Chapter - 6

CHAPTER - VI
ANALYTICAL TECHNIQUES

Different sets of analytical techniques were used by the author during his field investigation and during the laboratory studies. A brief review of these techniques and their utility is given in the following paragraphs.

Based on the considerations mentioned under characters of the individual stratigraphic sections, the Anjar and the Dayapar sections appears to be the most complete horizons for the consideration of the Cretaceous-Tertiary transition studies. A multi-disciplinary approach has therefore been adopted by the author to investigate the geological implications at these localities.

In order to achieve thorough information the *dinosaurian* pit sections of Intertrappean bed no. III was freshly excavated from the base of the overlying IV intertrappean flow till the underlying basaltic flow of intertrappean bed no. III was reached. Major lithological horizons were identified and detail lithologs were prepared based on the sedimentological, palaeontological, lithological characters and colour variations. For the same lithounits more than 50 m in thickness, sampling interval was taken at 5 cm intervals. In otherwise, the sample locations were decided and demarcated at all the variations up to the thickness of unit to the level of 0.5 to 1.0 cm. After deciding the sample line and sampling points the sampling for various purposes were carried out as given below:

VI.1. SAMPLE COLLECTION AND LAB STUDIES:

VI.1.1. Geochemical Studies:

For the geochemical studies, collection of samples free from possible contamination to minutest level is very necessary. For this purpose, the conventional use of chisels and/ or hammers were avoided. The sampling for low radiation was carried out with the help of chisels, spatula, and hammers made from the acrylic-PVC material. The samples were collected from the thoroughly cleaned surfaces after removing about 15 cm top surface of the fresh exposed section. The samples were packed in airtight PVC containers duly labelled for number, horizon, depth and for purpose of study and packed before proceeding for next sample. The entire section was sampled at close interval. The interval of sampling was reduced to 1.0 cm in vicinity of the brown limonitic layers and white siliceous and marly layers within the basal black and grey shale and the grey and chocolate coloured shale. The sampling interval was also reduced to 1.0 cm apart in vicinity of the ash layer within the brown and to the base of the cherty limestone horizon. Sampling interval in the cherty limestone, marls, grey and brown shales above the ash layer were mined as 5 cm interval or wherever there was change in the horizon depending upon the thickness. For thickness of unit less than 5 cm each horizon was sampled, and for horizon more than 5 cm thickness the standard interval of 5 cm was maintained. The samples were sent to PRL

laboratory, Ahmedabad, for analysis of PGE, RE, siderophile, chalcophiles, volatile elements, trace elements, lithophiles.

The similar procedure was adopted for sampling of Dayapar second intertrappean bed, where the *Dinosaurian* fossils were found. The bone fossil horizons were sampled at closed intervals in same manners like Anjar section. Certain brown and pink layers within the marly horizons, above and below the *Dinosaurian* bone fossil layers were also sampled at close intervals.

VI.1.2. Palaeomagnetic Studies:

The basaltic flows F1 to F7 were sampled for palaeomagnetic samples. Field palaeomagnetic polarity measurements were carried out on the oriented samples. Two oriented samples were collected from each flow after insitu demarcation of geographic north and horizontal planes on the faces of the samples. The field palaeomagnetic polarity of the samples were tested with the help of the Flux Gate Magnetometer. The palaeomagnetic north was also marked on the oriented sample at the time of field testing of polarity. Similar testing was done for each sample from all the flows of Anjar section, Bhachau, Baladia, Kera, Matanomadh, Roha, Dayapar and Ukra sections. The oriented samples were again brought to the PRL, Ahmedabad, for laboratory studies of magnetic polarity.

The samples were re-oriented as per the original field conditions at the time of collection. After re-orientation in the laboratory, the samples were fixed in the R.C.C. boxes with due care not to disturb the re-orientation setup of samples. After proper curing and hardening of the samples within the R.C.C. boxes, oriented core drilling was performed on them to obtain 6 cm long 1 inch diameter three different cores from each sample. The cores were dried with alcohol and were subsequently subjected to various treatments and finally remnant palaeomagnetism and palaeomagnetic polarity were studied with the help of spindle magnetometer. The laboratory measurements of the palaeomagnetism have suggested that the basal three flows F1, F2 and F3 of Anjar section show normal magnetic polarity, whereas the upper flows, i.e. F4, F5, F6 and F7 show a reversed polarity chron. The change in the polarity chron starts from F4. The third intertrappean bed appears crucial in view of the above polarity chron events from F3 to F4. It contains several hard and compact alternating bands of cherty limestone, chert, and marl, which could provide further resolution of the polarity chron event from Normal to Reverse. It was not possible to determine polarity chron event in the third Intertrappean bed, however, subsequent oriented drill core samples were collected from the limestone by French multi-disciplinary group in collaboration with the author, but the results are not yet received. The field test of palaeomagnetic measurements by the Flux Gate Magnetometer suggested NRNR polarity chron events.

VI.1.3. Geochronological Studies:

The samples for geochronological studies were collected from the F3 and F4 in first instance for K/Ar dating. The dating of these samples were carried out at the G.S.I. laboratory, Calcutta. The K/Ar dating for these showed 57.5±1.2 and 54.2±1.2 Ma age for flow F3 and flow F4 respectively. The samples of the same flow were collected again from same spots for $^{40}Ar/^{39}Ar$ dating. While sampling care was taken to collect fresh sample, the samples were tested at the PRL, Ahmedabad, which have indicated 65.7±0.7 Ma for flow F3 and 64.7±0.8 Ma for flow F4. Later on the entire section was sampled again covering all the seven flows of Anjar-Shinugra section. While sampling care was taken to select fresh, least altered fine grained sample from flows, as far as possible. These samples were also subjected to petrographic screening prior to final selection, and finally tested at PRL, Ahmedabad. The results are discussed in the thesis.

VI.1.4. Palaeontological Studies:

The sampling was carried out after completely exposing the section. The lithological horizons identified and lithologs were prepared before taking up sampling. The palaeontological sampling and various studies include: sampling for -

(a) micropalaeontological studies on *forams*, *charophytes*, *ostracodes* and *spore-pollens*.

(b) microsection studies of egg shell fragments, plant tissue structure and wood structure.

(c) histological studies of microsections for *Dinosaurian* bones, bone histology, skin, teeth, enamel, eggs, SEM studies of eggs, teeth and horn etc.

(d) infrared ray spectroscopy of certain samples.

(e) besides above, studies, identification of Index species/fossils was also carried out in order to establish the biozonations, based on prominent fossil forms.

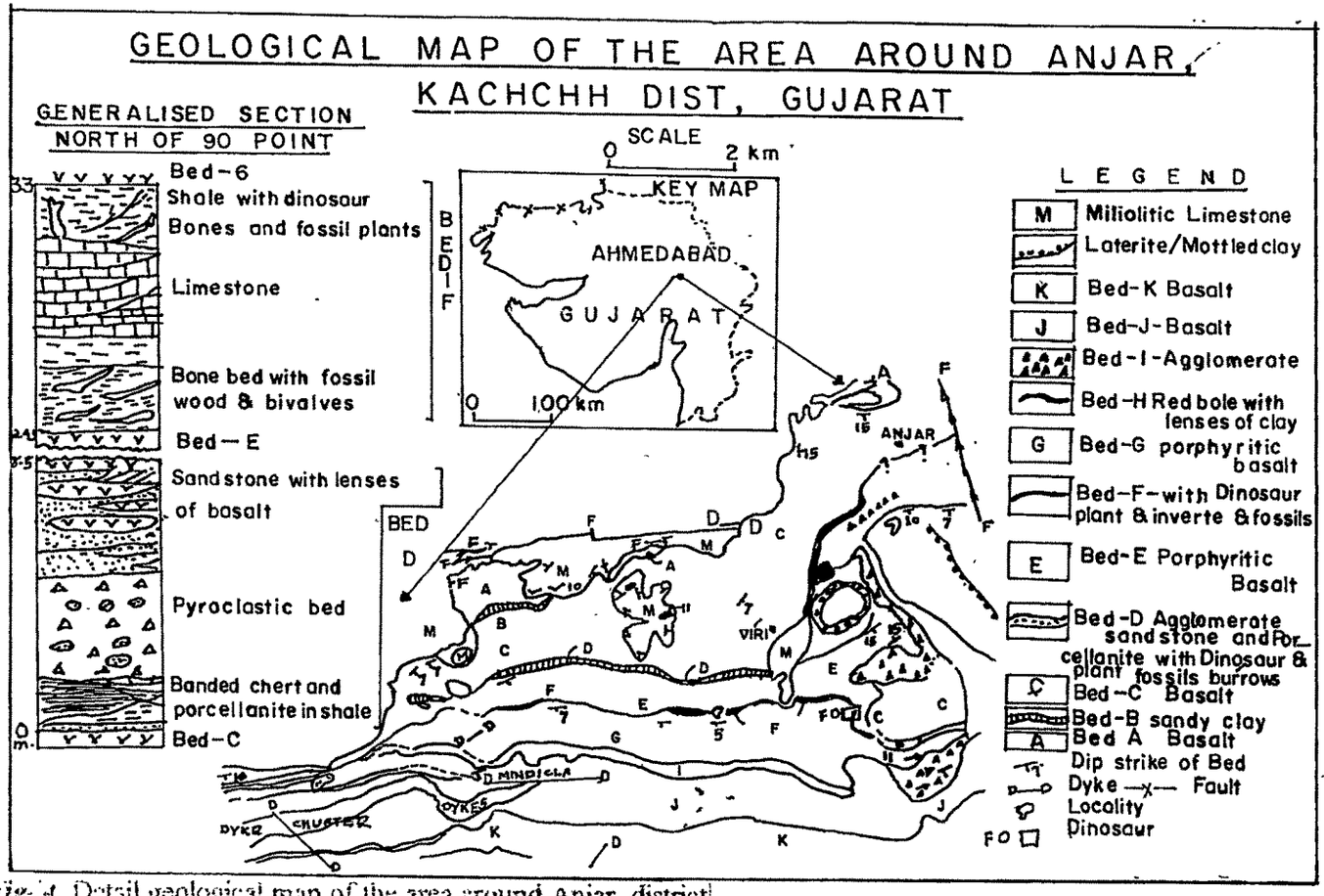

Fig. 4. Detail geological map of the area around Anjar, district Kutch, Gujarat