

CHAPTER 3 GEOMORPHOLOGY

3.1 General Geomorphology

Geomorphologic map of the study area and its adjacent area is shown in Fig. 3.1-1. In general, topography of the study area is flat as its average gradient 2/1000. Elevation of it is decreased toward southeast from 1,500m to 950m.

3.2 Methodology of Geomorphologic Analysis

Six scenes of LANDSAT/TM images and 427 sheets of monochromic aerial photographs were prepared for this analysis. LANDSAT/TM images are printed materials, whose band combination is 2, 3 and 4 assigned to the colors; blue, red and green respectively as the natural color composites. Used LANDSAT/TM images are listed up in Table 3.2-1. The aerial photographs were acquired in 1997 and 1998 in approximately 1:80,000 scale.

Table 3.2-1 List of LANDSAT Image Data

Satellite Name	Path/Row	Data Acqui.	Sun EL.	Sun Az.	Projection
LANDSAT/TM5	P176/R076	31DEC86	52	98	UTM
LANDSAT/TM5	P176/R077	31DEC86	52	97	UTM
LANDSAT/TM5	P176/R078	31DEC86	52	95	UTM
LANDSAT/TM5	P177/R076	26AUG84	40	53	UTM
LANDSAT/TM5	P177/R076	26AUG84	39	52	UTM
LANDSAT/TM5	P177/R078	26AUG84	39	51	UTM

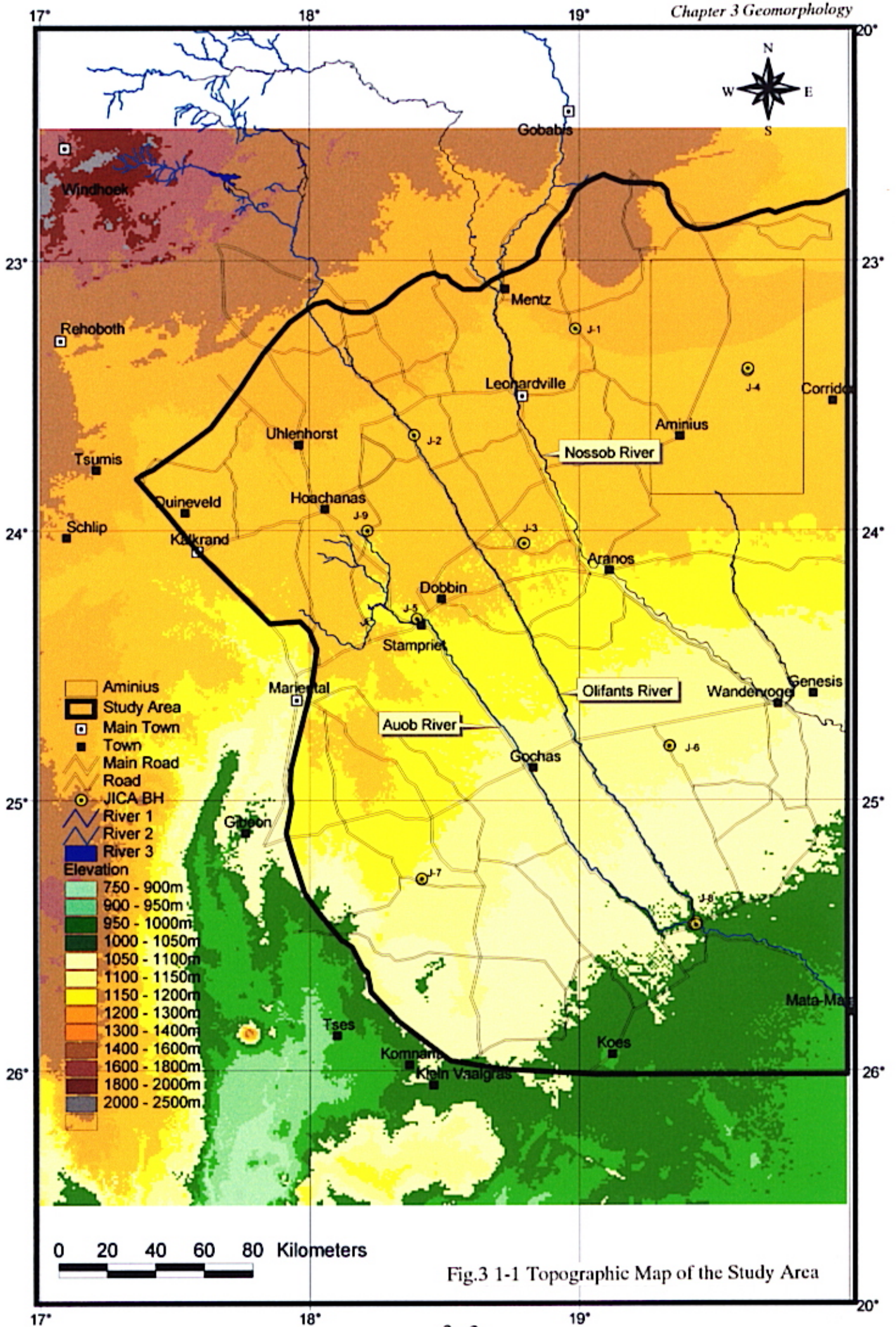


Fig.3 1-1 Topographic Map of the Study Area

3.3 Geomorphologic Characteristics

The geomorphologic interpretation chart is shown in Table 3.3-1. Interpretation results of geomorphologic characteristics are shown in Fig. 3.3-1.

The characteristics of geomorphology are closely related to the geology of the study area. Most of the areas where Kalahari calcretes crop out show significantly flat. However, the western and southern parts of the study area form cliffs or steep slopes, where Prince Albert Formation, especially its sandstones of Nossob and Auob Members, basalts of Kalkrand Formation and dolerite sills are distributed widely. These features provide three categories of hilly topography that they are called high, moderate and low hills in relation to their altitudes, textures and so on.

As surface conditions, sand dunes and other sand covers, bedrocks and vegetation are classified through this interpretation. The sand dunes developed in the northern and central part of the study area indicate typically linear shapes in all sizes, affected by seasonal winds in NW-SE direction. These dunes and other sand covers seal bedrocks underneath. Vegetations are mainly composed of natural colonies, but cultivated areas represented by Hardap irrigation project are apparently extracted from the images.

Drainage is divided into two groups. One is an external drainage such as surface streams and the other is an internal drainage, which is called as "Pans" in this district developed from sinkholes of dolines or uvalas in the distribution area of Kalahari Beds. They show almost circular or ellipse shapes with numerous sizes in their diameters.

Table 3.3-1 Geomorphologic Interpretation Chart

Unit Name	General Altitude	Geomorphology	Other Ground Surface Characteristics
Hh	High	Hill	Even and inclined with smooth surface
Hm	Moderate	Hill	Even and very smooth surface
Hi	Low	Hill	Rough texture
Sd	-	Linear	Yellow colored linear texture with N-S direction
Bd	Low	Rough to very rough	Colors and geomorphology depending upon their geology
Vg	-	-	Generally sparse

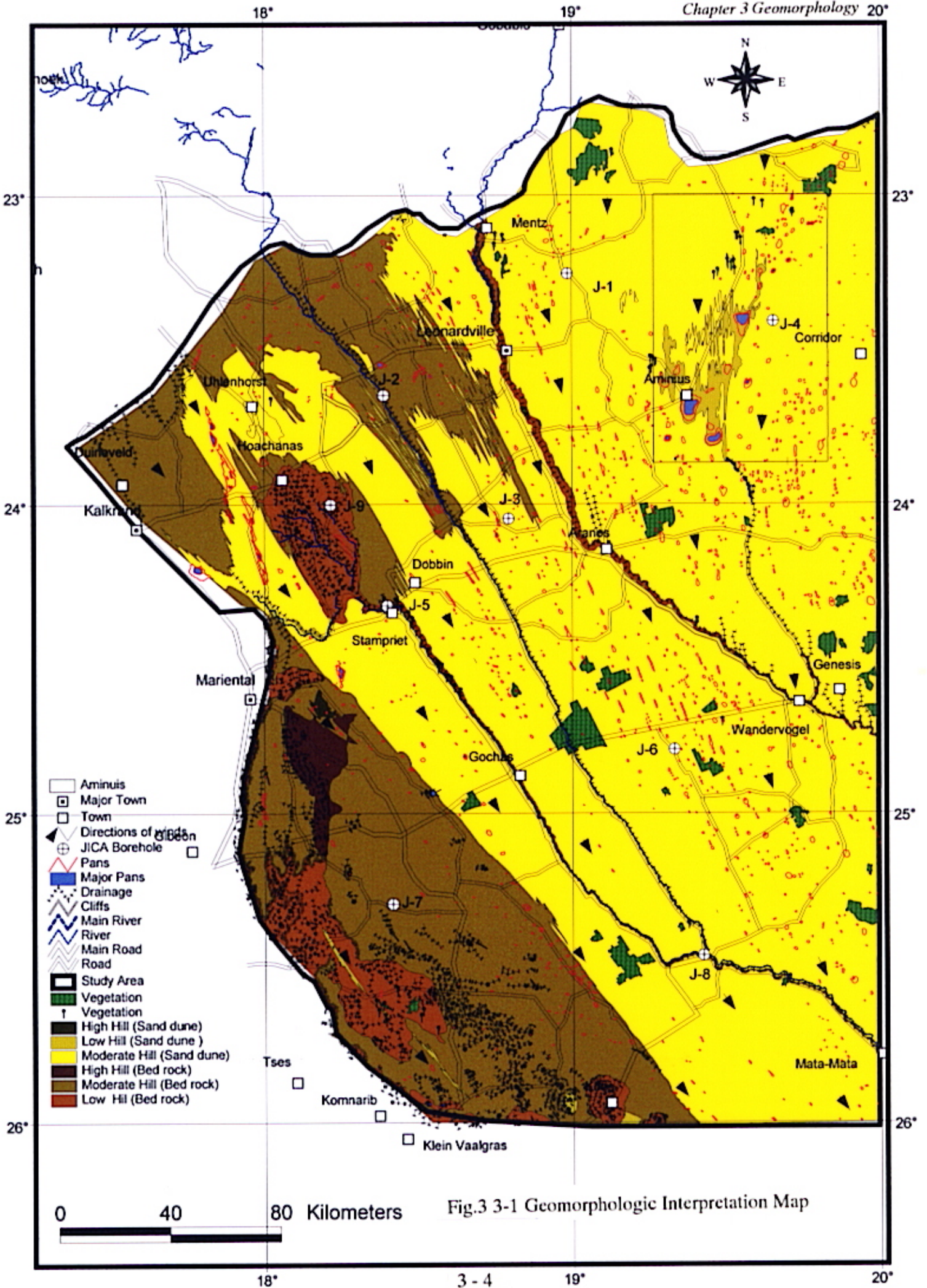


Fig.3 3-1 Geomorphologic Interpretation Map