SOME AMBIGUOUS FEATURES FOR GEOLOGIC INTERPRETATION

H. D. Tjia

Department of Geology

ICHTISAR

Penulis telah mendjumpai beberapa gedjala geologi jang mempunjai arti berlainan dari pada jang biasa dikemukakan oleh "textbooks"; antara lain ditemukan facet-facet segitiga jang terbentuk pada dipslope tjuram, kesan kasar sepandjang slickenside jang menundjukkan arah gerak sesar, dan sumbu-sumbu memandjang dari batuguling jang berkedudukan tegak terhadap arah pengangkutan.

ABSTRACT

Among geologic features, which do not indicate phenomena claimed by textbooks, are triangular facets developed on steeply inclined dipslopes, sensation of coarseness that does indicate the sense of fault displacement, and orientations of long pebble-axes perpendicular to transport direction. Examples of these features are demonstrated.

TOPIC DESCRIPTION

In the course of fieldwork the writer has encountered a number of geologic phenomena which, taken at face value, will have been interpreted wrongly. This note describes such features which comprise morphological, structural, as well as sedimentological criteria.

EXAMPLES

1. Triangular facets represent a geomorphic phenomenon which is generally assumed to indicate remnants of faultplanes. The facets occur as truncated spur ends and mark an intermediate stage of erosion of the fresh fault scarp to the faultline. The Lembang fault scarp is partially facetted, especially near Tjisarua approximately 15 km NNW of Bandung.

Triangular facets, however, were also observed on steep dipslopes without faulting near Tomo, West Java. A facetted scarp is displayed on steeply inclined dipslopes of volcanic arenaceous and rudaceous strata of the so called Tjilutung beds (Middle Pliocene); see figure 1. These facets have an essentially similar development like those on fault scarps. After the steeply inclined bedding planes have become exposed, continuous gullying has carved the dislope into patches, first into more or less trapezoidal shapes and later becoming triangular planes. Triangular facets on dipslopes appear to be conditioned by very steep inclination and the presence of ridgeforming beds bordering to weak layers.

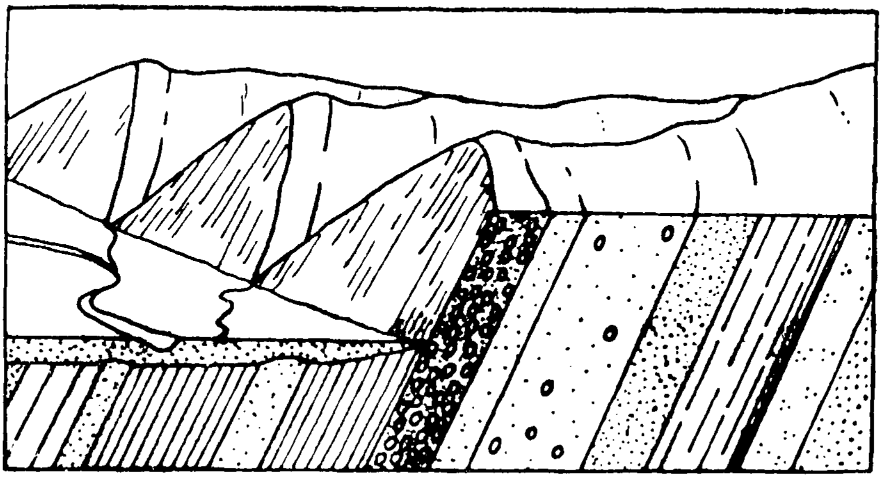

Fig. 1. Diagram of triangular facets developed on steep dipslopes consisting of ridge-forming rock adjacent to weak strata. Such a phenomenon is to be seen on the Tjilutung dipslopes located between Tomo and Parakankondang, West Java.

2. From the literature we know the Kei islands in the Banda Sea to be tectonically unstable. Verbeek (1908) reported on the formation of Ut island accompanied by earthquakes in 1852. Therefore, when we first saw a few circular depressions on the reef flat near Kolseer village, Kai Minor group (figure 2), we tried to interpret the pits as representing diapiric activity. These depressions are about 10 m across surrounded by a low, fractured rim of some decimeters height and 2 — 3 m wide, with inward facing slopes steeper than those sloping outward. Fractures in the rim are oriented radially as well as concentrically with respect to the depressions. The deepest part of the pit in the center is about 1 m deep.

Also influenced by the occurrence of mudvolcanoes elsewhere in the islands, the writer favoured a natural explosive origin for the pits. Luckily, the Kolseer villagers saved the author from embarrassment and stated that the depressions are bomb craters left by an air raid on the neighbouring airstrip during the Pacific War.

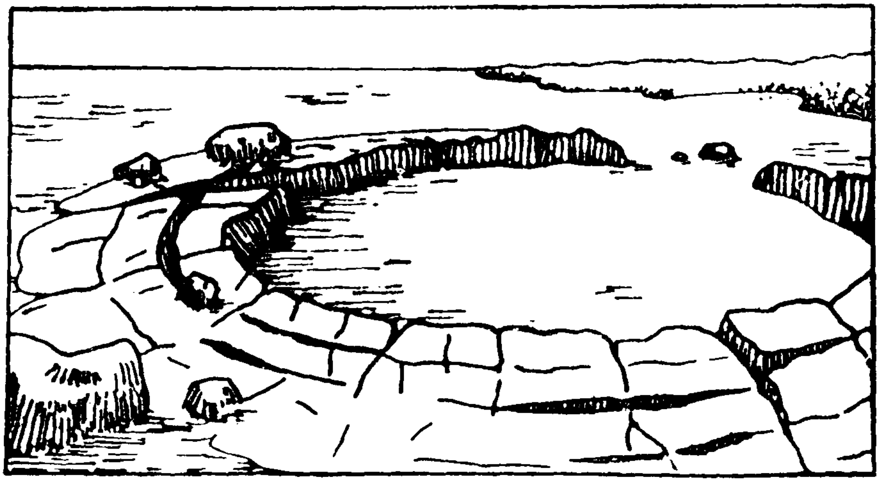

Fig. 2. A bomb crater in the reef flat near Kolseer village, Kai Minor islands. Note concentric and radial fractures in the limestone. The diameter of the pit is 10 m.

3. F a b r i c analyses of gravels generally state that long pebble-axes are oriented paralled to the direction of transport. Potter and Pettijohn (1963, p. 36) cited examples of pebble orientations perpendicular to current direction. Rods and ellipsoids in beach gravel are believed to lie parallel to the strandline. In streams both types of orientations have been observed. The orientation perpendicular to transportation direction has been explained in terms of larges size, ellipsoidal shape, and rolling, whereas the smaller particles do not show so distinct an orientation on account of filling-in open spaces left among the larger pebbles. Rod-like particles are said to be more likely oriented perpendicular to the direction of transport, except on foresets where these shapes tend to parallel the transportation direction. Potter and Pettijohn (1963) concluded hat pebble orientation seems to be governed by shape, size, and probably also by packing density, sorting, and stream gradient.

The writer has noted elongated pebbles in stream gravels of Java to be predominantly oriented perpendicular to the stream flows. These pebbles are also imbricated with inclinations upstream.

Rod-shaped stem fragments of ACROPORA like corals on the sandy beaches of Dobo, Aru archipelago, and Tolehu, Ambon, have preferred orientations of their long axes perpendicular to the strandline. The coral fragments vary from a few to 10 centimeter lengths and possess diameters of

1 cm or less. Where elongated pebbles of denser rock, like granitic pebbles on Tolehu beach, occur together with the ACROPORA stems, the long axes of the heavier particles are mainly oriented parallel to the waterline (60%, see Tjia, 1965, p. 57). The remainder is oriented diagonally (almost 26%) or perpendicular (13%) to the strandline. It was also noted that the two last mentioned orientations mostly consist of smaller pebbles than those lying parallel to the beach. Figure 3 is a tracing of a photograph showing fragment orientations on Tolehu beach.

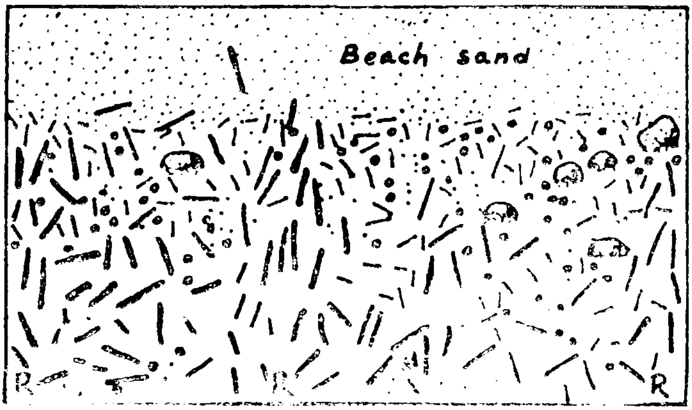

Fig. 3. Strips of aligned coral stem fragments (laths) separating broader areas where on particular orientation is discernible. The strips of aligned coral stems may indicate paths of small rip currents (R). Also note the orientation of long axes of granitic pebbles parallel to the strandline. The lower side of the figure is the seaward side.
The long dimension of the figure represents about 1.5 m.

From the writer's observations the following inferences are drawn concerning gravel fabric.

a. Elongated shape.

b. Size. Larges and heavier objects are apparently stable when their longitudinal axes lie perpendicular to the direction of movement, whereas lighter particles attain stability through parallel orientation with the current.

c. Ratio of current velocity and pebble density. A low ratio seems to favour parallel alignments of long pebble axes and current direction.

d. Packing density. The closer the packing the more abundant are orientations departing from the predominant orientation of long pebble-axes.

4. Sensation of smoothness which one obtains when stroking a fault surface parallel to its slickensides, should indicate the direction of movement of the adjoining fault face. All textbooks advocate this method to detect the sence of fault displacements. Recent laboratory and field experience conclusively show that most fault-plane features actually are oriented with their steeper, and therefore, coarser sides facing into the direction whence the adjacent fault plane came and yielding a sensation of coarseness when stroked in the sense as stated above. The protuberances on fault surfaces comprise secondary fractures, gouge marks, and results ot stick-slip and spalling (Paterson, 1958; Tjia, 1964; Riecker, 1965; Tjia, 1967). Fault-plane features which give the sensation of smoothness as expected by the classical method do also exist and represent the effects of plucking and smoothing of irregularities through masking with finegrained mylonite. Interpretation of sense of fault movement should, therefore, be based on a study of individual fault plane markings rather than relying on touch.

In Indonesia the author observed fault plane features, which render sensations of coarseness in the sense of fault movement, from faults within pre Tertiary and Tertiary rocks of the Lokulo area; Central Java (1966), a young fault plane of presumably less than 50 years age in Neogene limestone near Dobo, Aru islands (in press), and on many slump faces in Neogene as well as younger argillites in Java.

REFERENCES

Paterson, M.S., 1958, Experimental deformation and faulting in Wombeyan marble: **Geol. Soc. America Bull.**, v. 69, 465 — 476.

Potter, P.E. & Pettijohn, F.J., 1963, Paleocurrents and basin analysis: New York, Academic Press Inc.

Riecker, R. F., 1965, Fault plane features: and alternative explanation: **Jour. Sed. Petrology**, v. 35, 3, 746 — 748.

Tjia, H. D., 1964, Slickensides and fault movements: **Geol. Soc. America Bull.**, v. 75, 683 — 686.

Tjia, H.D., 1965, Orientations on two modern beaches: Djakarta, Baruna Expedition, v.l, 1, section, A, B, C, 51 — 61.

Tjia, H.D., 1966, Structural analysis of the Pre-Tertiary of the Lokulo area, Central Java: **Contrib. Dept. Geology**, Institut Teknol. Bandung, no. 63.

INSTITUT TEKNOLOGI BANDUNG

Tjia, H. D., 1967, Sense of fault displacements: **Geol. Mijnbouw,** v. 46, 392 — 396.

Tjia, H.D., in press, New evidence of diastrophism in eastern Indonesia.

Verbeek, R.D.M., 1908, Molukkenverslag: **Jaarb. Mijnb. Ned. Indië** v. 37, Wetenschappelijk Gedeelte.