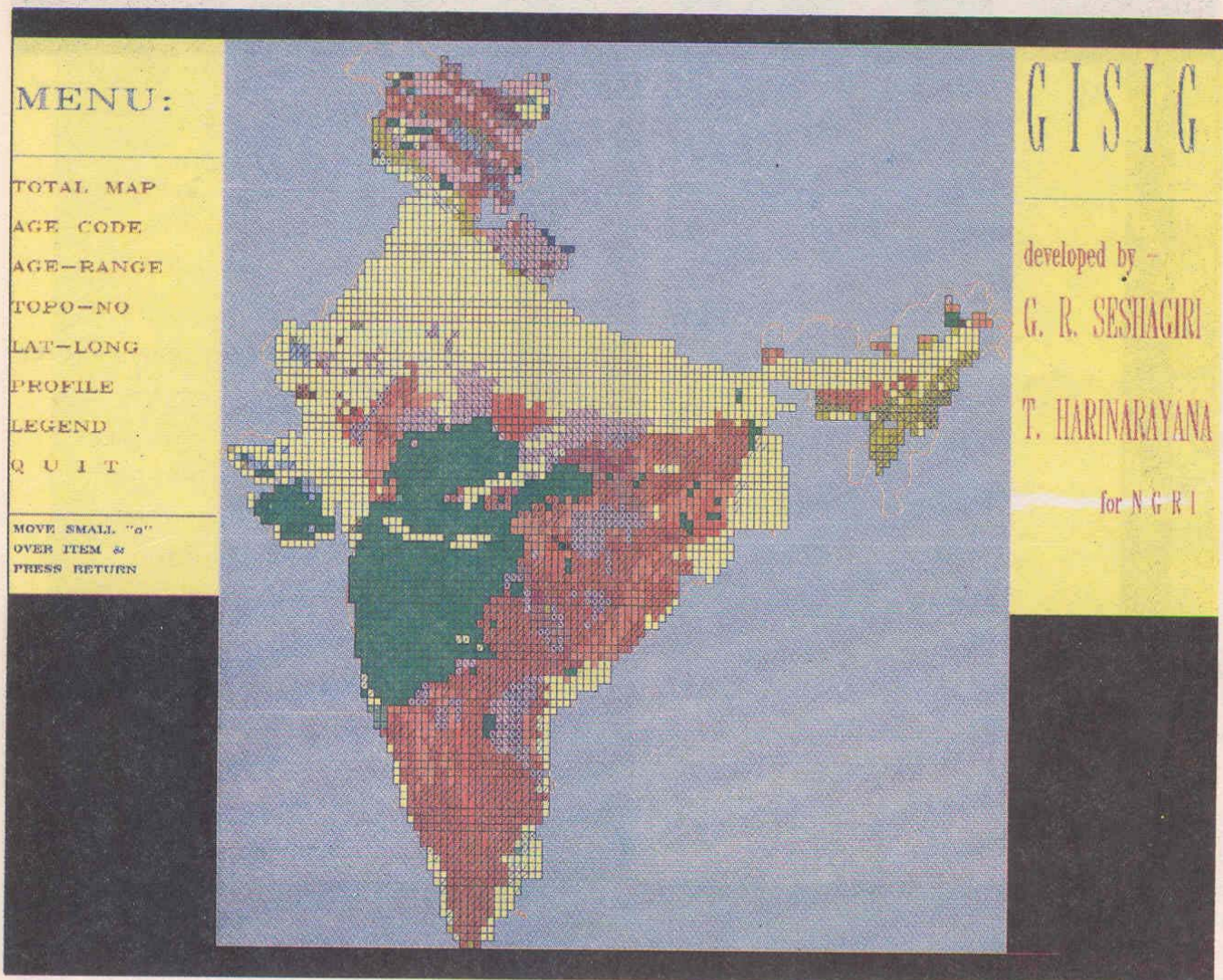


Fig 2(a): The geological map of India showing all the formations with different colours as seen on the TEKTRONIX Work Station, by choosing 'TOTAL-MAP'

has been planned on CYBER 180/850 (Seshagiri and Harinarayana, 1994), a mainframe computer of Control Data Corporation, under the aegis of NOS/VE operating system (CYBER user's manual, 1986). For this purpose two high level languages - FORTRAN and COBOL - have been used by linking the programs together. IGIS also uses the Precision Visuals DI-3000 (DI-3000 manual, 1986) software and the TEK-4125 colour Graphics Workstation (TEK4125 manual, 1987). The DI-3000 software is an integrated system of graphics software with around 200 subroutines, which are FORTRAN callable. A Calcomp colour copier (Calcomp User's Guide, 1991) which is connected to the workstation can be used to get colour print of the screen.

Since the development of IGIS is aimed to provide quick access to the geological information on an interactive basis, an indexed sequential file has been employed. An indexed sequential file is a type of file organisation on computer to store the data (Phillippakis and Kazmir, 1984). Here, the records are arranged in a sequential order and a table containing the index (address) of the record is available along with the file. This table, makes the search easier for computer, thereby reducing the access time. This type of file organisation helps us in reading the file both sequentially and randomly to read the required record directly. The information retrieval is achieved by a set of COBOL programs, as COBOL offers good file manipulation facilities.

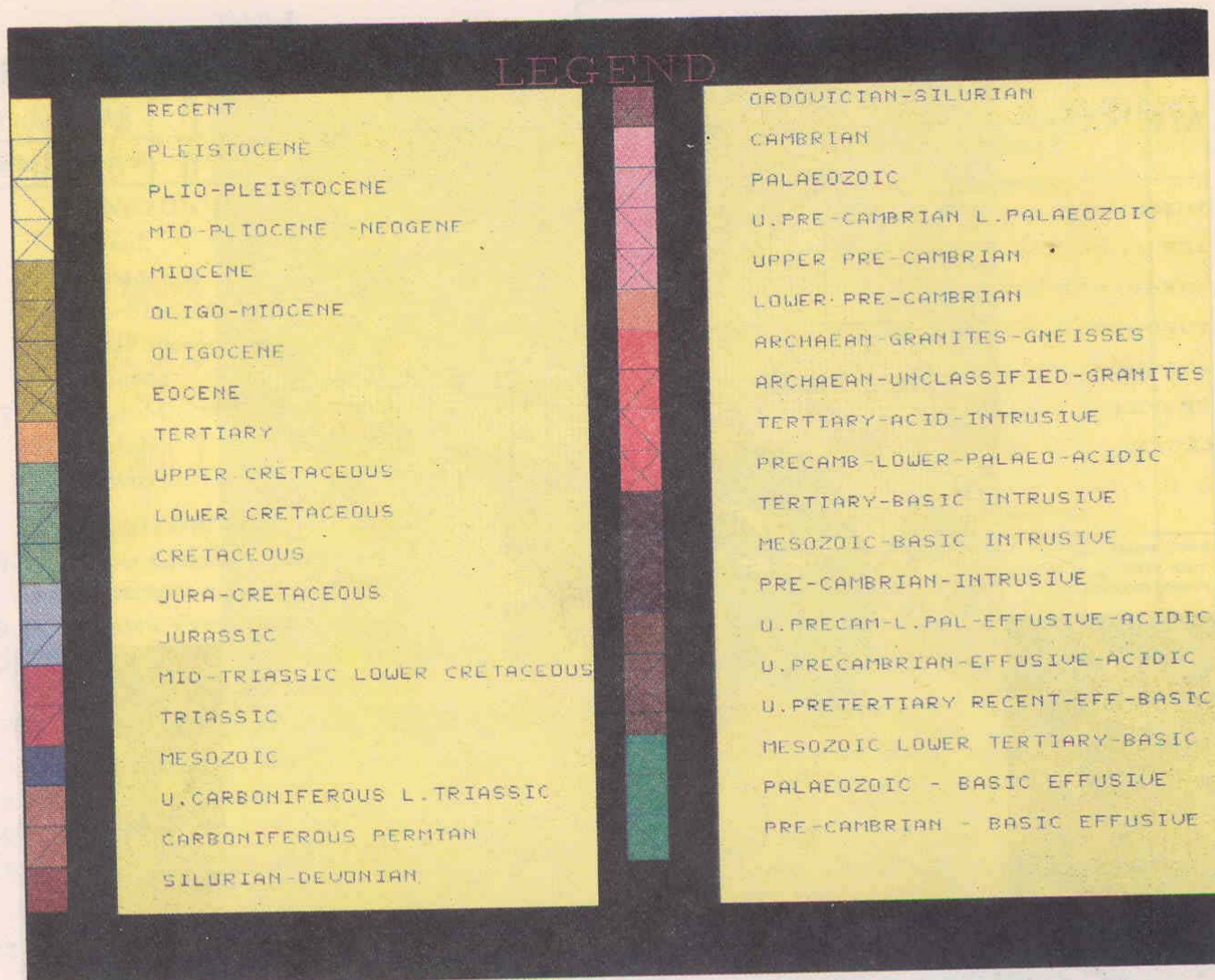


Fig.2(b): The display as seen on the TEKTRONIX Work Station, by choosing 'LEGEND' from the menu in fig.2(a)

In an interactive graphics session, the user's request (ie. by choosing an item from a given menu), is received by the DI-3000 software in FORTRAN environment and the same is communicated to a COBOL program. The COBOL program processes the request and an output is created from the information available in the indexed sequential file. This output is read by DI-3000 software and is used to generate the colour graphics on the workstation. The major steps involved in developing the software package are described in a flowchart and is shown in figure 1.

Operation of the Software

In IGIS software package, several options are provided and the user can select any option

interactively on the graphics terminal. The options incorporated in the present package are

- a) total geological map of India (TOTAL MAP)
- b) geological age code (AGE CODE)
- c) geological period (AGE RANGE)
- d) toposheet number (TOPO. NO.)
- e) latitude and longitude of an area (LAT-LONG)
- f) geology along a profile (PROFILE) and
- g) legend of the map (LEGEND).

If the user chooses the "total map" option, the complete geological map of India containing various geological formations will be displayed with different colours on the workstation screen (fig. 2). If one wants to see a particular rock type distribution he can

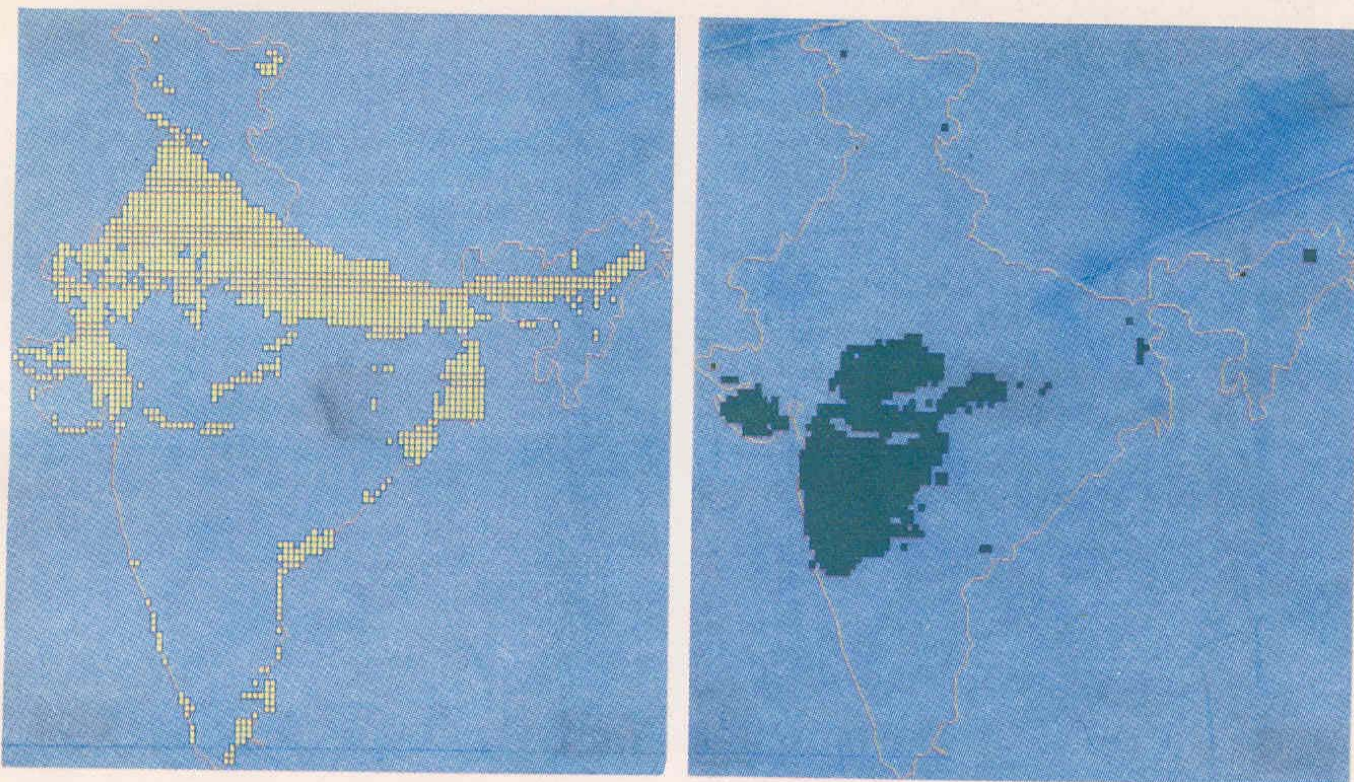


Fig 3: The occurrence of (a) Alluvium and (b) Traps for the whole of India, by choosing the 'AGE-CODE' option from the menu. (colour map enclosed)

select the "Age-code" option from the menu. The workstation screen displays the chosen rock type in different areas of its existence. As an example, the Alluvium and Trap rock formations have been shown for the whole of India in fig. 3 a & b. As an extension to the above option, 'AGE RANGE' option is also provided, which is versatile to view geological systems of a selected period. For example by giving code numbers 3,4,5,6 and 7, the system displays the PLIO-PLIOCENE, MIO-PLIOCENE, MIOCENE, OLIGO-MIOCENE and OLIGOCENE systems in entire India, which are 7 to 38 million years old.

Similarly, if one would like to see the geology of a particular toposheet area (option "d"), he can give the toposheet number of his choice. It is also possible to look at the geology of a smaller area by giving the latitude and longitude of diagonally opposite corners of a rectangular area (option "e"). Another option is to obtain the surface geology along a profile with the information of two ends of the profile (option "f"). The 'Legend' with colour codes and their corresponding rock types can be obtained by choosing option "g".

Concluding Remarks

A software package "Indian Geological Information System"- (IGIS) has been developed on a main frame computer considering the regional Geology for the whole country. The package is user friendly and can be used by a person with little computer background. The software package uses Precision Visuals DI-3000 software, which is a device independent software. Various options for selecting the information from the database are provided, in order to meet the general requirement of an earth scientist. For example, the user can have the graphical information of whole of India or part of India or the information of particular rock type or the geology along a profile. The present software package with minor modifications can be further extended for detailed geological maps of smaller regions and also for geophysical/geochemical data bases.

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