

## LINEAMENTS IN THE COASTAL ZONE OF GOA

B. G. Wagle

*National Institute of Oceanography, Goa*

### ABSTRACT

The paper describes the lineaments in the coastal area of Goa identified on aerial photographs and their correlation with the lineaments reported from the adjoining areas. The majority of lineaments along the coastal part of Goa follows a NW-SE, NE-SW and a few ENE-WSW trends. The NW-SE direction is predominant and corresponds with the regional Dharwarian trend followed by NE-SW trending linears due to cross folding of Dharwar Orogeny.

### INTRODUCTION

The study of lineaments, also called trend and fracture lines, has attracted the attention of geologists in India for over a decade. Grady (1971) based on an integrated analyses of aerial photographs and results of the air borne geophysical surveys followed by field checks produced an interesting map showing the relation between fault zones, intrusives and mineral deposits in the Eastern Ghats, North South Arcot, Salem and Dharmapuri Districts. Das and Roy (1976) noticed a system of fracture lines along the west coast of India from Bulsar to Rajapur parallel to the line of hot springs and dyke swarms of the Parnel area of west coast (latitude 16° 30' to 20° 40' N). Desai and Peshwa (1977), with the help of LANDSAT Imagery and aerial photographs of the southern part of Goa concluded that the Manganese mineralisation is localised along NNW-SSE to NNE-SSW fractures. Desai and Peshwa (1978) explained the drainage anomalies along the west coast area (North of Bulsar to Goa) due to lithologic and structural controls. However, very little information is available on the regional structure especially the lineaments in the Goa area. Goa forms the northern most extension of Dharwarian rocks along the west coast. In the northern part of Goa the Dharwars are covered by Deccan Traps. The study of the lineaments in the Goa area will be of considerable value in understanding the relationship of older lineaments in the Dharwars and their relation and reactivation, if any, in the younger Deccan Traps. As a part of photo-geomorphological study of coastal areas of the country a detailed study of the Goa Coast is in progress at the National Institute of Oceanography. The area under the present study covers the "Coastal Tract" and part of the "Sub Ghat" region of Goa (De Souza, 1965).

A set of panchromatic black and white aerial photographs of the area on a scale 1:25,000 and 1:15,000 (approx.) were examined under a stereoscope for lineament study. The interpreted images were made into a mosaic which provided an overview of the area and thus helped in the identification of the lineaments (Fig. 1).

## GEOLOGY AND STRUCTURE

The area is mostly covered by Dharwarian rocks, which include quartzites, phyllites, chlorite schists, gneisses, granites, metabasalt, metaconglomerates, metagreywakes, banded hematite quartzite, and other basic and ultrabasic intrusives. The Dharwars are covered in the northeastern part by Deccan Traps and laterites. The laterite is thick in the coastal area and is thin in the interior Ghats. The basaltic flows are horizontally layered and unconformably overlie the Dharwars. The older rocks and laterites are covered by Recent and Sub-Recent sediments i.e., lateritized soil cover, river alluvium and coastal dunes and beach sands.

The regional trend of bedding and foliation in the northern part of the area is NNW-SSE and in the southern part almost E-W. The area has passed through three distinct episodes of folding, all of Dharwarian age. The first folding took place along an E-W axis and the anticlines and synclines produced are of cylindrical nature. The second folding of intense nature took place along a NW-SE axis while the third folding of feeble intensity along a WNW-ESE axis (Wagle and Misra, 1975).

## LINEAMENTS

Within the area of study, 137 lineaments were recorded (Fig. 1) and they are manifested in various ways as follows :

### **Lineaments due to incised fractures**

In areas of topographic relief, erosion has cut down into some of the joints and faults giving straight and narrow valleys. Lineaments of this type are very common throughout the study area.

### **Vegetation Lineaments**

The majority of lineaments in the southern part are observed as linear trends in an otherwise patternless forest. Such trends result from alignment of trees or from a linear gap in the tree pattern. It is possible that such lineaments are the result of fractures in the bedrock which in turn affect the drainage, texture and composition of the soil cover.

### **Vegetation change lineaments**

Few lineaments in this area are manifested by a change of vegetation along (linear) fractures and can be traced along the southern coast of the area only. Lineaments of this type may also be the result of fracture in the bed rock affecting the drainage, texture and composition of the soil cover.

### **Lineaments expressed in stream courses**

Many of the rivers and stream in the northern part (Tiracol and Chapora) partly follow a linear course i.e., fractures.

### **Lineaments due to abrupt linear topographic changes**

Some lineaments are manifested by an abrupt change of topographic level.

## **RESULTS AND DISCUSSION**

On the basis of present study it is concluded that the lineaments in Goa are not randomly distributed but appear to be grouped in sets. The majority of lineaments along the coastal part of Goa follow a NW-SE, NE-SW and a few ENE-WSW trends. The NW-SE direction is predominant and corresponds with the regional Dharwarian trend followed by NE-SW trending linears due to cross folding of Dharwar Orogeny. The distribution of lineaments when compared with the rock types indicates that the lineaments are distributed regardless of the type of rock but are more common in Chitradurga group (Radhakrishna and Vasudev, 1977). Several distinct lineaments have been recognised in the area but the maximum intensity is in a NW-SE direction. (Rose diagram Fig. 2a). The trend corresponds well with the strike of beds and foliations i.e., regional Dharwarian trend shown in the rose diagram (Fig. 2b). Though the area has undergone three distinct episodes of folding viz., E-W, NW-SE, WNW-ESE (Wagle and Misra, 1975), most of the lineaments appear to have been formed during the intense NW-SE folding only. The other prominent trend of lineaments is NE-SW to ENE-WSW-i.e., normal to the major trend. These may be the linears resulting from cross folding of Dharwar orogeny. Desai and Peshwa (1977) have reported similar NW-SE, NE-SW and ENE-WSW trends, for the manganese mining belt in Goa.

Most of the dykes along the coast of Goa exhibit NNW to WNW and ENE to NE trend (Fig. 2c). The orientation of the dykes corresponds well with the lineaments and possibly the dykes follow the weak zones. From the configuration of the coast and associated linear features, it is clear that the present shape of the northern part of the coast is controlled by the lineaments while along the southern part the outline is highly sinuous and is far from straight.

According to Das and Roy (1976), all the hot springs or groups of hot springs along the west coast in Maharashtra occur along NNW-SSE trending

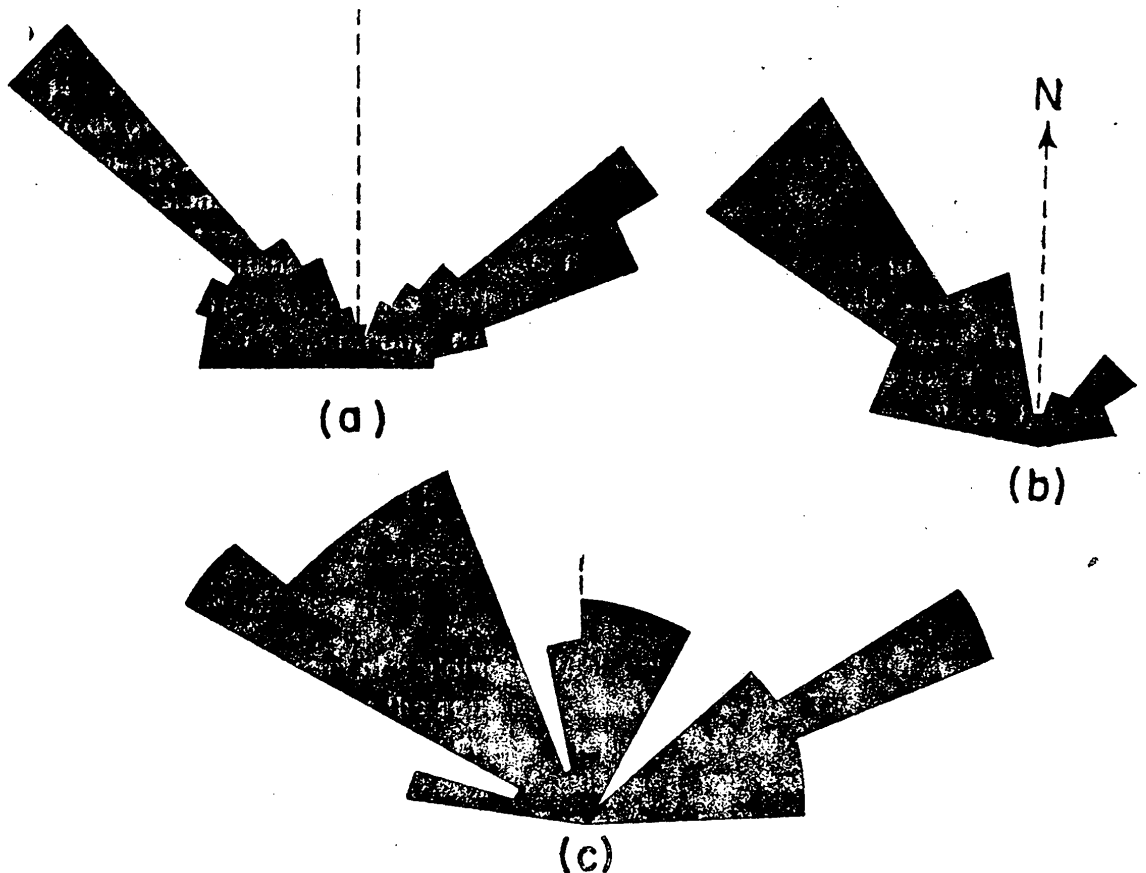


Fig. 2. Rose diagrams

a) Lineaments along Goa Coast    b) Dharwarian Trend    c) Dykes along Coast

linears. The Koyna area (Raina, 1972; Das and Roy, 1973; Peshwa, 1976) shows NW-SE, NNW-SSE and NE-SW trending linears. Deep seismic sounding along Koyna I and Koyna II profiles (Kaila *et al.*, 1959) reveals a major NNW-SSE fault immediately west of Koyna.

Some of the lineaments in the Deccan Traps north of of Goa reported by Das and Roy (1976, 1977), and Desai and Peshwa (1978) follow NW-SE, NNW-SSE, NE-SW and ENE-WSW trends. Kafkasam (1969, 1972) based on the study of gravity anomalies reported that the fractures in the Deccan Traps extend down to the basement.

Some of the lineaments associated with the hot springs in (NNW-SSE) Deccan Traps and those in Koyna (NW-SE, NNW-SSE and NE-SW) area, may represent a reactivation of the lineaments in the older Precambrian rocks and basement (NW-SE, NE-SW and ENE-WSW). This, however, would require detailed studies of Goa area particularly at the boundry of Traps and Dharwars.

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