CHAPTER-I

INTRODUCTION

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The Lower Gondwana sediments of India, because of their vast resources of coal, palaeogeographic, palaeoclimatic and palaeobotanical significance, occupy a unique position in Indian stratigraphy. They were laid down over a vast span of geological time ranging in age from Upper Carboniferous to Lower Triassic and were deposited under widely varying terrestrial sedimentary environments and varying climatic conditions. In Peninsular India these deposits occur as strings of isolated basins linearly arranged along some of the existing river valleys (Fig. 1.1). These are Sone-Damodar- Narmada valley basins trending in an east-west direction, Prahnita-Godavari valley basins trending in a northwest-southeast direction and Sone-Mahanadi valley basins trending in a northwest-southeast direction (Fig. 1.1). These Gondwana basins have been considered as tectonic troughs with faulted boundaries with the major faults confirming to the direction of strike of the Precambrian basement rocks. The preservation of Gondwana sediments along these three linear belts has been considered largely due to the boundary faults along which the basins subsided simultaneously with sedimentation. Although there are many similarities, there are also striking differences in the stratigraphy, nature of lithic fill, sedimentation trends and tectonic setting of the various Lower Gondwana basins of India (Ghosh and Mitra, 1972).

The Talchir basin (Fig.1.1) forms one of the most important coalfields of Orissa. It is an isolated basin surrounded by Precambrian basement rocks and forms the southeastern most extension of the Gondwana sediments of Sone-Mahanadi valley graben. The basin was named after the old feudatory state and town of Talcher ($20^0 57'$, $85^0 15'$) of the presently Angul district of Orissa. It is 112 km long, 29 km wide, northwest - southeast trending elongate basin spreading over an area of about 3150 km^2. The northern and southern boundaries

of the basin have traditionally been described as faulted (Blanford, Blanford and Theobald, 1856; Fox, 1934; Subramaniam, 1971; Raja Rao, 1982) and the basin has every appearance of having been preserved in the trough between these two lines of dislocation. The northern fault is marked by quartz veining and fault breccia and in one or two cases divides into branches (Pascoe, 1959). The southern boundary is also affected by a series of faults (Pandya, 1990).

Early work in the basin dates back to 1837 when Lt. Kittoe discovered the occurrence of coal near Talcher, but the knowledge on the basin was very meagre until 1856, when the basin was, first of all, mapped (Fig.1.2) by Blanford, Blanford and Theobald (1856). The strata recognized by them consist of Talchir (Upper Carboniferous), Damuda (Permian) and Mahadeva Group of Triassic age (Fig. 1.2).

The term 'Talchir Group' was introduced by Blanford et al. (1856) to give a special status to the lowermost Gondwana succession of the basin, which was devoid of coal and had a distinctly different lithology than the overlying coal bearing Damuda Goup. It is exposed over the greater part of the basin margin as a thin fringe amidst the Precambrian basement rocks and the overlying Damuda Group (Fig.1.2). They classified it into three divisions viz. Boulder bed, Tesselated sandstone and Blue nodular shales and assigned a glacial origin to the succession which has been a valuable contribution to the reconstruction of palaeogeography and palaeoclimate of the Gondwanaland. The succession is composed of boulder conglomerate (diamictite), sandstone, interbedded sandstone and shale and marlstone and shale, which represent deposition in a predominantly lacustrine environment (Pandya, 1990).

The Damuda Group, conformably overlying the Talchir Group is made up of about 750 m of strata that occupy the eastern and central part of the basin (Fig.1.2). Later, it has been classified into three Formations viz. Karharbari, Barakar and Barren Measure Formation from the base to the top (Fig.1.3). The lithologic framework of the group has been described to be conglomerate,

pebbly sandstone, coarse, medium and fine-grained sandstone, shale, carbonaceous shale and coal with a thick boulder gravel bed intervening the Karharbari and Barakar Formations. Altogether eleven coal seams have been recognized out of which only one seam occurs in the Karharbari Formation and ten seams are confined to the Barakar Formation. Succeeding Barren Measure Formation is devoid of coal seams. The Damuda strata are considered to have been deposited in a fluvial regime under humid tropical climate (Casshyap and Tewari, 1984) and the intercalated plant remains ultimately formed the coal seams.

The topmost Mahadeva Group is credited with a total thickness of about 250 m and occupies the western part of the basin (Fig.1.2). Considering the lithological makeup, stratigraphic position and plant fossils, the Mahadeva Goup has been renamed as Kamthi Group / Formation (Fig.1.3), which extended from Upper Permian to Triassic period transgressing Permo-Triassic boundary (Raja Rao, 1982; p.43). It is composed of fine to medium grained argillaceous and ferruginous sandstones at the base and a thick succession of pale greenish sandstone, shale, pink clay, ferruginous coarse and pebbly sandstone at the top. It is devoid of coal seams and was deposited under arid climate.

From the time of discovery of the basin till the present day many workers have contributed on the various aspects of the Gondwana sediments of the basin. Brief account on the regional geology, stratigraphy, structure, coal seams, and coal reserve of the basin has been given by Fox (1934), Pascoe (1959), Subramaniam (1971), Das and Rath (1974), Raja Rao (1982) and Manjrekar et al. (1995). Much work has been done on the palaeontological aspect and many mega plant fossils have been discovered and described (Das, 1958 c; Subramaniam and Nageswar Rao, 1960; Navale and Tiwari, 1965; Roy and Bhattacharyya, 1967; Khan, 1969). The petrology of coal has been described by Pareek (1963). Sedimentological study of some of the strata has been attempted by Das (1958 a, b, d); Bhattacharyya (1966); Pandya (1974, 1979, 1987, 1989,

1990). A regional northwesterly palaeoflow for the Gondwana succession of the basin has been indicated by Ghosh and Mitra (1972) and Casshyap and Tewari (1984).

Review of above literature indicates that the studies made so far do not provide adequate information about the palaeoflow pattern, provenance, depositional environments of the various formations and sedimentary response to tectonic events of the Gondwana succession of the basin, which remains as a gap in the history of sedimentation.

The southern margin of the Talchir basin near Angul (Fig.1.2, 1.3) is filled with a thick pile of Gondwana strata comprising Talchir and Damuda Group. The importance of the succession lies in the fact that it forms a part of the Type Area of the Talchir Group, which provided first ever evidences of Upper Carboniferous glaciation (Blanford et al., 1856) in the Peninsular India and the vast resources of coal associated with the overlying Damuda Group. In addition to this, wide lateral persistency of the beds, varied lithology and lithofacies, prominent cyclicity, remarkable change in lithological details from the base to the top and availability of some bore hole logs penetrating the Karharbari and Barakar Formations of Damuda group, provided an excellent opportunity to attempt a detailed sedimentological study of the area. In view of this, an area of about 140 km^2, northwest of Angul (Fig.1.3) has been taken for a detailed investigation in order to

1. Attempt a palaeocurrent analysis of the various lithostratigraphic units (Formations) with the help of available directional structures to establish the regional palaeoflow pattern.

2. Locate the position of the provenance with respect to the depositional site.

3. Assess the lithological composition of the source area and to indicate the progressive change in the lithological character of the source area in response to denudation / tectonics.

4. Interpret the depositional environments of the various lithostratigraphic units with the help of lithofacies and sedimentary cycles.

5. Link the depositional framework of the sediments to the tectonic events of the source area and the depositional site in order to build up a systematic sedimentation history.

The study, thus, shall be a first step towards basin analysis.

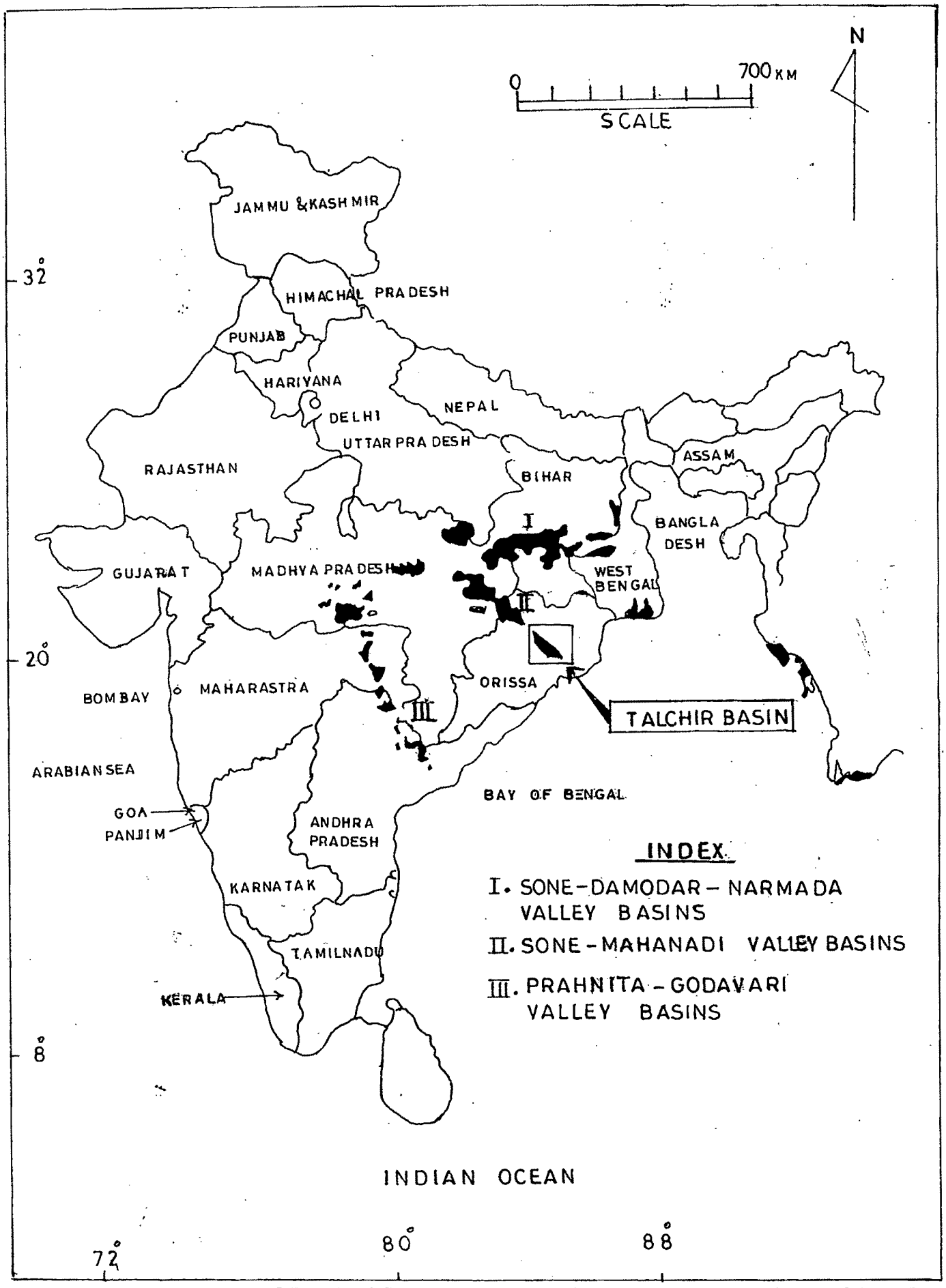

FIG. 1.1. DISTRIBUTION OF LOWER GONDWANA BASINS IN THE PENINSULAR INDIA AND LOCATION OF TALCHIR BASIN

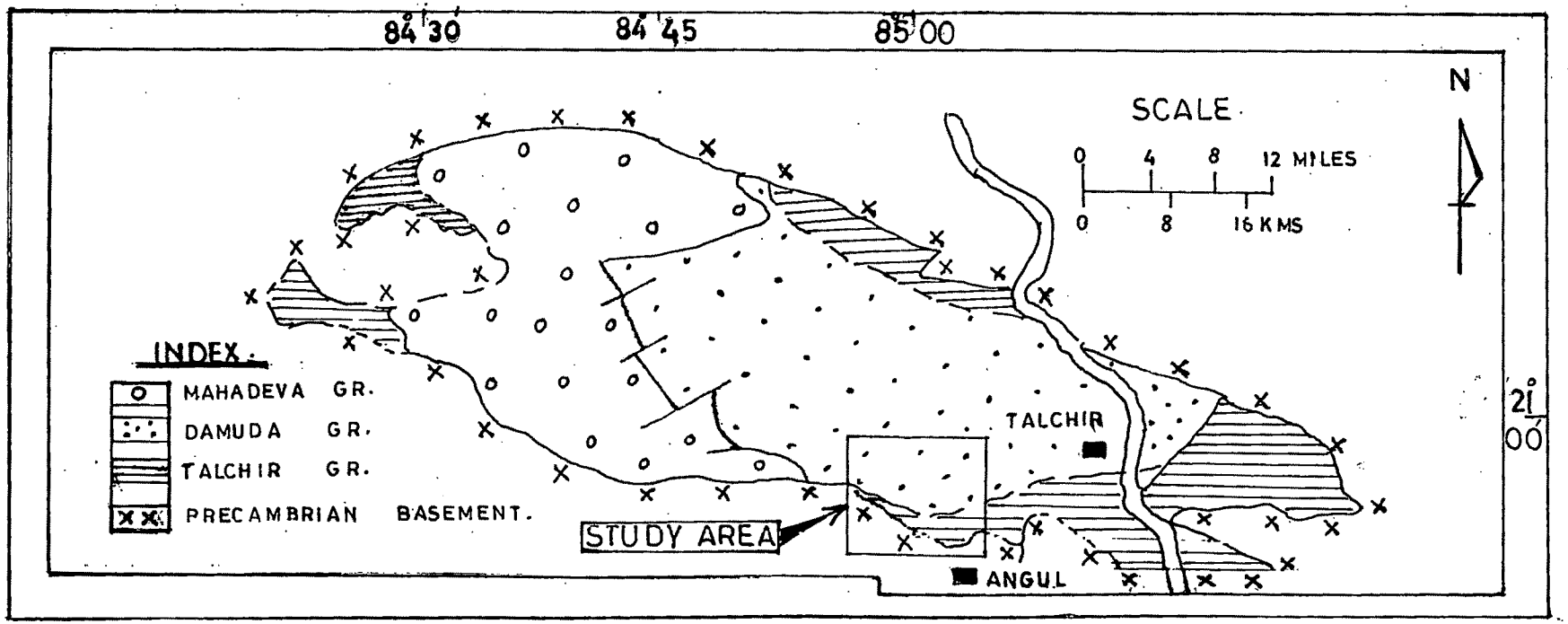

FIG. 1·2 GEOLOGICAL MAP OF TALCHIR BASIN SHOWING THE STUDY AREA

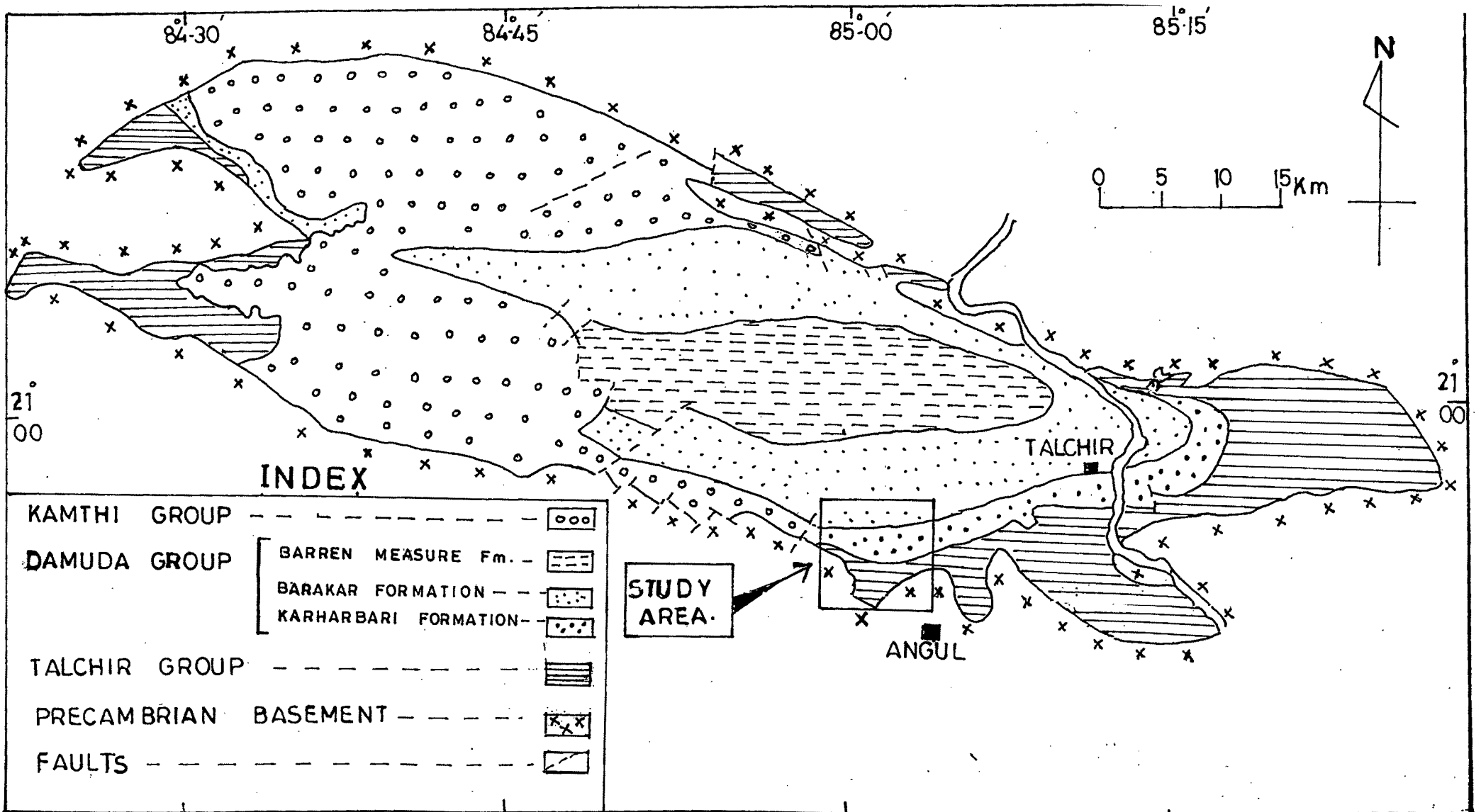

FIG. 1·3 . GEOLOGICAL MAP OF TALCHIR BASIN SHOWING AREA UNDER STUDY AND RECENT CLASSIFICATION OF DAMUDA GROUP