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Notes on the Evolution of the British Solomon Islands

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Notes on the evolution of the British Solomon Islands

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Although the photogeological interpretation of the British Solomon Islands Protectorate (Allum 1967) carried out over the last 2 years is intended to assist in the interpretation of the aerial geophysical survey and to provide a starting-point for more detailed field work, it also throws light on the evolution of the islands.*

San Cristobal

The north-western end of San Cristobal consists of a rectangularly shaped area about 20 miles long and 10 miles wide having, according to the photogeological interpretation, a central core of basalt on which lie, in succession, S_1 and S_2 sediments. Pudsey-Dawson's reconnaissance traverse and sketch map (1958) suggest that the S_1 and S_2 sediments are respectively mudstones and conglomerates, and raised reef limestones.

The straight coastlines of this area appear fault controlled.

At the opposite end of San Cristobal (i.e. in the south–east) there is a peninsula 14 miles long and about a mile wide having a central core of basalt partly covered by S_1 sediments (Thompson & Pudsey-Dawson 1958); around the coast of this peninsula there is a very wide fringing coral reef.

If this peninsula and its reef were raised by faulting, it would be an almost mirror-image of the north-western area, with the raised fringing reef of the south-eastern peninsula being equivalent to the S_2 sediments of the north-western area. In this connexion it should be noted that: (i) there is geophysical evidence for faulting along the south-eastern coast-line, where the south-eastern peninsula joins the mainland; (ii) there is photogeological evidence for faulting around much of the coast; (iii) the basalt forming the core of the island contains pillow lavas, and is therefore presumably of submarine origin; (iv) small areas of marine sediments (limestones) lie on the basalt on high ground on the main part of the island. There is thus little doubt that the island as a whole has been raised by upward fault movements.

It is suggested, therefore, that San Cristobal has grown by successive increments and that the south-eastern peninsula illustrates the way this occurs; it is probable that the north-western area is at a more advanced stage in structural development than the south-eastern peninsula and that the south-eastern peninsula will eventually resemble the north-western area.

Santa Isabel and Malaita

The photogeological interpretations also throw considerable light on the structural development of Santa Isabel and Malaita. At first sight these islands appear structurally very dissimilar, with the dominant structural themes being faulting in Santa Isabel and folding in Malaita.

* The opinions expressed in this paper are those of the author and they do not necessarily reflect those of the United Nations or the Institute of Geological Sciences.

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In Santa Isabel the fault traces, many of them 10 miles or more in length, trend NW–SE parallel to the length of the island, and divide the island into a number of rectangular fault blocks.

There is also evidence of folding in sediments preserved in a graben near the middle of Santa Isabel (158° 55′ E–7° 52′ S). These sediments are folded into a syncline gently plunging to the north-west, with the axial trace parallel to the graben; farther to the south-east along the graben, the same syncline plunges to the south-east. The rocks underlying the sediments and the rocks forming the horsts on either side of the graben are the basalts, which form the core of the island.

Towards the north-western end of the graben, the horst on its southern side is partly covered with sediments in the form of an anticline; i.e. the basalts of the horst are exposed in an eroded anticline. Here, the sediments of the graben can be seen to be continuous with those of the horst. There is therefore no doubt that the sediments once covered the basalts in this part of the island, and that they formed an anticline and a syncline on the horst and graben respectively. The problem is to account for the formation of the folds, and also for the fact that the anticline and syncline are coincident with the horst and graben respectively.

The basalts are known to contain pillow lavas (Stanton 1961) and thus presumably to be of submarine origin. They are known from photogeological evidence to be divided into rectangular fault blocks at different elevations. There is therefore little doubt that the basalt has been raised by block faulting, and that the horst and graben structure has been formed by differential movement between the fault blocks.

It is therefore suggested that the folds were formed by differential movement between the supporting underlying fault blocks, with the sediments subsequently being preserved in the down-faulted graben and being partially removed by erosion from the relatively upfaulted horsts.

The variation in the direction of plunge within the graben (referred to above) would be expected, if there were small-scale differential movement within the rocks underlying the sediments in the graben. The stages in the formation of the folds would be: (i) sediments lie horizontally on basalt; (ii) graben forms with the sediments being flexed upwards at the sides of the graben and downwards at the side of the horsts—differential movement in the graben itself produces variation in the direction of plunge of the syncline; (iii) erosion removes the sediments from the horsts.

This suggested mechanism accounts simultaneously for (*a*) the presence of submarine lavas and marine sediments above sea level, (*b*) the existence of the horsts and grabens, (*c*) the presence of folds within the sediments, (*d*) the reversal of the direction of plunge in the sediments within the graben, and above all (*e*) the coincidence of the syncline with the graben and horst respectively.

If some other mechanism, such as regional stress, is postulated to account for the folding, then a different mechanism is required to account for the raising of the basalts above sea level, and still another explanation is required to account for the reversal in the direction of plunge; even then, the coincidence of the anticline and syncline with the horst and graben respectively is not accounted for.

In Malaita the dominant structural theme is folding. In the north-west of the island, which is largely covered by sediments, the photogeological interpretations record ten axial traces between opposite coasts (i.e. between about 160° 45′ E–8° 50′ S and 160° 55′ E–8° 30′ S); the fold axial traces are approximately parallel to each other and trend NW–SE. It is also relevant that the longest and most numerous fault traces are those trending NW–SE parallel to these fold axial traces.

The folds are alternately anticlines and synclines. In several of the eroded anticlines, which form the higher ground, considerable areas of basalts are exposed which are believed, by analogy with the well-exposed basalt cores of San Cristobal, Guadalcanal, Choiseul, and Santa Isabel, to be parts of the basaltic core of the island. These basalts, which include pillow lavas and submarine black tuffs (Pudsey-Dawson 1960; and University of Sydney 1957), are undoubtedly of submarine origin.

The coincidence of the more elevated blocks of the submarine basaltic core of the island with the anticlinal structures in the sediments, and the parallelism of many of the longest fault traces with the fold axial traces, suggest that, here again, as in Santa Isabel, the folding of the sediments was caused by differential movement of fault blocks in the supporting, underlying basaltic core.

If erosion of Malaita continues until the majority of the sediments have been removed, the structural picture presented will be almost identical to that of Santa Isabel. The basaltic core will probably be found to be divided into long rectangular-shaped fault blocks, with the long dimensions trending NW–SE; within the relatively down-faulted blocks, some of the synclinally folded sediments will be preserved.

When all this is considered in conjunction with the fact that the fault traces and fold axial traces of Malaita are parallel to the fault-traces of Santa Isabel already discussed, it is concluded that, despite the superficial appearance to the contrary (i.e. the obvious structural predominance of folds in Malaita and faults in Santa Isabel), the structural evolution of Santa Isabel and Malaita is closely similar and related.

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