CHAPTER I

I N T R O D U C T I O N

General

Out of 1,86,800 sq.km. area of Gujarat State, only 74,000 sq.km. area is covered by rock exposures, and the rest is covered by a thick pile of alluvium. Aravalli group, consisting of metamorphic and igneous rocks ranging in age from 2000 to 800 million years, is exposed in the Pre-cambrian terrain of north-eastern and eastern Gujarat. The major occurrences and workable deposits of graphite are also located in the Aravallis and have attracted considerable attention both in the past and the present. Recent photogeological studies and ground checking have

indicated that graphite occurrences are confined to the metasediments.

The present investigation was undertaken with a view to explain the origin and occurrence, and to find out the industrial applications of the graphite deposits of Panchmahals and Baroda districts of the State of Gujarat.

Location

In the State of Gujarat, the major occurrences and workable deposits of graphite are located at Ankli, Sewania, Nadatod, Jhab-Redhana and Narukot villages in Panchmahals district and Virpur, Muthai, Khos, Chaena, Khodvania and Jaloda villages in Baroda district (fig. 1).

Physiography

The area is divided into two closely related physiographic units viz. hilly terrain and undulating low lying cultivated land, controlled by the lithogy and structure of the geological formations.

The hilly area is represented by flat-topped ridges of metamorphic and igneous rocks. The hill ranges composed of granites and quartzites appear north of Ankli, north of Nadatod and around Jhab-Redhana areas of Panchmahals district.

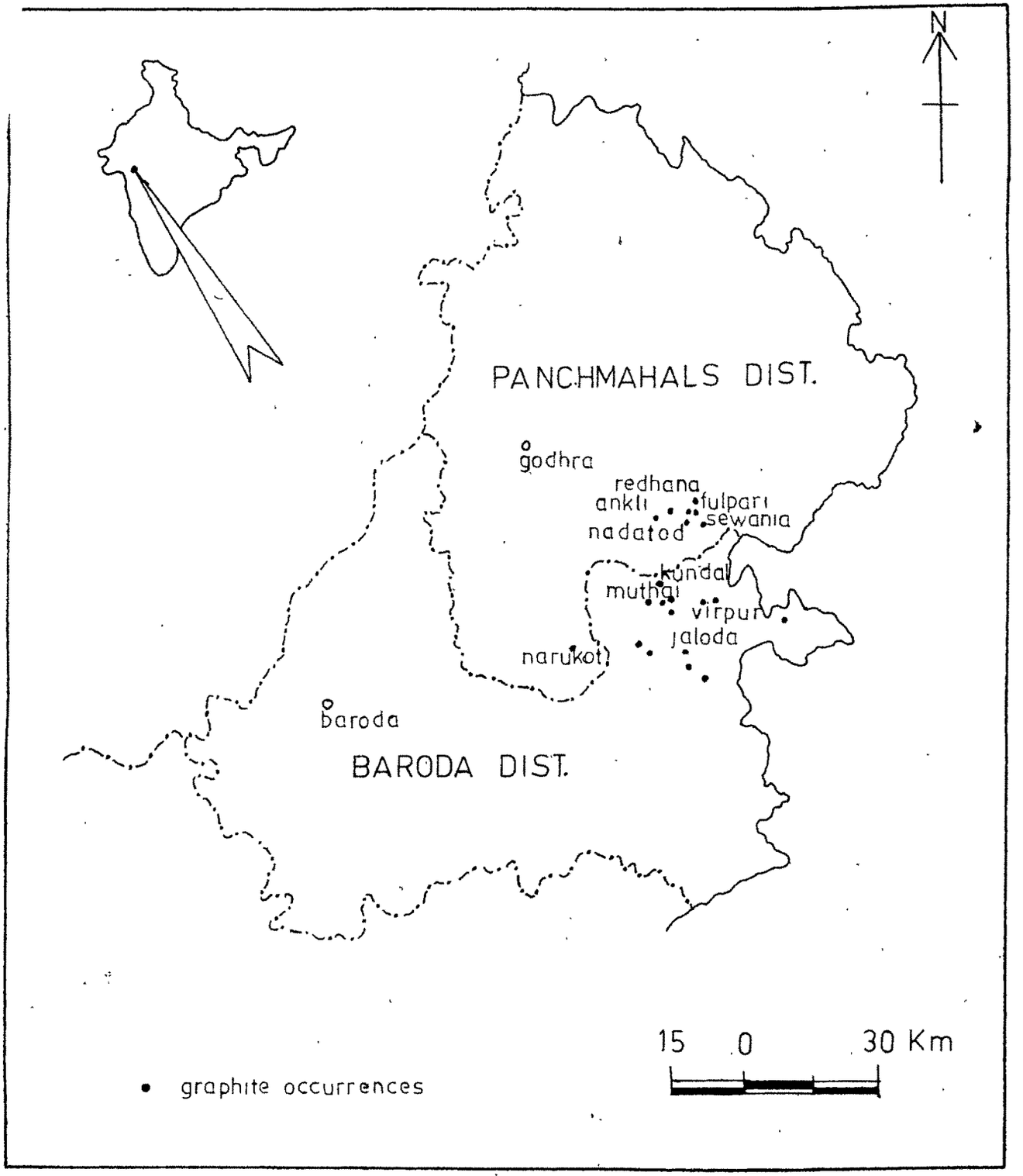

Fig.1 GRAPHITE OCCURRENCES IN PANCHMAHALS AND BARODA DISTRICTS (GUJARAT STATE).

The area is comparatively flat and is intermittently pockmarked by small hillocks. The graphite bearing area is mostly low and undulating, consisting of metasedimentaries viz. shale, phyllite and schist. Hillocks are composed of either pegmatite or granite. The crystalline limestone bands are exposed at places and are of limited extent. Near Ankli and Sewania, the area is comparatively more flat compared to other areas of Panchmahals. Panam is the only perennial river in this area, the tributary of which is flowing close to the Sewania mine. The entire region is dissected by small nalas and gullies. The drainage system forms a dendritic pattern.

The hilly terrain composed of granites and pegmatites. At Muthai, Chaena and Virpur, the graphite occurrences are confined to the low undulating ground surrounded by quartzitic and granitic hillocks. At Jaloda the graphite deposits located upto the top of the hill (150-200 ft above the ground) are exposed in the depression between the two quartzitic hills. Granitic gneiss covers vast areas and is well exposed. The isolated hillocks as well as ridges of quartzite are the prominent land features. The granite and pegmatite mainly occur as intrusives in the metasedimentary rocks. The metasedimentaries of the area consist of shale,

mica schist, phyllite, and gneiss with alternate bands of crystalline limestone, quartzite and dolomite. The area is mainly drained by two rivers Sukhi and Anir. River Sukhi bifurcates at Muthai and near Luneja villages. Its tributaries flow by the mine areas e.g. Muthai, Virpure. The course of the river for the most part, it is along the fault plane while the tributaries follow the line of fractures and joints in the rocks. The nalas and gullies are mostly dry, except during the monsoon season. The drainage pattern is dendritic.

Climate and Rainfall

The area is subjected to considerable variation of temperature. The winter season (November to February) is pleasant, during which the climate is dry and cool with maximum temperature reaching up to 25°C. The summer season (March to June) is dry and hot, during which the temperature at times goes up to 46°C. The rainy season sets in with the break of monsoon in the last week of June or in early July. During the rainy season the climate is moist. The annual rainfall varies from 750 mm (30") to 1000 mm (40") with an average of 860 mm (35") approximately.

Vegetation

The area is marked by considerably diverse vegetation. The hilly areas generally support moderately wooded jungles mostly of deciduous trees. The quartzitic and granitic hill tops and their slopes are mostly barren or covered by a few evergreen trees. On the other hand the phyllitic hill tops and their slopes are fully cultivated.

The flora of economic importance comprises of Teak (Tectona grandis), Sal (Shorea robusta), Mahuva (Basia latifolia), Kahir (Acacia Cat e chu), varieties of Eucalyptus and Mango trees. Teak seems to be prevalent throughout, growing profusely in quartzitic and granitic areas. Also Sal and Kahir are useful as timber.

Mahuva thrives well in the low lying tracts of micaceous and granitic gneisses. Apart from its value as timber tree, its flowers from which an alcoholic liquor is distilled are favourite article of food for local inhabitants.

Mango and Tamrind are very common in village areas. Among others occurring around villages, in plain areas are Eugenia Jambolana, Bor (Ziziphus Jujuba),Nim, Banyan and Pipal.

Wild-date and Palmyra (Borassus flabellifer) also grow. These are the only two species of palms commonly noticed. Many varieties of cactus are grown as fences for farms and houses. The area is characterized by scattered patches and tracts of cultivated land either on hill-tops, or in the low-lying plains. The chief crops are Wheat, Juar, Bajra (Millets), Maize, Gram, Cotton, Tur and Oil-seeds. Chillies, turmeric, sugar-cane and rice are also grown on a small scale.

Communication and Transport

Ankli, Sewania, Jhab-Redhuna and Nadatod of Panchmahals district and Virpur, Muthai, Khos, Chaena, Khodvania and Jaloda of Baroda district are connected by road with Devghad Baria and Chhotaudepur which are the terminals for meter gauge railway connecting Champaner Road and Vishwamitri respectively on the broad gauge line of the Western Railway. The mines in these areas are accessible in fair weather only by cart tracks which are linked by metalled road with Devghad Baria and Chhotaudepur. Baroda is connected with Devghad Baria by a good motorable road both via Piplod and Chhotaudepur.

Purpose and Scope of Investigation

The main purpose in undertaking the present investigation at the instance of Shri S.D. Desai, was to study the origin and occurrence of the graphite deposits and to assess the quality of graphite for industrial applications. The geological mapping of the area where graphite occurs, was carried out on a 4" to a mile scale map, enlarged from 1" Toposheets No. 46 F/14 and 14 F/15.

The Aravalli Group of rocks consisting of phyllites, quartzites, mica-schists and crystalline limestones are folded, faulted and intruded by granites, pegmatites and quartz veins. In general, the graphite occurrences are confined to low, undulating grounds with considerable soil cover. The mined sections were examined along the strike and dip of the rock exposures. The field characters which included mode of occurrence, structures, nature of variation in rock units, metamorphic variation etc., were carefully studied. Graphite-bearing mined and surface samples and the associated rocks were studied optically to determine their mineral composition, texture and structure. Proximate and chemical analysis of all graphite-bearing samples were carried out to determine the percentage of graphitic carbon and chemical composition respectively. The bulk samples

of graphite ore from four mines (Ankli, Sewania, Virpur and Muthai) were collected and beneficiated to assess their economic feasibility. X-ray Diffraction technique was used to determine the crystallinity of graphite. Scanning electron microscope was used to determine the size and shape of graphite particles.