N87-17137

SPACE SHUTTLE RADAR IMAGES OF INDONESIA

Floyd F. Sabins
Chevron Oil Field Research Company
La Habra, California

John P. Ford
Jet Propulsion Laboratory, California Institute of Technology
Pasadena, California

Sabins (1983) interpreted SIR-A images of Indonesia; Sabins and Ford (1985) interpreted SIR-B images. These investigations had the following major results: (1) major lithologic assemblages are recognizable by their terrain characteristics in the SIR images and (2) both local and regional geologic structures are mappable. This report summarizes these results.

I. TERRAIN CATEGORIES

Erosion of various rock types produces terrain categories with distinctive features in radar images. The following terrain categories are illustrated in Figure 1 and described below.

Coastal and alluvial plains (Figure 1A) are characterized by low relief and numerous meandering streams. Brightness differences are caused by differences in vegetation cover. Figure 1A along the southeast coast of Kalimantan includes patches of mangrove which produce a distinctive bright tone.

Clastic terrain (Figure 1B) is underlain by sandstone and shale which form distinctive terrain caused by differential erosion of resistant sandstone and nonresistant shale. In areas of horizontal to gentle dips, the sandstones form table lands underlain by shale slopes. In areas of moderate to steep dips, sandstone forms broad dip slopes with narrow, steep antidip scarps. Shale forms linear valleys. Where beds are dipping toward the radar antenna, dip slopes have extensive bright signatures; antidip scarps are shadowed and have dark, narrow linear signatures. Highlights and shadows are reversed where beds dip away from the antenna.

In tropical climates, carbonate rocks (Figure 1C) weather to karst topography which has a characteristic pitted appearance caused by closely spaced pinnacles and depressions caused by solution and collapse. Karst terrain is expressed as closely spaced, irregular highlights and shadows in radar images.

Volcanic terrain (Figure 1D) consists of cinder cones, eroded necks, lava flows, and other landforms that are recognizable by their morphology. These landforms are only recognizable in relatively young volcanic terrain. Older volcanic areas that have been eroded and deformed lack the distinctive morphologic features.

Melange rocks (Figure 1E) form in the collision zones between crustal plates and consist of slabs and blocks of a wide range of oceanic rocks in a shaley matrix. Erosion produces an irregular arrangement of rounded hills and ridges with an unsystematic drainage pattern.

Metamorphic terrain (Figure 1F) formed on metamorphosed clastic strata consists of angular ridges and steep valleys. Metamorphism has obliterated any topographic expression of the original stratification.

II. GEOLOGIC STRUCTURE

Sabins (1983) illustrated and interpreted SIR-A images of the major types of local and regional geologic structures in Indonesia. Figure 2 shows additional examples of local structures as imaged by SIR-B.

Folds are expressed by attitudes of beds (strike and dip) and by outcrop patterns. An oval-shaped syncline along the Kendilo River, Kalimantan, is shown in the SIR-B image and map (Figure 2A,B). The structure is outlined by ridges of dipping clastic strata with the dip directions oriented radially toward the center of the structure.

A regional unconformity (Figure 2C,D) is expressed by a horizontal erosion surface that truncates underlying folded clastic strata in northwest Borneo. Elsewhere in this area the images show layers of horizontal clastic strata and volcanic flows overlying the unconformity surface which indicates that this is not a modern erosion feature.

Lineaments (Figure 2E,F) are expressed as straight and aligned stream segments and as linear scarps. Many, but not all, lineaments are the expression of faults and fractures that are preferably eroded.

Figure 3A is a SIR-B image strip in southwestern Kalimantan that shows the expression of regional structures. The interpretation map (Figure 3B) shows a moderately eroded anticline and syncline in the southeastern area (right portion) that are well expressed in the image. In the northwest part of the image, folds are more deeply eroded and less prominent. Nevertheless, these subtle features are detectable because of the highlights and shadows in the radar image. The rocks are predominantly sandstone and shale with some limestone beds that form karst topography.

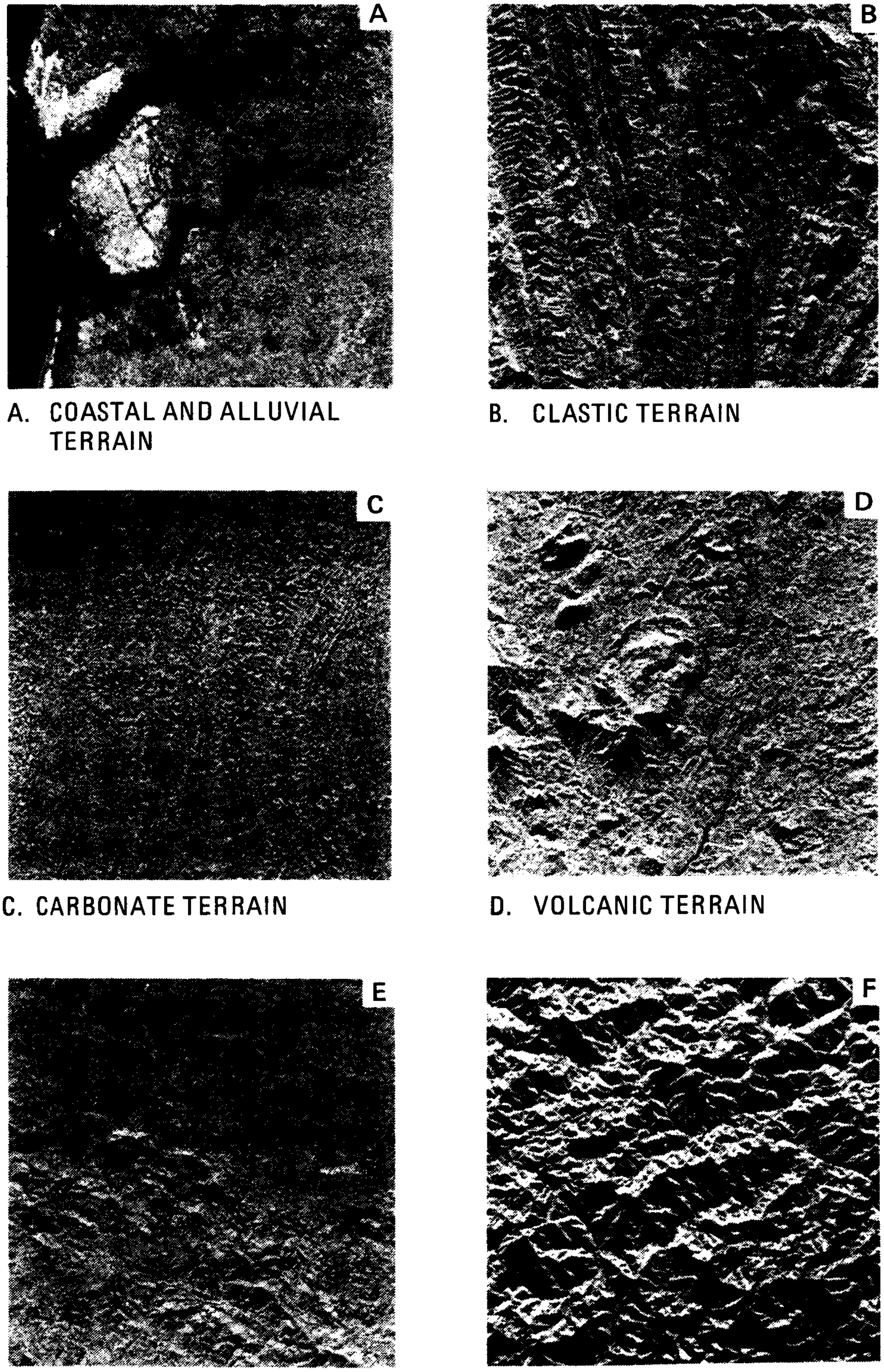
III. SUMMARY

SIR-A images of Indonesia acquired in 1981 were interpreted earlier to develop criteria for recognizing lithologic terranes and structural features. SIR-B images acquired in 1984 provide the opportunity to study additional areas in Kalimantan and Sumatra. The earlier interpretation criteria are applicable to these new images.

REFERENCES

Sabins, F. F., 1983, Geologic interpretation of Space Shuttle radar images of Indonesia: American Association Petroleum Geologists Bulletin, v. 67, p. 2076-2099.

Sabins, F. F. and J. P. Ford, 1985, Space Shuttle radar images of Indonesia: Indonesian Petroleum Association, Proceedings, Fourteenth Annual Convention, v. 2, p. 471-476, Jakarta, Indonesia.



A. COASTAL AND ALLUVIAL TERRAIN

B. CLASTIC TERRAIN

C. CARBONATE TERRAIN

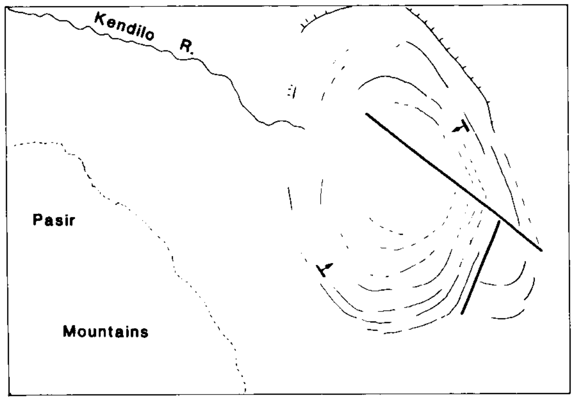
D. VOLCANIC TERRAIN

E. MELANGE TERRAIN

F. METAMORPHIC TERRAIN

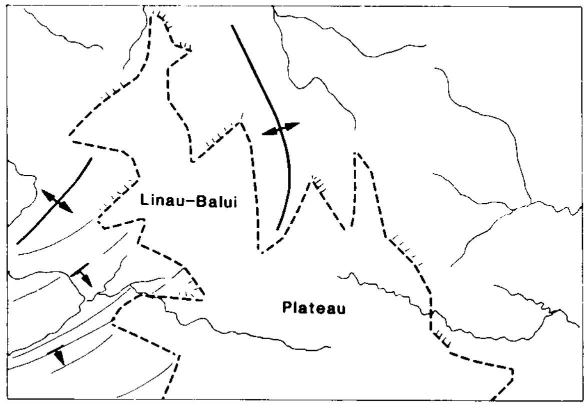
Figure 1. Terrain types in SIR-A and -B images of Indonesia; each image covers an area of 30 by 30 km

A. SYNCLINE

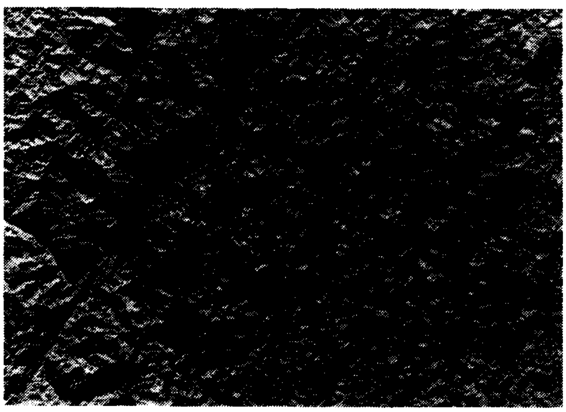


B. MAP

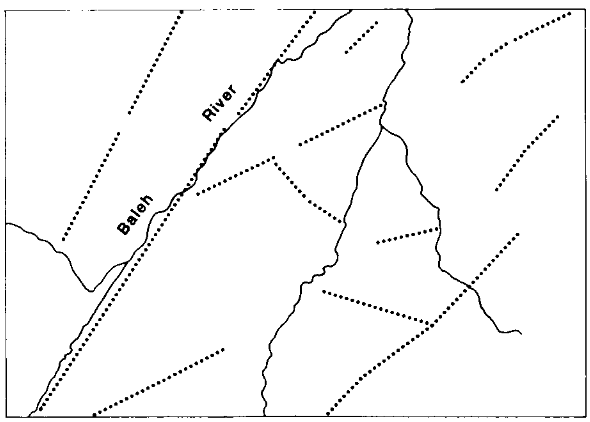
C. UNCONFORMITY



D. MAP



E. LINEAMENTS

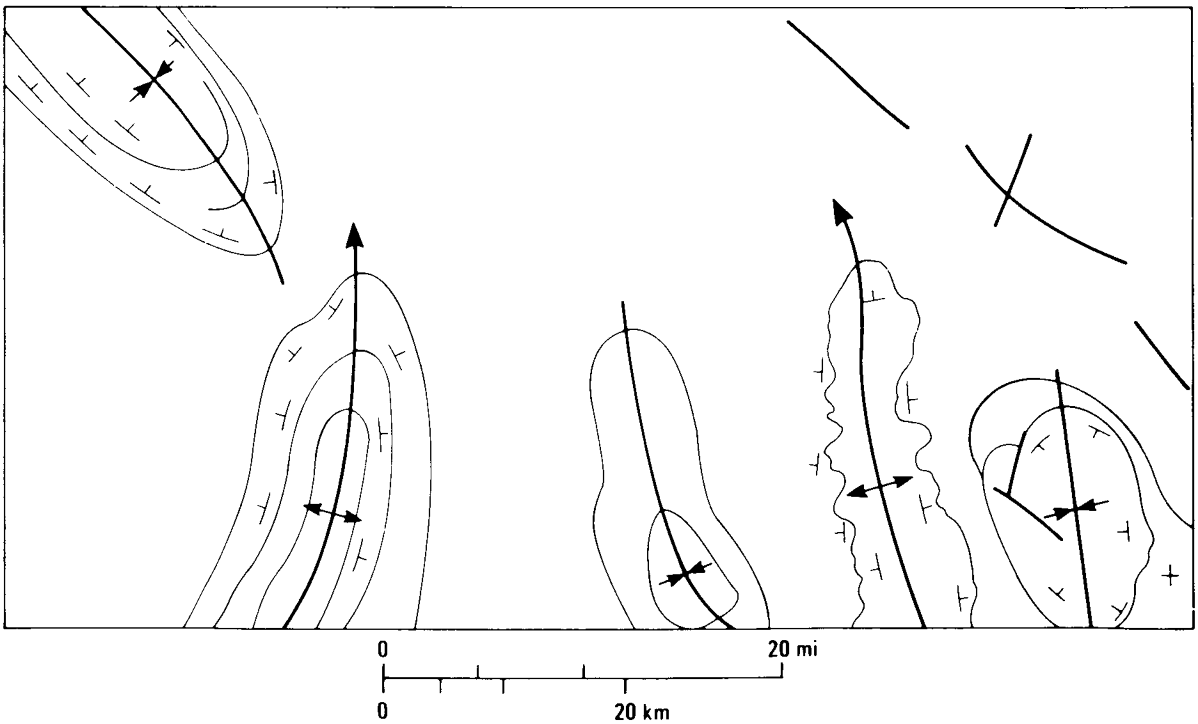


F. MAP

Figure 2. Local structures in SIR-B images of Kalimantan, Indonesia; each image covers an area of 20 by 30 km

ORIGINAL PAGE IS OF POOR QUALITY

A. SIR-B IMAGE ACQUIRED OCTOBER 1984 WITH A 48° DEPRESSION ANGLE.



B. GEOLOGIC INTERPRETATION MAP.

Figure 3. Regional geologic structure on SIR-A image of southeast Kalimantan, Indonesia